CASBEE®

A decade of Development and Application of an Environmental Assessment System for the Built Environment

Shuzo MURAKAMI,
Kazuo IWAMURA & Raymond J. COLE

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Contributors

(Affiliations as of August 2013)

1. Representative Authors:

Shuzo MURAKAMI, President, Institute for Building Environment and Energy Conservation (IBEC)
Kazuo IWAMURA, Professor, Tokyo City University (TCU)
Raymond J. COLE, Professor, University of British Columbia (UBC)

2. Contributors on the Editorial Board:

Shuzo MURAKAMI, President, IBEC
Kazuo IWAMURA, Professor, TCU (Chair of the Board)
Raymond J. COLE, Professor, UBC
Takashi AKIMOTO, Professor, Shibaura Institute of Technology
Toshiharu IKAGA, Professor, Keio University
Masato ITO, Director, Sumitomo Mitsui Trust Bank
Shun KAWAKUBO, A-Professor, Hosei University
Takeshi MIYAMORI, Housing Bureau, Ministry of Land, Infrastructure, Transport and Tourism
Tsuyoshi SEIKE, A-Professor, The University of Tokyo
Hiroaki TAKAI, Director, Takenaka Corporation
Nobuhaya YAMAGUCHI, Director, Shimizu Corporation
Junko ENDO, IBEC
Nobufusa YOSHIZAWA, IBEC

3. Invited contributors from abroad

Martin TOWNSENT, Director, BRE, UK
Scot HORST, Senior Vice President, LEED, USGBC, USA
Gretchen SWEENEY, Director, LEED, USGBC, USA
Thomas LÜTZKENDORF, Professor, Karlsruhe Institute of Technology, Germany
Frank HOVORKA, Head of sustainable real estate policy, Caisse des Dépôts
Co-chair, UNEP FI Property Working Group, France
David LORENZ, Professor, Karlsruhe Institute of Technology, Germany
Serge SALAT, President, Urban Morphology and Complex Systems Institute, France
ZHU, Yingxin, Professor, Tsinghua University, China
HO Chin Siong, Professor, Faculty of Built Environment, UTM, Malaysia

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Postscript and Acknowledgement, by Kazuo IWAMURA

Preface

CASBEE-Systemized Assessment Tools

Shuzo MURAKAMI,
President,
Institute for Building Environment and Energy Conservation (IBEC)

Building construction is an extremely energy-intensive process and takes a heavy toll on the environment. As such, it is the responsibility of the industry to promote environmentally-friendly, sustainable buildings. In the 1990s, in order to effectively achieve this goal, there was a growing movement among developed countries toward the development of assessment tools such as BREEAM (BRE* Environment Assessment Method) in the UK. Today, a variety of environmental assessment tools developed around the world have become crucial components in social movements for the advancement of sustainable buildings.

The development of CASBEE (Comprehensive Assessment System for Built Environment Efficiency) began in 2000. A decade later, the assessment system known as the CASBEE Family now includes over twenty tools specific to fields ranging from buildings to urban areas.

Recognized for its clear concept, CASBEE generated strong interest among government agencies, industries and academics. This prompted further diversification of the tools that allow the assessment of various building types, endpoints, and objectives. Ranging from administrative support to design support, property appraisal and building branding, the systemized CASBEE tools enable broad applications. The most significant characteristic of CASBEE is that all the tools are developed and organized consistently with a unified concept. It is clear that without such a concept, the creation of a systemized group of tools would be difficult to achieve.

In promoting sustainable buildings, CASBEE has become an industry-standard tool with societal significance. However, the corresponding growth in its user base has resulted in some first-time users finding the CASBEE system and its numerous tools somewhat complex and difficult to understand.

Meanwhile, CASBEE has garnered considerable global interest and been actively promoted overseas.

To address such issues, and also for the benefit of global users, this document is intended to offer an easy-to-understand introduction to the CASBEE system structure.

Building assessment tools are used by diverse stakeholders in a variety of applica-

*BRE: Building Research Establishment

tions. Users include designers, tenants, building users, property owners, building managers, administrators, developers and financial institutions. The systemized CASBEE tools are designed to offer ease of use to users with diverse purposes. As noted, CASBEE tools are developed and systemized consistent with a comprehensive and unified concept, rather than being created independently. Such systemization is the basic element in easily understanding the CASBEE Family.

Unlike other tools, CASBEE offers systemized tools that can be applied to a variety of spatial scales such as resindential and other buildings, urban districts and cities. CASBEE can also be used for the assessment of various temporal scales such as planning, designing, construction, building use and renovation.

The two core components of environmental planning on which the CASBEE tools were based are: the reduction of environmental load (L) and the improvement of environmental quality (Q). Furthermore, Q/L values are used to define Built Environmental Efficiency (BEE) as the basis of CASBEE's 5-level assessment indicator. Tools designed based on these components are the most defining characteristic of CASBEE.

CASBEE can be applied to a wide range of buildings including residential housing, office buildings and schools.

In addition, the tools may be applied for a variety of purposes such as administrative support, design support and property appraisal.

CASBEE has been developed by a research committee as part of a joint industry-government-academia project with the support of the Ministry of Land, Infrastructure and Transport. This partnership has been instrumental in developing CASBEE's clear and solid concept to the benefit of a broad spectrum of users in Japan.

Environmental assessment as tool for promoting sustainable buildings has become an important social movement. Amidst such a global trend, we hope CASBEE will make a meaningful contribution to solving global environmental issues. As the movement for the advancement of sustainable buildings continues to evolve, we will strive to further improve the contributions and offerings of CASBEE in this effort.■

1. Introduction

1.1. Situating CASBEE within a broader context

1.2. Background of CASBEE development

<Colunm-1> Sustainability and Trust

<Colunm-2> LEED and CASBEE: Transformation in a Global Context

CASBEE®

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of an Environmental Assessment System
for the Built Environment

1.1 Situating CASBEE within a broader context

Raymond J. COLE,
Professor, University of British Columbia, Canada

1.1.1. CASBEE within a historical context

Until the 1990 release of the Building Research Establishment Environmental Assessment Method (BREEAM) in the United Kingdom (Baldwin, *et. al.,* 1990) little, if any, attempt had been made to establish an objective and comprehensive means of simultaneously assessing a broad range of environmental considerations against explicitly declared criteria and offer a summary of overall building performance. BREEAM can now be viewed as the beginning of a culture of building performance assessment that has spurred the development numerous other systems worldwide and, to varying degrees, all building environmental assessment methods have drawn on the collective knowledge and experience of other systems.

An underlying premise of the voluntary assessments and certifications offered by these systems is that if the market is provided with improved information and mechanisms, a discerning client group can and will provide leadership in environmental responsibility, and that others will follow suit to remain competitive. Building environmental ratings have provided building owners with a credible and objective means to communicate to prospective tenants the environmental qualities of the building they are leasing and, by emphasising more demanding performance goals and the benefits over typical practice, have begun to reframe expectations.

Over the past twenty plus years, building environmental assessment has matured into a legitimate area of research and study. Not only has environmental performance assessment been a category of almost every major green building conference over the past fifteen years or so, but the 1st International Conference on Building Sustainability Assessment in Porto, Portugal in 2012 (Amoeda, *et al.,* 2012) devoted exclusively to the topic is testimony to this claim.

The emphasis of the discussion and research regarding building environmental assessment methods has changed significantly over this period. (Cole and Valdebenito, 2013) Initially, concerns and efforts were primarily related to a host of technical features and requirements of assessment tools: scope, structure, weighting protocols, performance indicators, etc. (Nibel, 2000; Andresen, 1999) As more systems were developed and used, the emphasis shifted to their side-by-side comparison: what is included, differences in assigned weightings within the respective systems, assessment and certification fees, number of buildings registered/certified, etc., often with the aim of offering a basis for selecting one method over another. (Yokoo and Oka, 2000; IEA, 2001; Kaatz, 2002; Ding, 2008; Haapio and Viitaniemi, 2008; Kajikawa, Inoue and Goh, 2011; Reed, *et al.,* 2011) Again with greater application, the development of versions of the methods for different building types – residential, or aspects - existing buildings, core and shell, etc., – initially as separate systems and later, as for example in the case of LEED in North America, harmonizing them into a coherent and recognizable suite of tools. More recently, given that several of the methods have existed for more than ten years and matured into established industry systems, the focus is shifting toward their application – where and why are assessment tools being used and by whom – particularly beyond their country of origin (Cole, 2011; Todd and Tufts, 2012) and on explicit comparisons of BREEAM and

LEED. (Rivera, 2009; Julien, 2009; Reed, *et al.,* 2010; Sleeuw, 2011) From its introduction in 2001, CASBEE has been increasingly evidenced in this discussion.

Assessment tools in use worldwide generally fall into two general categories:

- Those developed by an organization within a country that maintains and manages it and provides the associated educational support and operational infrastructure. All the major recognized systems – BREEAM, LEED, CASBEE, Green Star in Australia, etc., – fall into this category.

- Those developed by academics either for research purposes or in hopes that they could become a certification system but to date have yet to gain widespread adoption in their respective countries. The difficulties in generating the necessary organizational and financial resources required to support the attendant educational, management and certification programs means that the number of assessed buildings assessed by using these methods remains modest.

Organisational Context
While the technical characteristics of the assessment systems have enjoyed widespread attention, their origins and organisational settings are less discussed and there are scant records on the roles and contributions of the individuals and organizations that created and shaped them. Indeed, this history is often unrecorded and subsequently at risk of being lost.

Assessment systems are initiated through the actions of individuals and organisations, for example:

- In the UK, *ECD Architects and Energy Consultants, Stanhope Properties and the Building Research Establishment* (BRE) initiated efforts in 1988 to encourage the construction industry to take environmental issues seriously. Following 18 months of identifying and debating what they considered the most significant global, neighbourhood and indoor environmental considerations, the first BREEAM for offices was launched 1990 through the BRE. Since 1999, the BRE has certified and approved products through *BRE Certification*. This was renamed *BRE Global* in 2006 in recognition of its offering of its services worldwide and environmental certification and rating – including BREEAM – were also "brought under the BRE Global brand" [1] at this time.

- The *U.S. Green Building Council* (USGBC) was co-founded by three private sector individuals - Mike Italiano, David Gottfried and Rick Fedrizzi - in 1993. This membership-based non-profit organization - formed to promote sustainability in how buildings are designed, built, and operated - developed *Leadership in Energy and Environmental Design* (LEED) as its primary vehicle for market transformation. While the development continues to be shaped through a broad range of technical committees, approval is required by the collective USGBC membership. Development of LEED began in 1994, spearheaded by Natural Resources Defense Council's (NRDC) senior scientist Robert Watson who served as the founding chairman of the LEED Steering Committee. The first draft version of the US Green Building Council's Leadership in Energy and *Environmental Design* (LEED) was piloted in 1999 (Todd

[1] BRE: Our History, Downloaded January 15th 2013 from www.bre.co.uk/page/jsp?id-1721

and Lindsey, 1999), but the widely used version – LEED Version 2.0 – was released in 2000. An important development was the creation of the *Green Building Certification Institute* (GBCI) in 2008. The GBCI became responsible for the administration of LEED certification and professional credentialing, permitting the USGBC to focus on developing and refining the LEED standards.

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- In Australia, the strategic consulting, engineering and project delivery company - Sinclair Knight Merz - through a Memorandum of Understanding with the Building Research Establishment, developed Australian BREEAM in 2000. This was sold to the Australian Green Building Council (GBCA) in 2002 and subsequently developed as the Green Star Environmental Rating System for Buildings in 2003. Green Star is considered pivotal in meeting GBCA's key objective "to drive the transition of the Australian property industry" towards sustainability by promoting green building programs, technologies, design practices and operations and the integration of green building initiatives into mainstream design, construction and operation of buildings.

All of the above voluntary building environmental assessment systems are used and/or referenced internationally and are considered as major systems. These, like many others operating within their respective countries, are now viewed as the single most potent approach to market engagement and transformation. Certainly, to some extent, this has occurred and it is reasonable to argue that they have institutionalized the range of environmental performance issues deemed important in green buildings and have played a significant role in mainstreaming green building practices. The major systems have been increasingly referenced and adopted by institutions and authorities in their respective countries as a required building environmental performance "standard."

1.1.2. CASBEE within a global context

CASBEE has provided a unique role and contribution within the evolving theory and practice of building environmental assessment, primarily in respect to its structural and operational features relative to those of other major systems.

All green building assessment systems are primarily directed at the twin goals of improving indoor environmental quality and 'doing less harm' or, more generally, reducing the degenerative consequences of human activity on the health and integrity of ecological systems (McDonough and Braungart, 2002; Reed, 2007). Their scope and structure represent their developer's understanding and priorities of these environmental performance issues and are clearly influenced by a host of unique cultural and capability considerations.

Building environmental assessment methods typically consists of three major components (Cole, 1999; Cole, 2005):

- A declared set of environmental performance criteria organized in a logical fashion – the structure.
- The assignment of a number of possible points or credits for each performance issue that can be earned by meeting a given level of performance – the scoring.
- A means of showing the overall score of the environmental performance of a building or facility – the output.

The development of assessment methods has, for the main part, been driven by the scoping and structuring of performance criteria. Although it is generally accepted that environmental criteria must be organized in ways that facilitate meaningful dialogue and application, the structuring of criteria within the assessment method is perhaps most important during the output of the performance evaluation, when the "story" of the performance must be told in a coherent and informative way to a variety of different recipients. While CABSEE addresses the range of environmental considerations evident in the other major systems, their organisation and emphasis is qualitatively different and implicitly embody Japanese cultural traits, e.g., the value placed on a predetermined set of rules and group-conscious interdependency, the emphasize on continuums rather than binary divisions of opposite poles, and Japan's emphasis on technical prowess and, especially, service. (Blaviesciunaite, 2012) More importantly, the conceptual underpinnings of CASBEE offer important distinctions in each of the above three areas.

The structure of environmental assessment methods is shaped by a number of considerations and practicalities. The majority of systems organize performance criteria or credits in distinct categories – site, water, energy, materials, indoor environmental quality, etc., and, with the exception of CASBEE, rely on the simple addition of points attained within these to derive an overall score. A key distinction lies between those methods that adopt a hierarchical framing of the issues (main categories with criteria and sub-criteria wherein score at this lower level are weighted and aggregated to attain an overall score) and those that have credits (with implicit or explicit weightings) that are simply added.

- The South African *Sustainable Building Assessment Tool* (SBAT), for example, explicitly introduced performance criteria that acknowledge social and economic issues. (Gibberd, 2001; Gibberd, 2005) A total of 15 performance areas are identified, equally divided within the overarching sustainability framework of environmental, social and economic categories, each described through five performance criteria. (See Figure 1.1.1) Further, SBAT considers how it could become an integral part of, and subsequently influence, the building production process by relating its application to a nine-stage process based on the typical life cycle of a building: Briefing, Site Analysis, Target Setting, Design, Design Development, Construction, Handover, Operation, Reuse/Refurbish/Recycle. Weighting the three respective social, environmental and economic categories offer an overall performance score.

- The more recent Deutsche Gesellschaft für Nachhaltiges Bauen (DGNB) Certification System comprises of five general sustainability "quality" categories are assessed and form the overall aggregate building score: Ecological; Economic; Socio-cultural & Functional categories with Technical; and Process categories conceptually cross-cutting them. A sixth quality with 6 sub-criteria – location – is evaluated and presented separately. (See Figure 1.1.2) Criteria within these performance areas are evaluated individually and aggregated to determine an overall performance designation of gold, silver or bronze.

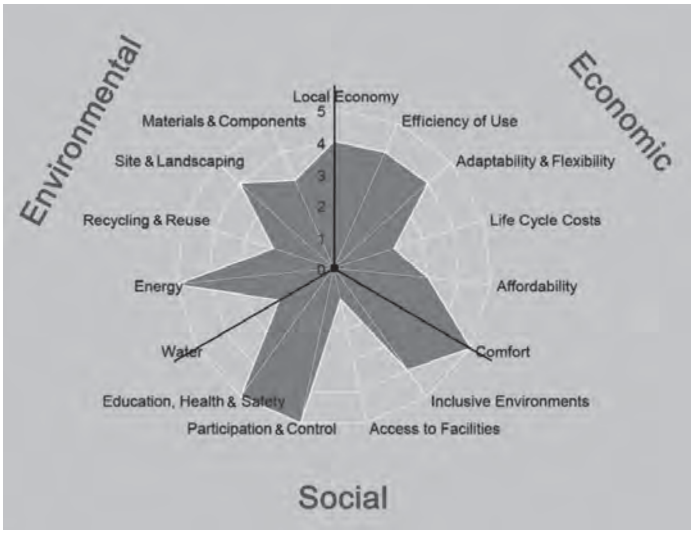

Figure 1.1.1: Sustainable Building Assessment Tool (SBAT) (Gibberd, 2001; Gibberd, 2005)

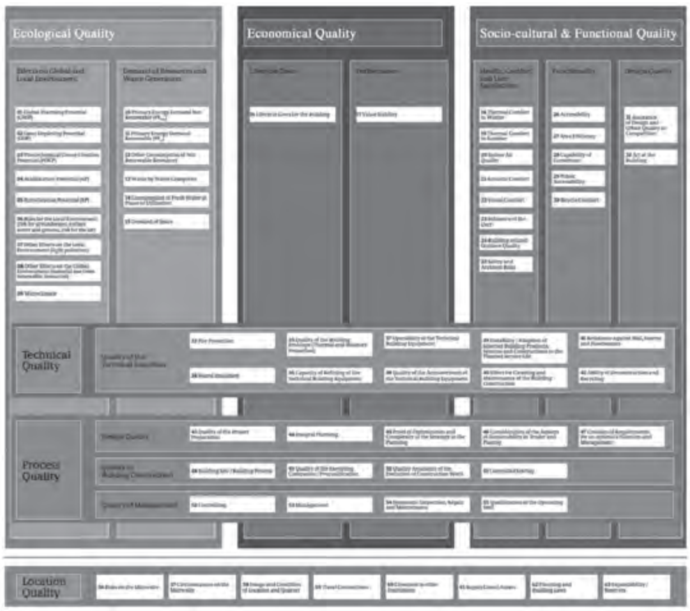

Figure 1.1.2: Deutsche Gesellschaft für Nachhaltiges Bauen (DGNB) Certification System

Other systems desiring to shift from “green” assessment to “sustainability” assessment have typically simply added an additional set of social and economic performance requirements to the key environmental ones in green building assessment.

Some of the key unique conceptual distinctions offered by CASBEE related to the structure and definition of the performance assessment criteria are:

- The use of the hypothetical boundary to explicitly distinguish the evaluation of Building Environmental Quality (Q) which relates to the “…improvement in living amenity for the building users within the hypothetical enclosed space” and the evaluation of Building Environmental Load (L) which relates to the “…negative aspects of environmental impact which go beyond the hypothetical enclosed space to outside” (JSBC, 2010). By scoring these separately to determine the Building Environmental Efficiency, i.e., the ratio of Environmental Quality and Performance to Environmental Loading, the structure of the CASBEE itself embodies and conveys an eco-efficiency view of assessment. This is important because it illustrates how the structure is, itself, educational. In CASBEE, the BEE explicitly conveys the environmental impacts associated by offering human amenity and illustrates a variety of permutations of Q and L can offer a similar overall measure of performance. (See Figure 1.1.3)

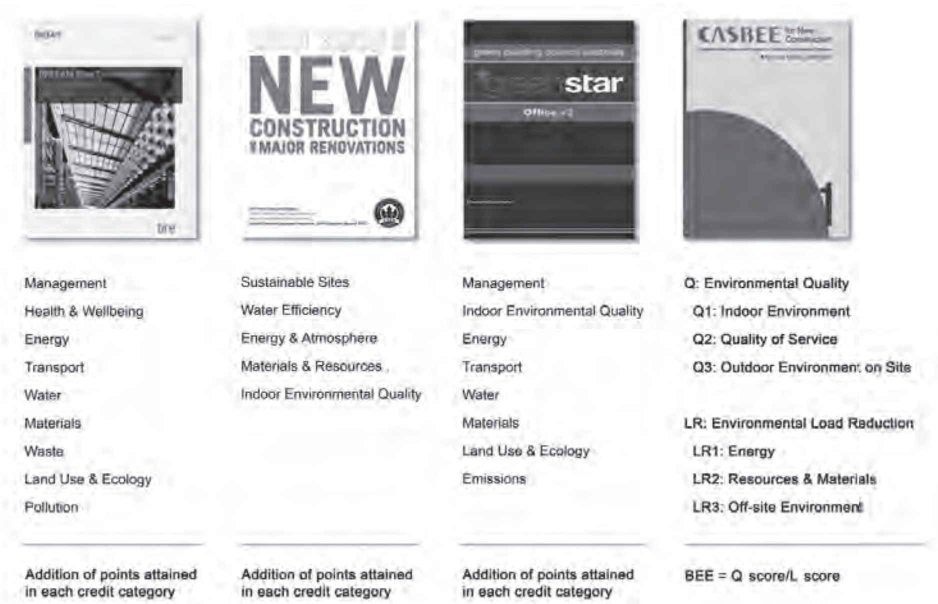

Figure 1.1.3: Deriving Overall Performance Score in Major Assessment Methods

- In contrast to many other systems wherein there is typically no specific order as to how the requirements are to be met and where the importance of the credit entirely relies on the weightings, the distribution of the credits in CASBEE imply a hierarchical relationship, i.e., Q1 evaluates separate categories of the indoor environment, Q2 – how well the separate categories are integrated and Q3 aims to relate the building with its surroundings. (Blaviesciunaite and Cole, 2012) This nesting of performance criteria again provides a conceptual clarity for the framing of environmental considerations that is less evident in other assessment systems.

- The credits are assessed on a five scale, where “1 is earned for satisfying the minimum conditions required by laws, regulations and other standards of Japan… and a building at what is judged to be general, typical level earns 3” (JSBC, 2010). Levels 4 and 5 then are assigned to performance levels that exceed the standard practice. Herein, the specific performance requirements in CASBEE are consciously less clearly specified than in other systems but are framed to equally account for the range of efforts that are invested in the achieving performance requirements. Thus, rather than assigning points for achieving specific performance requirements, CASBEE distributes points in a way that corresponds to the level achieved and acknowledges how the context affects this possibility. (Blaviesciunaite and Cole, 2012)

- Building environmental assessment methods were initially conceived, and still largely function, as voluntary, market place mechanisms by which owners striving for improved performance would have a credible and objective basis for communicating their efforts. Within this context, ensuring that the methods are simple, practical and inexpensive in both use and maintenance was deemed paramount in their design. At a practical level, the accommodation of complexity relates to the relationship between the structure of the assessment method (i.e., the range and organization of the performance issues) and the specificity of the constituent criteria requirements. Whereas a key ambition of other assessment methods is to strive for simplicity, CASBEE, especially in the process of scoring, weighting and presenting the evaluation results, is more accepting of complexity.

- As a direct response to Japan’s declared commitment to significant carbon emissions reductions, a separate evaluation process for Lifecycle CO_2 is used in CASBEE.

CASBEE offers an equally significant conceptual distinction by explicitly distinguishing between the way that performance information is organized during the assessment process and how it is transformed to communicate a variety of different outputs. As mentioned earlier, while employing an additive/weighting approach, it breaks away from the simple addition of points achieved in all performance areas to derive an overall building score, which has been the dominant feature of all previous methods.

The Building Environmental Efficiency (BEE) score is represented on a plane with Q on the Y-axis and L on the X-axis and which is delineated into five distinct performance designations ranging from “S” – the highest level, through “A”, “B” down to “C”. Moreover, stars are assigned according to the obtained S~C level. Most importantly, this graphic provides the ‘landscape’ on which the BEE values of multiple projects or shifts in performance can be readily communicated.

CASBEE is therefore based on a more diverse approach to both assigning points and presenting the results. By using several types of graphical representations, CASBEE therefore permits a variety of "stories" to be communicated – an overall performance as well as more detailed descriptions – rather than the single score-sheet used in many other systems.

1.1.3. CASBEE within a changing context

Whereas early in the history of building environmental assessment systems there were fewer systems and developments occurred relatively slow, today it is a rapidly developing field and they are in continual states of evolution and development. Therefore not only does information on the various systems become quickly dated, trying to assess future directions is equally problematic. Nonetheless, several possible ways in which CASBEE is able to respond to this changing context as well as offer positive direction:

- Moving Cross-Scale: The major environmental assessment methods were initially conceived to assess individual buildings, and performance issues are bounded by those factors that influence and are influenced by them. The sequence in the development of assessment methods is important in revealing the increasing acknowledgment of a broader context. The majority of the systems began with a version for new office buildings and then subsequently expanded the range of products to include existing office buildings, multi-unit residential and then other broader applications – schools, homes, etc. Now, the major building environmental assessment methods offer a suite of products, each targeted at a specific building type or situation and, more recently, have introduced versions that address a broader context e.g., LEED for Neighbourhood Development (LEED-ND®), BREEAM Communities, etc. While these versions reference performance issues at the buildings scale, they are typically distinct tools. From the outset, CASBEE has conceptually set its "family" of tools within a framework defined by scale and lifecycle. CASBEE for Urban Development (CASBEE-UD®), by retaining the use of the BEE determined by Q/L, permits the expansion or reduction of the hypothetical boundary. Individual buildings are therefore set within a logical and hierarchical framework. Perhaps the most significant recent advance in the ongoing development of CASBEE has been to extend assessment beyond the neighbourhood scale to embrace the city. Retaining the same conceptual framing of Q and L within the previous scales, these performance dimensions focus primarily on Social and Economic factors, and CO_2 emissions respectively. (See Figure 1.1.4)

Figure 1.1.4: Assessment Tools for Various Scales

CASBEE-City is designed to assess Japan's effort toward low carbonization and to provide an equitable assessment system for all cities – be they small, medium or larges commercial and industrial. While industrial cities invariably have higher greenhouse gas emissions than commercial and cultural cities, they produce goods that are exported to and used in other cities. CASBEE-City provides the opportunity to contrast two approaches for assessing and presenting the greenhouse gas emissions:

1. *Emitter-pays*: All greenhouse gas emissions are allocated to the industrial areas producing areas.
2. *Beneficiary-pays*: Greenhouse gas emissions as a result of industrial production are reallocated to those areas consuming industrial products and thereby sharing the burden of associated greenhouse gas emissions.

The importance of this is two-fold. Firstly, it points not only to the necessity to understand resource flows and production impacts within developments – be they buildings, neighbourhoods or cities – but also the exchanges between them. Secondly, the ability to represent the shifts and exchanges on the CASBEE Q-L graphic, is illustrative of the versatility of CASBEE's powerful conceptual underpinnings.

- Building Valuation: The need to establish a business case for the development of 'green' commercial properties within the real estate industry has paralleled the technical development and application of building environmental assessment methods. (Lorenz and Lützkendorf, 2008) Although the possible capital cost premiums associated with attaining higher building environmental performance has been a recurring issue over the past twenty years, the emphasis of these economic considerations has also changed considerably. Initially the business case was framed around the added benefit and reduced revenue costs to the building owner. Today, however, the business case is increasingly rooted in the added value associated with higher building environmental performance and the demonstration that green buildings may be 'worth more' to investors, owner and tenants. (Sayce et. al., 2009) Whereas the cost arguments have consistently referenced building environmental assessments, e.g., the cost of LEED (Kats, 2003; Matthiessen, 2004), very little attention has been directed at connecting green rating to value. CASBEE is the first system to introduce a version explicitly linking building environmental performance assessment with real estate appraisal. CASBEE for Property Appraisal (CASBEE, 2009) is an "appraisal support tool that measures the impact degree of [design for the environment] on the property value" that when widely applied will significantly increase the demand for green buildings.

These and other features permit CASBEE to more readily respond to and accommodate changing issues and priorities.

1.1.4. CASBEE within a future context

There are several emerging trends that will shape the future design, roles and use of assessment tools:

- *Voluntary & Mandatory Mechanisms*: The majority of current "green" environmental assessment methods is voluntary in their application and has the primary objective of stimulating market demand for buildings with improved environmental performance. Indeed, the "acceptance" of current assessment methods currently derives largely from their voluntary application. However, the voluntary nature of existing methods significantly compromises both their comprehensiveness and rigor. Higher environmental performance requirements are increasingly being mandated bringing into question the ways that voluntary assessment methods will have to be cast within a broader array of mechanisms for creating necessary change. As such, the relationship between building environmental assessment methods and other change instruments both regulatory and incentive based, will likely gain in importance. Historically, regulation provided minimal acceptable performance requirements and the voluntary mechanisms offer the complementary high performance aspiration. Recently, the mandates of far reaching performance requirements such as carbon neutrality will profoundly change these roles. In Europe, for example, demanding energy and carbon emissions standards for buildings are now being introduced requiring phased reductions to net-zero energy performance. (Dyrbøl, et. al. 2010; Kolokotsa, et. al. 2011) Although the structure and specific performance requirements of the assessment systems will be important in this regard, the organizational context of the JSBC may permit a more effective integration of CASBEE with other mandatory mechanisms in Japan.

- *Achieved Performance*: The assessment of building environmental performance of new buildings is typically made at the design stage and based on default patterns of occupant behaviour, systems efficiencies and building operation. There is sufficient evidence to show that a building's performance in use is often markedly different from that anticipated or predicted during design and this discrepancy has initiated a shift towards basing assessments on achieved performance. The International Living Building Institute's *Living Building Challenge*, for example, requires one-year energy and water use data to be submitted before certification is granted. It is anticipated that the owners and developers the major assessment systems will be actively seeking to base assessments on the actual performance of buildings, particularly energy and water use, and energy-related emissions.

- *Regionalization*: The past decade or so has witnessed many countries worldwide now either having or in the process of developing domestic systems. This carries the implicit expectation for domestic systems to encourage green building practices appropriate to their specific climatic and cultural contexts. Within many countries, there can be significant regional differences and environmental priorities that must be recognised and accounted for in an assessment system. Currently, this is accomplished either by permitting changes to the relative weightings of performance criteria or offering additional points if credits of specific regional significance have been achieved. One can anticipate that the notion of regionalization will eventually be infused more effectively throughout the assessment methods. Japan has a wide range of regional differences and thereby faces a number of challenges when aiming to adequately adopt a singular framework. CASBEE is currently being incorporated into governmental programs depending on the willingness of the administrative regions to adopt the system. Each regional authority is permitted to make locally determined adaptations within CASBEE and thereby ensure that a balance is achieved between the priorities of regional and national levels. (Blaviesciunaite, 2012)

- *Simplified Certification Procedures*: Although assessment systems may begin with simple organizations, credit and performance requirements, this invariably changes as they mature. With greater use and greater understanding of the evaluation of specific performance criteria in different contexts, typically more requirements are placed on the assessment process. Perceived improvements are typically by adding more requirements rather than reducing them. CASBEE is the only system that has "brief" versions of its basic suite of tools to support consensus building between owners, designers and builders at the early stages of design, setting performance targets and establishing reporting systems for local governments. In contrast to the 3-7 days required to complete a full CASBEE assessment for New Construction, the brief version takes only a couple of hours.

- *Branding*: The demand for "brand recognition" in a global market, the desire for international standards and the motivation of the owners of the systems to expand the adoption of their assessment systems abroad, are among many of the forces driving toward the increased international use of some of the most established methods. (Cole, 2010; Cole and Valdebenito, 2013) Although this branding can, in one sense, be seen as a measure of their success, there are several problems associated with this development. Issues here relate to the protection and maintenance of the brand which can constrain making major structural changes to the system. Moreover, since all assessment tools have their roots in the culture and organizational practices that operate within their respective countries, the ability to nurture or retain approaches to green building assessment that support culturally and climatically appropriate design practices within this emerging context of globally deployed "brand" systems remains a major concern.

- *Multiple Certifications*: While building owners have been striving for and achieving the highest level of performance offered by the assessments systems in their countries (e.g., LEED Platinum in North America, BREEAM Outstanding in the UK, CASBEE "S" rank in Japan or 6 Stars in Australia), a new phenomenon is emerging particularly in several Asian countries. The notion of achieving "double" or "triple platinum" wherein building owners are having their buildings assessed with both the domestic system and one or two other systems – one of which is typically an international "brand". It can be anticipated that such a phenomenon will occur in Japan.

In summary, the conceptual underpinnings that have shaped the design, development and application of CASBEE provide a consistent, scientifically-based and qualitatively robust way of framing building environmental performance assessment. The expandability of the Building Environmental Efficiency (BEE) across scale – from buildings to cities – and the flexibility of the CASBEE scoring graphic to represent the performance of either individual buildings or portfolios, individual cities or a range of cities, are enormously powerful attributes. Such characteristics in and of themselves offer considerable education value in representing and communicating the performance of buildings individually and collectively. What is perhaps equally significant in situating CASBEE within a broader context is that it is a reflection of its organizational and cultural setting. Many lessons can be learned from CASBEE's structure and content, but these must necessarily be viewed through a cultural lens. Such is the case with all assessment systems.

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1.2. Background of CASBEE development

Shuzo MURAKAMI,

President, Institute for Building Environment and Energy Conservation (IBEC), Japan

1.2.1. Global environment issues as a background

The seminal book – "The Limit to Growth" (Meadows, et. al., 1972) – that presented the potential cosnsequences of human demands on the earth's resources was published by the Club of Rome in 1972. The following year's oil shock inspired Amory Lovins, et. al. to publish "Soft Energy Paths" in 1979 and appeal to public sentiments. At the end of the 20th century, the whole concept of civilization and mass consumption started to be seriously debated, and a sense of emerging problems regarding the global environment became more tangible. With such trends, the United Nations' Brundtland Commission released "Our Common Future" in 1987 (WECD, 1987) which introduced the concept of "Sustainable Development." This notion has susbsequently served as a significant paradigm for society, the economy and politics.

Large amounts of resources and energy are consumed in the building sector. However, in response to the growing awareness of global environment problems, those in the building sector also recognized the necessity of making contributions toward the mitigation of environmental problems. The development of BREEAM was spurred by such circumstances. Its innovative scope and method attracted worldwide attention and eventually led to the global movement for developing assessment tools. Following BREEAM, other assessment tools for building environmental performance such as LEED were also developed and used around the world (BRE, 2013; USGBC, 2013), significantly contributing to the reduction of building-related environmental loads. Figure 1.2.1 shows the assessment tools developed worldwide.

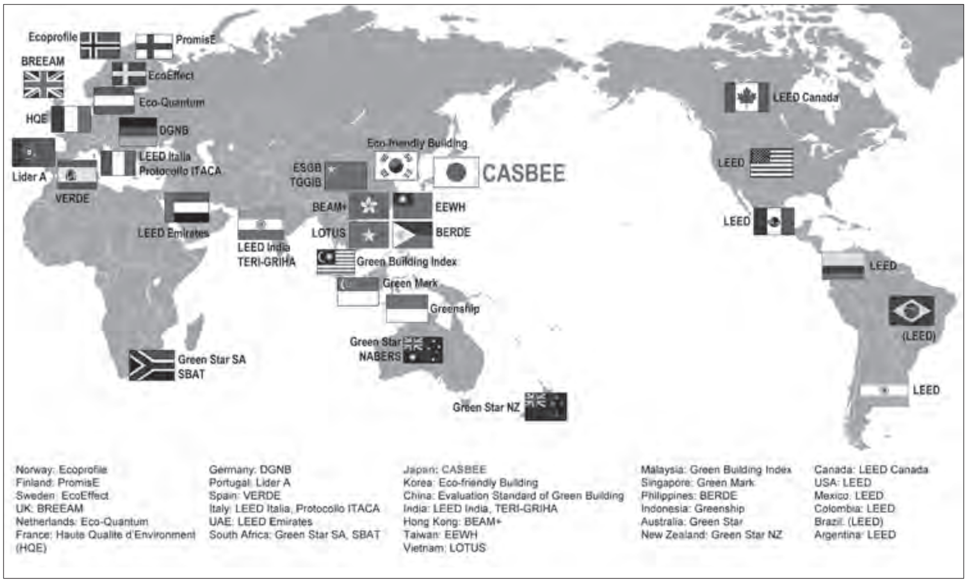

Figure 1.2.1: Assessment tools developed worldwide (as of September 2012)

In Japan, under the leadership of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), a committee was established inside IBEC, and in 2001, initiated the development of tools to evaluate the environmental performance of buildings. The term Comprehensive Assessment System for Built Environment Efficiency (CASBEE) was coined through the activities of this committee. (Murakami, 2004)

1.2.2. Summary from a historical perspective of environmental assessment and research in the building sector

1.2.2.1. Three stages of environmental assessment

The environmental assessment of buildings, while seemingly a new topic, had been discussed and practiced several years before global environment problems surfaced. However, earlier environmental assessments of performance of buildings focussed on evaluating their indoor environment quality - that is to say, the environmental assessment conducted for the "amenity improvement for everyday life of building users." This type of assessment exclusively dominated the traditional environmental assessment methods in the discipline of architectural environmental engineering, which can be regarded as the first stage of building environmental assessment. At that time, environment problems did not exist on the global scale that they do today. The environmental loads on the natural systems related to building construction and operation were hardly taken into consideration in perfprmance assessment. Incidentally, it was in the late 1950s when the discipline called "Principles of Architectural Planning" was renamed "Environmental Control Engineering" in the University of Tokyo's Department of Architecture. and research on indoor environmental assessment has remained a major topic in this discipline.

In the 1960s, pollution became a problem throughout Japan and other industrialized countries. In urban areas, the so-called neighborhood environment became an important social issue and an administrative procedure for evaluating the influence on the environment was widely accepted by the public as the "Environmental Impact Assessment". This can be described as the second stage of environmental assessment wherein only the negative aspects of a building against its surroundings (i.e., pollution) were included for assessment as environmental influence (i.e., environmental load). A typical example is acceleration of wind caused by interaction with a building. The stance at the second stage is quite explicit and is opposite to that of the first stage, because environmental loads on the outside were exclusively assessed. The administrative procedure for the environmental assessment has stayed in effect to date.

The third stage is defined by the environmental assessment starting between the end of the 1980s and the early 1990s when global environmental issues became high on the international political agenda. This stage is characterized by the explicit inclusion of the health of the "Earth" as a relevant subject for the assessment. Although the reduction of "environmental loads" remained a primary issue, the aspect of amenities was also considered to improve the quality of life (QOL). Two different aspects represented by an incompatible vector (environmental load reduction and environmental quality improvement) were included for the assessment which, to some extent. resulted in less clarity than at the first or second stage.

The assessment of the third stage is currently of the primary interest worldwide and the term "environmental performance assessment," now simply means this type of environmental assessment. This book also addresses the tools for the third-stage assessment.

1.2.2.2. The word "environment" – its versatility and ambiguity

The word "environment" is quite versatile and today is used in a variety of contexts. As described in the previous section of the history of environmental studies, what are known as "living environment" and "global environment" represent entirely different dimensions of "environment" in terms of the relation to external diseconomies. The idea of environmental loads and associated problems created a broad public and political sentiment sufficient to demand a paradigm shift away from the culture of the 20th century where people were encouraged to consume more and more.

When the "living *environment*" is considered, its goal is the improvement of so-called QOL. On the other hand, the word "global *environment*" entails the demand for reduction of environmental loads. Despite their fundamentally different essence, according to conventional logic, therefore, there is frequently a trade-off between these two environments. Finding a solution to the conflict between these two is a critical challenge in the field of environmental engineering. In CASBEE, as is described later, this problem is handled by associating each assessment item with either Q (Quality: environmental quality) or L (Load: environmental load), thus separately assessing these two categories. Of numerous discussions about "environmental issues," few were carried out with a definite awareness of the difference between the two, which is a cause of confusion about how to deal with environmental issues. (Murakami, 2004)

1.2.3. The importance and effect of environmental assessment tools

1.2.3.1. Visualization of performance and the positioning of environmental performance assessment

When traveling, hotel rankings displaying a number of stars such as the Michelin Guide are useful in making choices regarding where to stay. These rankings are called the visualization of performance wherein specialized information is quantified by experts in the context of quality of service in society and the results are released to the public. Having better information accessibility for the public in the form of performance visualization can make a considerable difference from the viewpoint of abatement of information asymmetry to general users who are isolated from and may struggle to understand specialized information. In addition to the rankings in the service industry initiated by Michelin, there are also ranking systems in such fields as Japanese artistic skills or martial arts (dan rank) or the handicaps in golf, which started in the UK. These are individual skill rankings, but the intention and effect of visualization are the same.

The building or city performance assessment tools also intend to visualize performance. This visualization is especially important, because the buildings and cities are, in themselves, social assets. The goals of developing the assessment tools include the reduction of building-induced environmental loads and the performance improvement by making the information on building performance visible and accessible to the public as global environment problems become more serious. As mentioned before, this form of contribution has been welcomed worldwide. At present, almost every country where construction is a major industrial activity has developed its own assessment tools or adopting ones that have been developed elsewhere, producing profound reduction of the environmental loads associated with the building sector.

1.2.3.2. Environmental information share and market reform through visualization

Visualized performance not only benefits users by making performance information accessible to the public, but also gives incentives for better performance to owners/designers/

builders or those in local government. Following the development and increased popularity of assessment or rating tools, revolutionizing the market in construction/urban industries through such visualization is the next emerging challenge in the building sector and urban development. Publicized ranking results consequently encourages stakeholders such as building owners, designers and local governments to design and construct a city or building with superior environmental performance. This effect is the linchpin for market reform. Figure 1.2.2 shows the reformed market structure. It is essential to collect the data on green buildings assessed by the tools in order to demonstrate the benefits of buildings with superior environmental performance and thereby, increase the number of construction orders or investment opportunities and creating an excellent selection of high-quality buildings in the market.

The importance of market reform through visualization lies in the performance being improved by publicly available information and the subsequent autonomous decisions, not solely by the enforcement of the laws. Such movement of the market change resulting from performance assessment has already surfaced in Japan and North America and is gaining momentum across the world. Significant contributions toward the reduction of global environmental loads are being realized in the building sector and urban development.

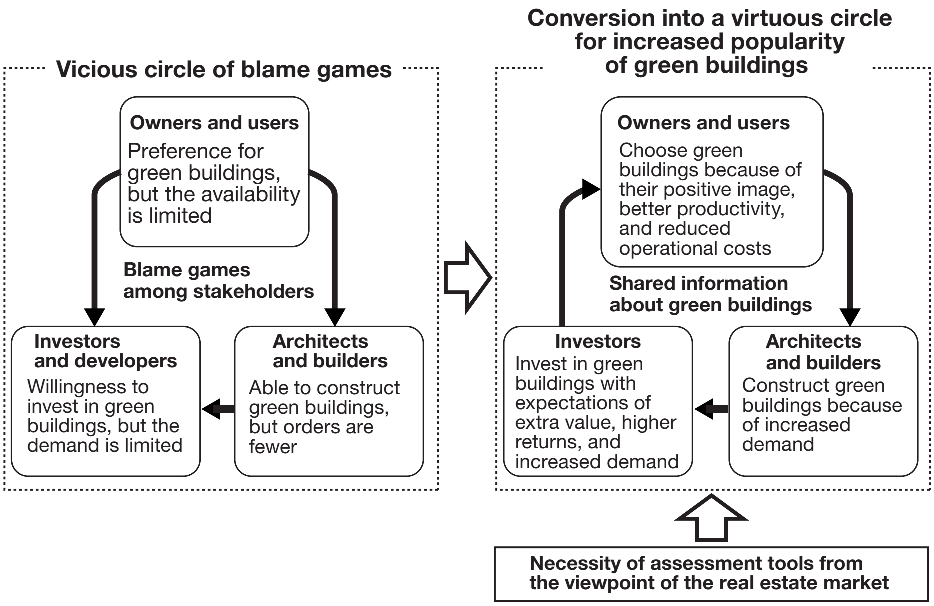

Figure 1.2.2: Reforming the real estate market to gain wider popularity for green buildings and the role of assessment tools (RICS, 2008)

1.2.4. The features of the assessment tool system and methods

Compared to other tools available worldwide, CASBEE exhibits a unique and simple structure. The key characteristics of CASBEE are as follows:

1.2.4.1. Clear definition of spatial boundaries to be assessed

In many tools in use worldwide, the subject of assessment is often vaguely defined as a building or a location. However, the clear definition of spatial zones to be assessed should never be omitted before conducting an assessment. In this regard, of the assessment tools available throughout the world, only CASBEE is explicit on this issue. In CASBEE, the virtual enclosed space boundary is introduced as an area surrounding the building concerned and is treated as a site boundary. The inside and the outside of the virtual enclosed space boundary are specifically framed to be evaluated separately. The key here is that the surrounding area of the building is explicitly included for the on-site assessment. (Murakami, 2004) This concept is illustrated in Figure 1.2.3.

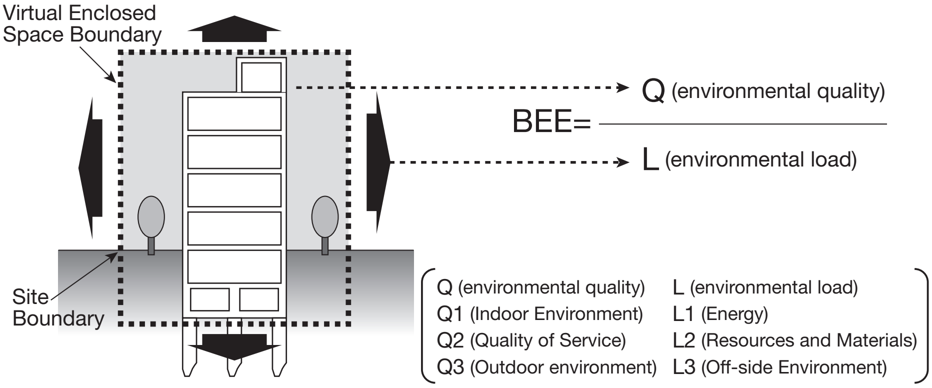

Figure 1.2.3: Setting of the spatial boundary for CASBEE assessment and the definition of Built Environment Efficiency (BEE)

With the exception of CASBEE, no other tools give a clear definition describing the site from the perspective of an area to be evaluated.

1.2.4.2. Clear definition of environments to be assessed

As already mentioned, a pair of different aspects represented by an incompatible vector, that is, improvement of Q (environmental quality) and reduction of L (environmental load) are included for building environmental assessment in this global environment era. Only the CASBEE tool system was designed with this point of view. In CASBEE, as shown in Figure 1.2.3, each item to be evaluated is first associated with either Group Q or Group L and is further assigned to the respective sub-group for more detailed categorization.

1.2.4.3. Scoring method

Many assessment tools have adopted the simple addition of scores attained from the respective assessment items. However, as shown in Figure 1.2.3, the originality of the CASBEE assessment method stems from use of the aforementioned Q and L to obtain a scalar indicator determined by Q/L (referred to as the Built Environment Efficiency; BEE). The BEE is a concept akin to Factor Four proposed as the efficiency of resources use by Weizsäcker in Germany. (von Weizsäcker, *et. al.,* 1998)

1.2.4.4. Stratified structure of a scale of defined areas for assessment

All the assessment tools starting from BREEAM were initially developed to assess office buildings and/or multi-unit residential buildings. The applicability of several tools such as BREEAM, LEED and CASBEE gradually expanded so as to perform the assessment on a scale of a district (or local area or neighborhood). (Cole, Brown & McKay, 2010) *CASBEE for Cities*, which was released recently, is the only tool enabling city-scale assessment. (Murakami, *et. al.,* 2011)

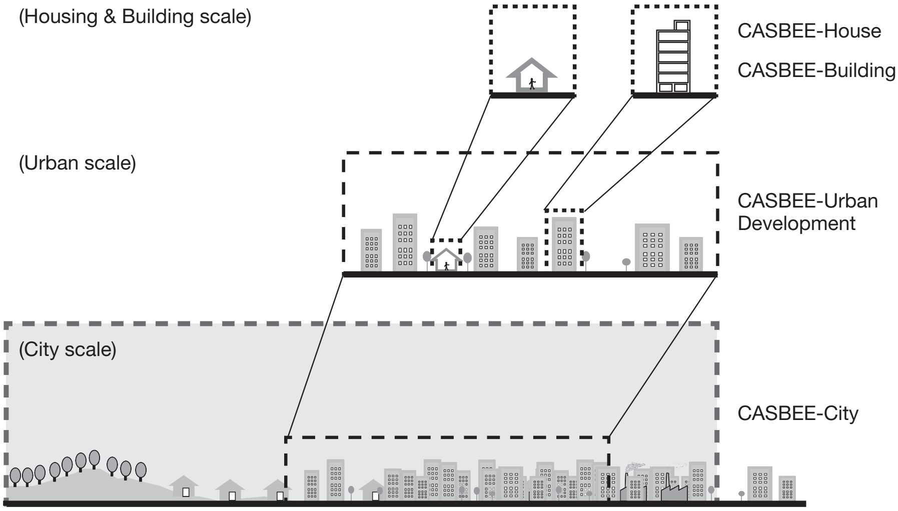

Figure 1.2.4: Stratified structure of a scale of defined areas for CASBEE assessment

1.2.4.5. Inclusion of time scale for assessment

Initially, almost all the assessment tools dealt with the new construction of buildings. The subsequent development of tools to assess the existing buildings occurred in many cases. In evaluating the existing buildings, it is not easy to collect the data necessary for the assessment. Considering the vast number of existing buildings and their often low environmental performance, the promotion of environmental assessment of existing buildings is a policy that is challenging but meaningful.

In CASBEE for Cities, urban environment can be assessed in the context of past, present and future. Urban development is usually planned and executed over a long time span. The outcomes of urban environment policy can be better presented by comparing how the city was in the past, how it is in the present, and how it would be in the future. As part of the campaign of urban environment policy, it is useful for municipal authorities to share such assessment results with their citizens. (Murakami, *et. al.,* 2011)

1.2.5. Conclusions

Since the disaster at the Fukushima nuclear power station, the necessity of energy conservation in the building sector has become a matter of increased urgency. The environmental load produced in the building sector is so huge that it accounts for 30 to 40% of either the total consumed energy or total CO_2 emissions. Therefore, the reduction of building-induced environmental loads is one of the greatest challenges in this field. As an anticipated effective means of alleviating the current situation, the environmental performance assessment incorporated in social/administrative systems has proved appealing to the world. In Japan, as indicated in Figure 1.2.5, many local governments have made it mandatory to include the CASBEE assessment result in the application for building permits. (IBEC, 2013) This way of popularizing green buildings, in cooperation with local governments regarding the use of building assessment tools, is unique to Japan.

The experts and specialists in the building sector have a great responsibility for improving the contents or applicability of assessment tools to attain further acknowledgement of the tools, whereby more contributions toward the mitigation of global environmental problems can be made.

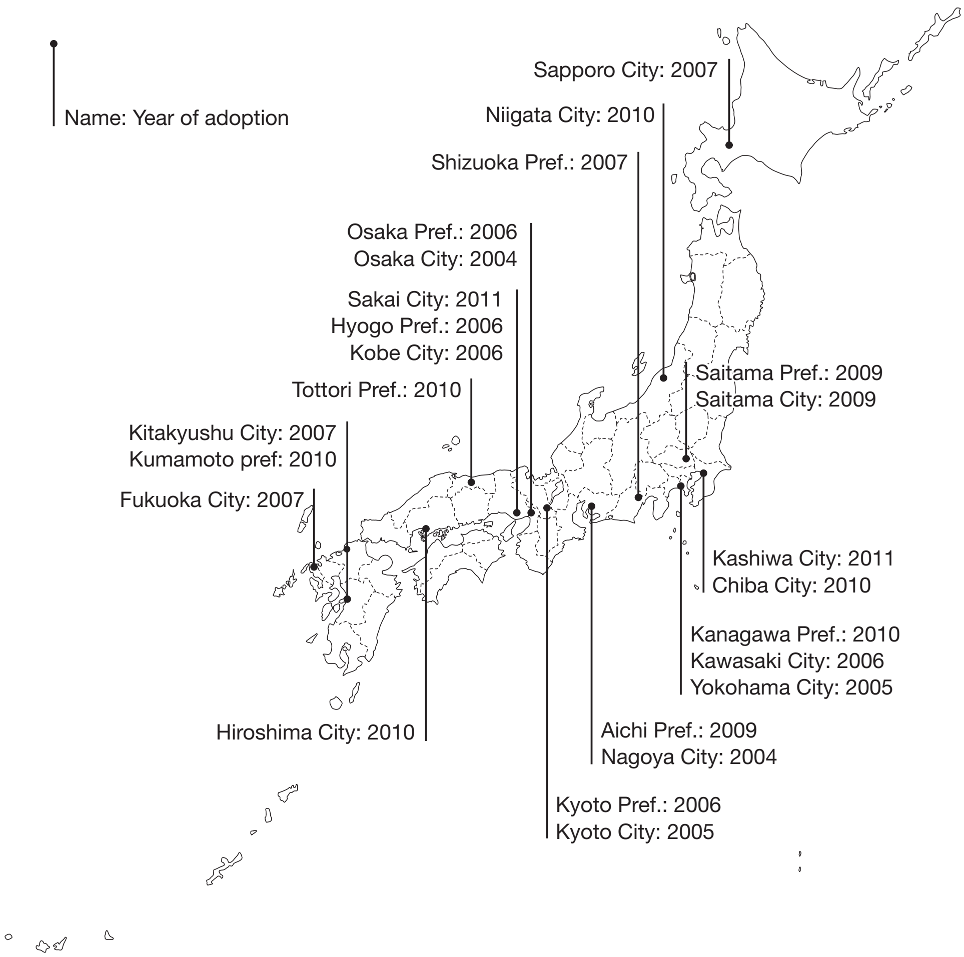

Figure 1.2.5: CASBEE utilization by local governments for new buildings

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<Column-1>

Sustainability and Trust

Martin TOWNSEND,
Director of BREEAM, Building Research Establishment, UK

It is a great privilege to be asked to write a short article to celebrate the 10th anniversary of the launch of CASBEE. In the 10 years since it was created, our knowledge and awareness, has changed considerably the way in which we design, use and specify our buildings. Such changes, owes much to the work of the various rating tools across the world with CASBEE being the important ingredient in the Japanese market. But this debate now extends beyond just the envelope of the building, to the community and the supply chain which support it.

However, the choices we make when specifying products and services and designing and developing buildings, have major impacts on both the sustainability of our projects and their success. In order to make the best choices we need information that we can trust.

It would be very easy to talk about a wide range of current and emerging topics around green buildings, but one thread spans them all. The need for transparency and trust, which I feel is worthwhile exploring further in the few short paragraphs of my contribution.

The increasing demands from regulators and the market for greater sustainability in building developments has, perhaps inevitably, led to a rash of ‘green’ claims for building products and services. The fact that many of these are not backed up with any credible scientific data or third-party certification can make selecting them for use in a development project something of a lottery. Achieving a more sustainable built environment depends on specifiers being able to trust the claims made for building products, systems and services. Providing impartial, authoritative information that the industry can trust is a key element of the work that Japan Sustainable Building Consortium (JSBC) and BRE do.

Trusted product and services

One way that specifiers can be assured that products and services can be trusted to perform as claimed, is to select those that have been appropriately certified. Expert, independent approval and certification schemes will ensure not only that sustainability claims are substantiated, but also that the products and services meet performance standards appropriate for their intended use. It is important to remember, however, that there are different degrees of certification offering different levels of assurance.

With first-party certification, for example, it is the organisation providing the goods that offers the assurance that they meet certain claims. In second-party certification, an association to which the organisation belongs may provide this assurance. But in third-party certification an assessment is carried out by an independent body – which declares that the product or service will perform as required.

This independent assessment allows third-party certification to objectively distinguish products and services from others on the market, and gives customers confidence about their performance.

It is also important to distinguish certification from testing. Certification should ensure that products and services it certifies meet – and continue to meet – appropriate standards, through a robust combination of regular company audits and a schedule of on-going tests. While testing can deliver a valuable measure of a product's performance at a given time, certification monitors that performance for as long as the product remains certified.

Whether a product is just tested or fully certified, it must be done against a robust and scientifically based standard. The output of research needs to be used both in publications to help industry, consumers and users but also as the basis for sound, technically robust standards. If is often these standards that create the real difference.

Responsible sourcing

Another important and growing issue is the Customer concerns about construction product sourcing which often extends beyond purely environmental issues. In fact the responsible sourcing of materials is often in the headlines. A number of exposés have revealed poor working conditions and in the extraction of raw materials with little regard for the environment or the people that live nearby.

The wellbeing of the local workforce is just one of the wide-ranging ethical, environmental and social issues that must be considered throughout the supply-chain when determining if a product has been responsibly sourced. A number of schemes, such as Fairtrade, Rainforest Alliance and Marine Stewardship Council, have been established to enable specifiers to identify responsibly sourced materials.

Better buildings and developments

There is, of course, more to developing sustainable buildings than specifying appropriately certified building products. A wide range of environmental, economic and social issues must be integrated in the design, construction and use of the buildings.

And this is the great space that CASBEE, BREEAM and other rating tools occupy, to help deal with these complexities. Since its launch CASBEE has expanded from its original focus on individual new buildings at construction stage, to encompass many of the life cycle stages of buildings. Providing such a thread to ensure a building can be certified at the various stages of a buildings life, has become an important step change in how we now look at assessment of development.

Sustainability and quality

Along with quantifiable improvements – for example in carbon emissions, resource consumption, waste reduction – less tangible improvements in quality are increasingly being noted in buildings designed with a strong focus on sustainability.

Achieving the standards required by a scheme such as CASBEE requires careful planning, design, specification and detailing, and a good working relationship between the client and project team. These are also the very qualities that can produce better buildings and better conditions for building users. The greater efficiency and quality associated with sustainability are also helping to make such building more commercially successful. There is growing evidence, for example, that certified and rated buildings provide increased rates of return for investors, and increased rental rates and sales premiums for developers and owners.

A study carried out by Maastricht University and published by the Royal Institution of Chartered Surveyors (RICS) in March 2012, entitled Supply, Demand and the Value of Green Buildings, provides empirical evidence of the value of certified buildings. The study used a sample of office buildings in London, using data from transactions over the 2000-2009 period and found that these buildings achieved a premium on transaction prices and on rents.

Looking ahead

By its very nature sustainability is all encompassing – not limited to any particular sets of products, buildings or issues. Our assessment and certification systems must be widened accordingly if the momentum for greater sustainability in the built environment is to be maintained.

CASBEE has already been expanded from a scheme able to assess single buildings, to one that can be used on almost any type of building in any location. The range of issues addressed by the Scheme has also grown, but many more environmental, social and economic aspects need to be considered. The challenge is to broaden the Scheme without increasing its complexity – expansion must go hand-in hand with efforts to make assessments more accessible and transparent. The support and feedback from the industry that we have enjoyed to date will be vital in this process.

The eventual goal is to make sustainability mainstream and routine – involving everybody. We will need to link tools such as CASBEE and BREEAM to BIM and a wide range of other databases to allow sustainability information to be quickly and easily accessed.

We are living in exciting times, and I believe the next 10 years will see even more significant change than the past 10, with rating tools enabling the change in this debate, but with them changing as well to ensure we make better and quicker decisions on the nature of components, buildings and communities. ■

<Column-2>

LEED and CASBEE: Transformation in a Global Context

Scot HORST,
Senior Vice President, LEED, USGBC, USA

Gretchen SWEENEY,
Director, LEED, USGBC, USA

In this century it is becoming clearer than ever that humans are connected everywhere on this planet. The United States and Japan are leading economies, and the way building occurs in these nations can profoundly impact the methods used to design and operate buildings in the rest of the world. Voluntary building rating systems such as CASBEE and LEED help to guide decision-making related to buildings as the global economy becomes increasingly interconnected. Therefore it is essential to learn from each other's experience and build on each other's strengths.

In the first decade of the 21st century, the U.S. Green Building Council, a not-for-profit based in the United States, established the Leadership in Energy and Environmental Design (LEED) green building rating system and embarked on a path toward transforming the way people imagine and shape the built environment. The impact of LEED was more profound. By collecting best practices from the U.S. design and construction market into one 37-page document, LEED gave people an accessible tool for realizing their best intentions for their building projects.

Use of LEED began growing quickly in the United States, as did the amount of information in the rating system and the community of people interested in supporting sustainable building. USGBC soon found that project teams outside the U.S. were starting to use LEED, despite very little marketing or investment effort by USGBC. From 2007 on, the number of LEED projects outside the U.S. grew at an annual rate of over 50%.

In a global economy, building owners discovered that the best way to attract investors and tenants from around the world to high-profile commercial buildings was to achieve LEED certification. But achieving LEED was not a simple task for teams working within a cultural, regulatory or environmental context that LEED did not address. USGBC started receiving requests from other countries for permission and support to create their own adaptations of LEED.

The result was LEED rating systems specifically adapted for Canada, India, and Italy. However, ensuring that each system was consistent with the principles of LEED took substantial amounts of time and attention. In 2009, USGBC adopted a different approach to international use of LEED based on global consistency. The new approach re-envisioned LEED as a global benchmark that would allow people to compare a building in Tokyo to one in New York City.

This approach was not without controversy. Some argued that green buildings should be measured differently in different parts of the world. But USGBC sought to create a shared understanding of what it means to achieve a better building. This model also ensured consistency for organizations using LEED in multiple countries, and better supported LEED project teams wherever they worked.

Design Locally, Benchmark Globally

USGBC took a variety of initial steps toward realizing a global system, including removing U.S-centric approaches to credit achievement in the draft of the newest version of the rating system, LEED v4, and balancing those with approaches that were applicable around the world. Other steps included introducing the International System of Units (SI) into LEED v4, revising sections of the LEED v4 Reference Guides to focus on special considerations for projects outside the U.S., and working toward offering LEED credential exams, certification reviews, rating systems and reference guides in languages other than English.

The next step was to allow for design that was specific to local cultures and geographies. LEED would use metrics that were consistent around the world while embracing local solutions. USGBC began seeking the help of carefully selected experts who could propose new approaches to credit achievement – called Alternative Compliance Paths (ACPs) – for their regions. The new model would produce a global set of core LEED rating systems enhanced by ACPs that suited regional contexts.

ACP development began in earnest in 2012 under the auspices of the LEED International Roundtable, an advisory group of green building councils and organizations that currently represents 30 countries. The Roundtable connects USGBC to local professionals who propose equivalent regional or local standards and ACPs. Roundtable activity started in Europe, where the effort had a head start thanks to the work done by the Italy Green Building Council (GBC Italia) to identify appropriate European standards while creating LEED Italia.

The original country-by-country approach positioned LEED as a direct competitor with other local rating system initiatives. This competition stimulated innovation but also created confusion. The best approach appeared to be a hybrid one. Now USGBC is collaborating with other system developers by establishing common metrics and criteria for use in multiple programs. In certain instances, it is working towards mutual recognition of compliance with some of the more challenging requirements. This new approach has unleashed the creativity of professionals everywhere, and directed it towards making LEED useful and transformative in every region. Instead of a frustrating conversation about which country is next in line for their own version of LEED, people all over the world are now improving the impact of LEED in parallel.

LEED and CASBEE

CASBEE is a set of smart solutions. LEED addresses some of these solutions, but many of them reflect regional priorities, such as CASBEE's earthquake resistance standards. The community of LEED users has much to learn from CASBEE. For example, CASBEE specifies Quality of Service standards such as encouraging spaces for rest and refreshment, and planning interior décor, durable interior building components , and spaces where it is easy to rearrange the layout . The draft version of CASBEE for Market Promotion takes a collaborative approach similar to that of LEED, seeking to be compatible with other systems, and to incorporate common metrics.

USGBC continues to encourage shared learning and collaboration between CASBEE and LEED. In June 2013, LEED International Roundtable members based in Japan, China, Taiwan and South Korea began the work of identifying ACPs for LEED 2009 for new construction in East Asia. This is just the first step toward collaborating with Japan and its neighbors. We anticipate finding new ways for LEED to recognize project teams when they accomplish certain requirements in CASBEE. We may also find common criteria, and better align our understanding of the best ways to build sustainably.

A New Language for a New Era

The nature of the global economy has changed the nature of buildings. In this era, a skyscraper built in Tokyo likely will be very similar to a skyscraper built in New York City. USGBC has acknowledged this reality by shaping LEED into a global system, i.e., a common language for project teams around the world. This language is a starting point for collaboration – it does not express every good idea, nor does it use every dialect. Instead, the "language of LEED" seeks to embrace the value of local expressions by creating points of connection with local rating systems and tools. CASBEE offers ideas and context-appropriate solutions that a global system cannot. Together, LEED, CASBEE and other assessment methods can source an abundance of local expertise while building bridges among people with a shared resolve to improve their buildings and their lives.■

References

LEED for Healthcare v2009 includes a credit for places for respite, Sustainable Sites credit 9.1 (Connection to the natural world – places of respite), which the LEED v4 draft includes as Sustainable Sites credit 7 (Places of respite).

LEED v4 begins to deal with durability of building structure and enclosure via the Materials and Resources (MR) credit 1 (Building life-cycle impact reduction), Option 4 (whole building life-cycle assessment).

With LEED v4, the LEED for Interior Design & Construction rating system begins to address design for adaptability.

2. Basic Concept of CASBEE

2.1. R&D structure: Academia + Industry + Governments (supported by MLIT)

2.2. Cross-scale classification from a single home to a whole city

2.3. Time-process classification according to the life-stage of built environment

2.4. Virtual enclosed space boundary

2.5. From Eco-Efficiency to Built Environment Efficiency (BEE)

2.6. Unique rating index: Built Environment Efficiency (BEE)

2.7. Graphic indication system of the rating results for dissemination

2.8. Input operation and output results

<Column-3> Assessment Systems and LCCO$_2$

2.1. R&D structure: Academy + Industry + Governments

(supported by the Ministry of Land, Infrastructure, Transport & Tourism: MLIT)

Comprehensive Assessment System for Built Environment Efficiency (CASBEE) is a method for evaluating and rating the environmental performance of buildings and the built environment. It is a comprehensive assessment of the quality of a building, evaluating features such as interior comfort and scenic aesthetics, in consideration of environment practices that include using materials and equipment that save energy or achieve smaller environmental loads. The CASBEE assessment is ranked in five grades: Superior (S), Very Good (A), Good (B+), Slightly Poor (B-) and Poor (C).

CASBEE was developed by a research committee established in 2001 as part of a joint industrial/government/academic project. The first assessment tool, CASBEE for Office, was completed in 2002, followed by CASBEE for New Construction in July 2003, CASBEE for Existing Building in July 2004 and CASBEE for Renovation in July 2005. The CASBEE assessment tools were developed on the basis of the following three principles:

[1] Comprehensive assessment throughout the life cycle of the building,
[2] Assessment of the Built Environment Quality and Built Environment Load and
[3] Assessment based on the newly developed Built Environment Efficiency (BEE) indicator.

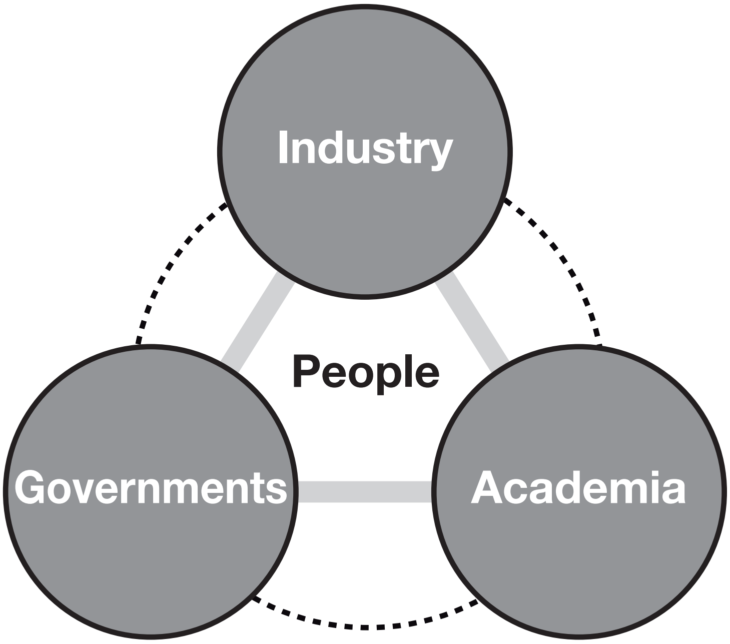


Figure 2.1.1: Organizational Composition of JSBC

2.2. Space-scale classification from a single home to a whole city

CASBEE is comprised of assessment tools tailored to different scales: construction (houses and buildings), urban (town development) and city management. These tools are collectively known as the CASBEE Family (see, Chapter 3).

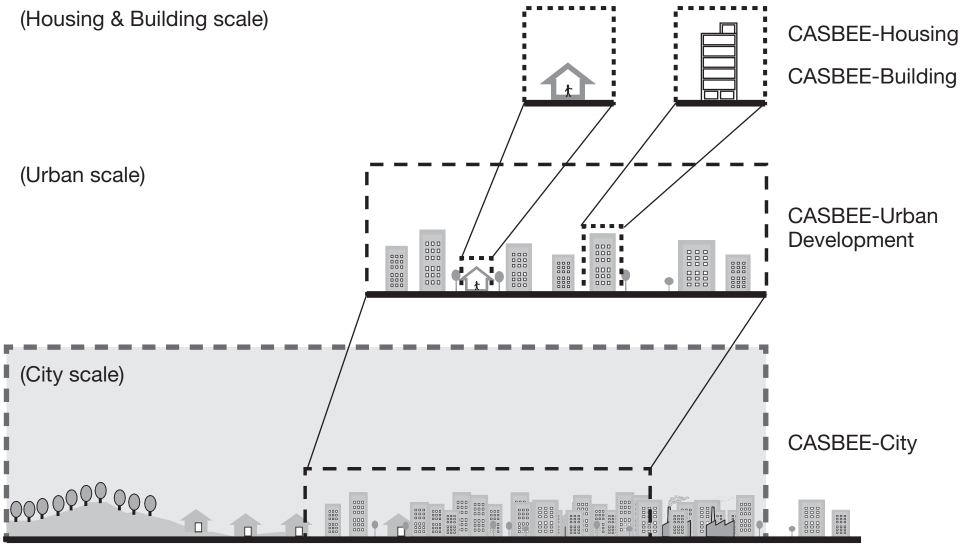


Figure 2.2.1: Stratified structure of a scale of defined areas for CASBEE assessment

As shown in figure 2.2.1, CASBEE-Housing and CASBEE-Building are applied for individual houses and buildings to assess their environmental performance. CASBEE-Urban Development is used to evaluate environmental performance of urban blocks and town development. CASBEE-City evaluates environmental performance on a local government scale. These are assessed based on BEE indicators by CASBEE.

2.3. Time-process classification according to the life-stage of the built environment

CASBEE was developed in the suite of architectural design processes, starting from the pre-design stage and continuing through design and post design stages as shown below.

Pre-design

This is the stage at which the preconditions that form the background to the plan, such as natural, social, cultural and business environment, are subjected to a multi-faceted, three-dimensional investigation and analysis. In the process, the parties involved identify design themes and build shared concepts and policies.

Design

The concept and policies distilled in the pre-design stage are examined further at the design stage to define their ecological, technical, social, cultural, esthetic and economic aspects. The design also passes through a self-evaluation process at this stage to integrate the design as best practice.

Post-design

When a design that has been integrated through the design stage is put into practice, it is subjected to an overall verification followed by ongoing retrospective verification through its life cycle, to evaluate sustainability. The results of the verification are constantly reflected in improvements to the implemented design and concept.

Figure 2.3.1: The cyclical process of building design

Corresponding to the building lifecycle, CASBEE is composed of four assessment tools for building scale: CASBEE for Pre-design, CASBEE for New Construction, CASBEE for Existing Buildings and CASBEE for Renovation, and to serve at each stage of the design process.

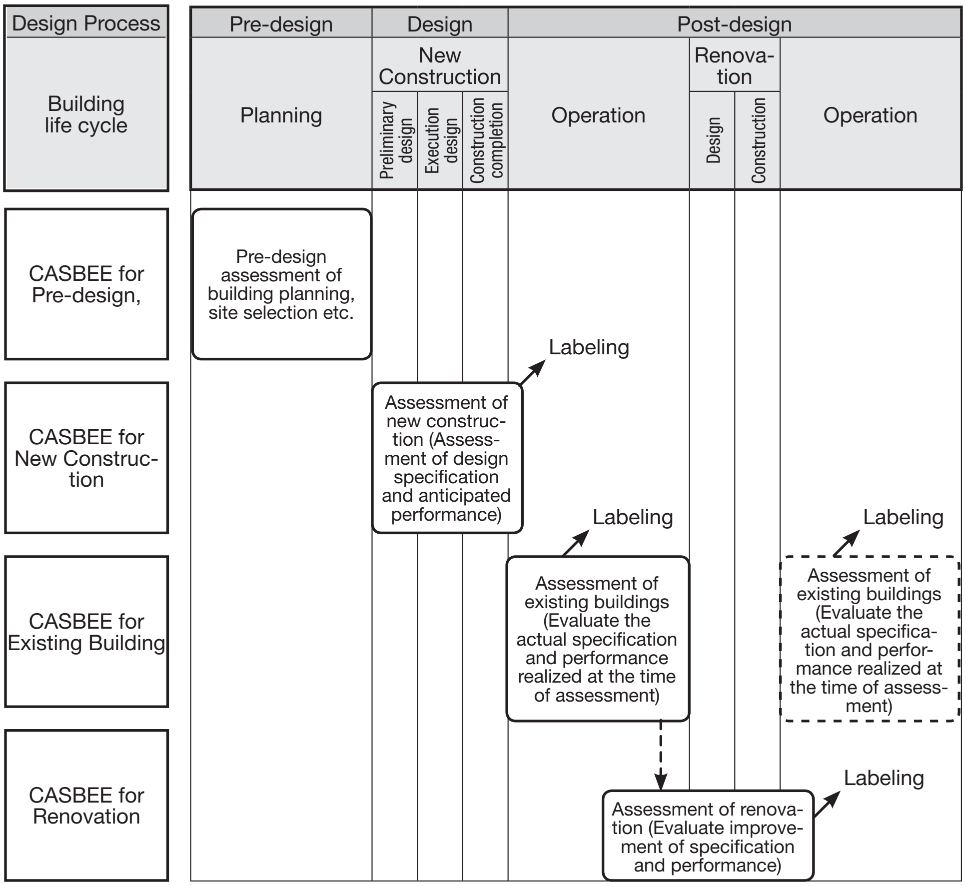


Figure 2.3.2: Four tools of CASBEE for building scale corresponding to the building lifecycle

2.4. Virtual enclosed space boundary

The development of CASBEE started from the perception that the above situation required the reconstruction of the current environmental performance assessment framework into a new system clearly based on the perspective of sustainability. Therefore, a virtual enclosed space bounded by the borders of the building site, as shown in Figure 2.4.1, is proposed here in making environmental assessments of buildings. The on-site space bounded by these virtual boundaries can be controlled by the parties involved in the building, including the owner and planner, but the space beyond is public (non-private) space, which is largely beyond control.

The environmental load can thus be defined as “the negative environmental impact that extends outside to the public environment beyond the virtual enclosed space.” The improvement of environmental performance within the virtual enclosed space is defined as “the improvement in living amenities for building users.” Dealing with both factors, environmental assessment clearly defines these two factors, and distinguishes one from the other as defined by BEE in Equation 1 of the following section. This makes the philosophy of assessment of CASBEE much clearer, and it has been used to form the framework for CASBEE, and it is the basis of the CASBEE framework.

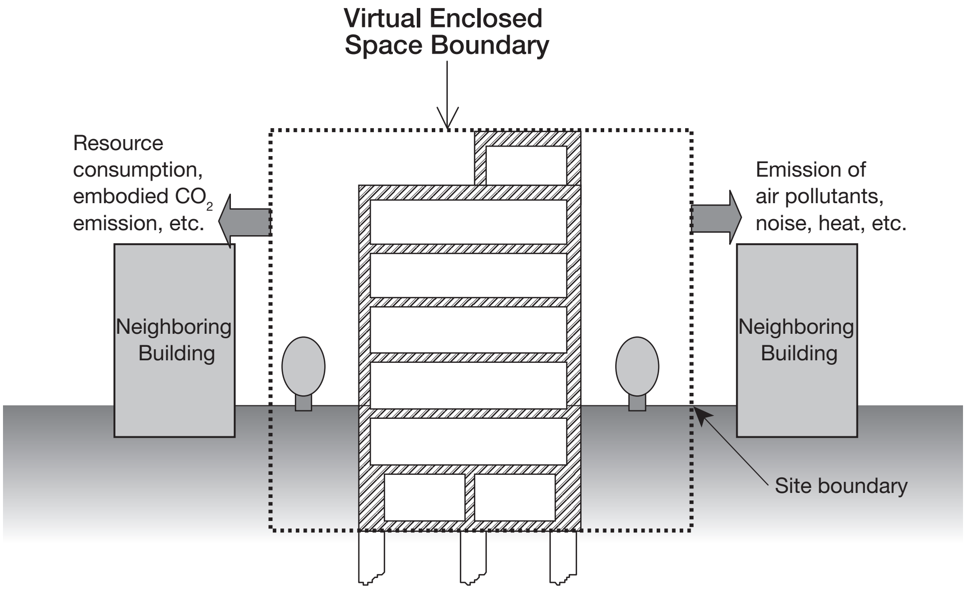


Figure 2.4.1: Virtual enclosed space set out by the site boundary

2.5. From Eco-efficiency to Built Environment Efficiency (BEE)

The concept of eco-efficiency has been introduced for CASBEE to enable the integrated assessment of two factors: inside and outside the building site. Eco-Efficiency is normally defined as "Value of products and services per unit environmental load."* Efficiency is commonly defined in terms of input and output quantities, so a new model can be proposed for an expanded definition of eco-efficiency, as "(beneficial output)/(input + non-beneficial output)." As Figure 2.5.1 shows, this new model of environment efficiency can be extended to define Built Environment Efficiency (BEE), which CASBEE uses as its assessment indicator.

Definition of the environmental efficiency: $$\frac{\text{Economic value of products and services}}{\text{Environmental load unit}}$$

↓

Definition of the environmental efficiency in building assessment: $$\frac{\text{Productive output}}{\text{Input + non-productive output}}$$

↓

Definition in the CASBEE assessment: $$\frac{\textbf{Environmental quality of the building}}{\textbf{Environmental load of the building}}$$

Figure 2.5.1: Development from the Eco-efficiency concept to BEE

* From the World Business Council for Sustainable Development (WBCSD)

2.6. Unique rating index: Built Environment Efficiency (BEE)

2.6.1. Assessment category: Q (Quality) & L (Load)

Under CASBEE, there are two spaces: internal and external, divided by the virtual enclosed space boundary, which is defined by the site boundary and other elements, with two factors related to the two spaces. Thus, we have put forward CASBEE in which the "negative aspects of environmental impact which go beyond the virtual enclosed space to the outside (the public property)" and "improving living amenity for the building users" are considered side by side. Under CASBEE, these two factors are defined below as Q and L, the main assessment categories, and evaluated separately.

Q (Quality): Built Environment Quality :

Evaluates "improvement in living amenity for the building users, within the virtual enclosed space (the private property)."

L (Load): Built Environment Load:

Evaluates "negative aspects of environmental impact which go beyond the virtual enclosed space to the outside (the public property)."

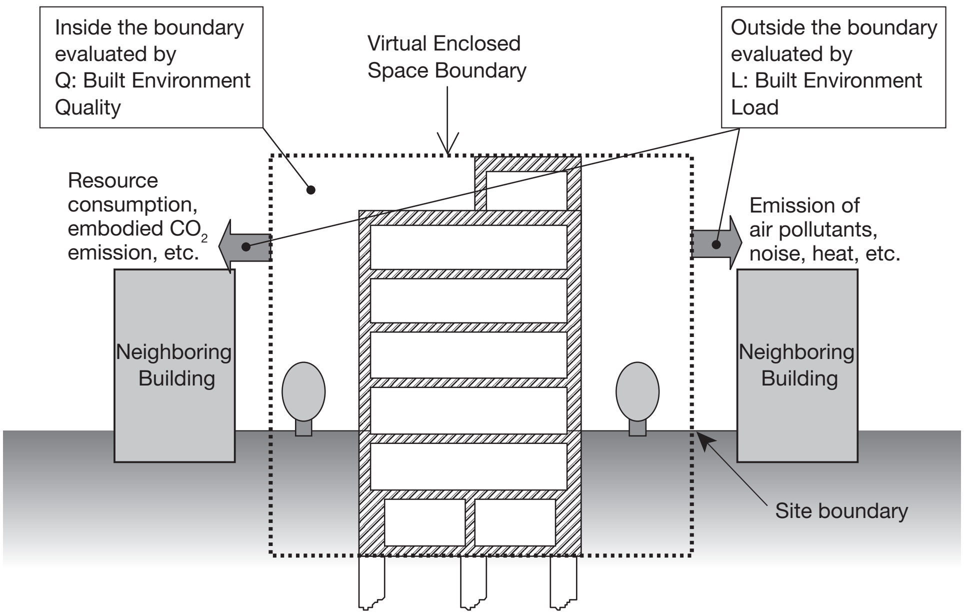


Figure 2.6.1: Division of the assessment categories for Q: Built Environment Quality and L: Built Environment Load based on the virtual enclosed space boundary

CASBEE covers the following four assessment fields: (1) Energy efficiency (2) Resource efficiency (3) Local environment (4) Indoor environment. These four fields are largely the same as the target fields for the existing assessment tools described above in Japan and abroad, but they do not necessarily represent the same concepts, so it is difficult to deal with them on the same basis. Therefore, the assessment categories contained within these four fields had to be examined and reorganized. As a result, the assessment categories were classified as shown in Figure 2.6.2 into BEE numerator Q (Built environment quality) and BEE denominator L (Built environment load). Q is further divided into three items for assessment: Q1 Indoor environment, Q2 Quality of service and Q3 Outdoor environment on site. Similarly, L is divided into L1 Energy, L2 Resources and Materials and L3 Off-site Environment.

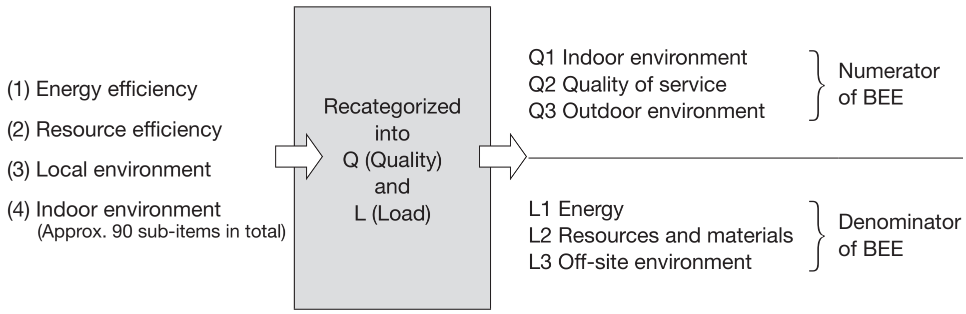


Figure 2.6.2: Classification and rearrangement of assessment items into Q (Built environment quality) and L (Built environment load)

2.6.2. BEE=Q/L

As explained above, BEE (Built Environment Efficiency), using Q and L as the two assessment categories, is the core concept of CASBEE. BEE, as used here, is an indicator calculated from Q (Built environment quality) as the numerator and L (Built environment load) as the denominator.

$$\text{Built Environment Efficiency (BEE)} = \frac{\text{Q (Built environment quality)}}{\text{L (Built environment load)}}$$ <Equation 1>

The use of BEE enabled simpler and clearer presentation of building environmental performance assessment results. BEE values are represented on the graph by plotting L on the x axis and Q on the y axis. The BEE value assessment result is expressed as the gradient of the straight line passing through the origin (0,0). The higher the Q value and the lower the L value, the steeper the gradient and the more sustainable the building is. Using this approach, it becomes possible to graphically present the results of built environment assessments using areas bounded by these gradients. The figure shows how the assessment results for buildings can be ranked on a diagram as rank C (poor), rank B-, rank B+, rank A, and rank S (excellent), in order of increasing BEE value.

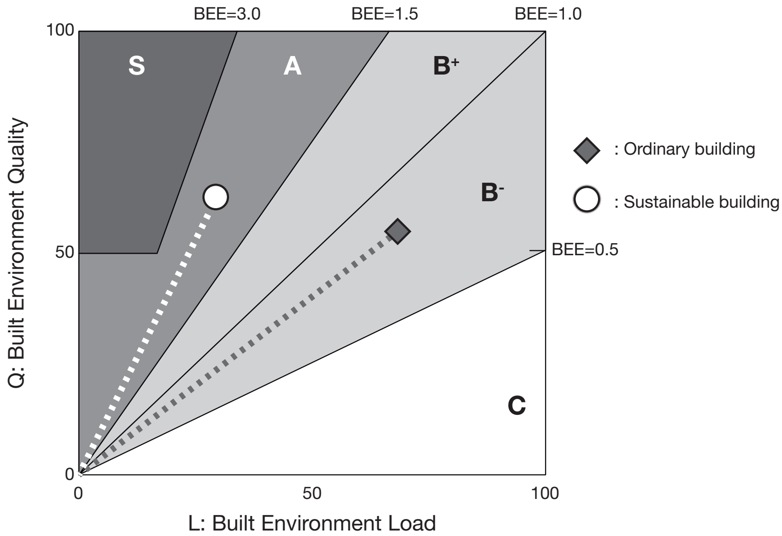


Figure 2.6.3: Environmental labeling based on Built Environment Efficiency (BEE)

2.6.3. Excluded aspects from the CASBEE assessment items

CASBEE is a comprehensive tool originally focused on evaluating the environmental performance of buildings. Therefore, it is not intended to evaluate all aspects of building performance and quality. In particular, specialized assessment systems already exist for fields such as aesthetic and economic performance, so they are excluded from consideration by CASBEE.

1) Aesthetic aspect

CASBEE emphasizes living amenity and working convenience for building users as the key aspects of the environmental quality of buildings. Scenic consideration in matters such as building position, form and exterior materials, and efforts to adapt to regional character are considered here, but we have decided not to evaluate aesthetic design characteristics, such as building beauty, which are difficult to evaluate objectively.

2) Cost and profitability aspects

CASBEE is intended to be an assessment tool applicable to a wide range of building types in both the public and private sectors. As such we have decided that assessment of cost-effectiveness should be left for building owners to judge according to their individual business situations. The market value of the completed building, the profitability of business conducted in the building and other aspects less related to global environmental problems play a large part in the project client’s judgment of how much to invest in improving a building’s environmental performance.

CASBEE serves as an indicator for considering the “best balance of quality and the environment,” based on the assumption of broadly economic buildings, and its assessment items include social perspectives such as consideration for regional character.

2.7. Graphic indication system of the rating results for dissemination

2.7.1. BEE chart

Built Environment Efficiency (BEE), which is calculated from the assessment results of Q (Built Environment Quality) and L (Built Environment Load), is shown here. The values for Q and L are derived from SQ (the total score for the Q categories) and SLR (the total score for the LR categories). First the numerator Q is defined as Q = 25(SQ-1) to convert the SQ (from 1 to 5) for the built environment quality into the Q scale of 0 to 100. Then the denominator L is defined as L = 25(5-SLR) to convert the SLR (from 1 to 5) for load reduction into the L scale of 0 to 100.

BEE is presented as a graph with Q on the Y axis and L on the X axis, so that BEE is the gradient of the line joining the point with coordinates equal to the Q and L values to the origin (Q = 0, L = 0). The higher the Q value and the lower the L value, the steeper the gradient and the more sustainable the building is. CASBEE labels buildings with an overall environmental performance assessment rating ranging from C through B-, B+, A and S, corresponding to areas divided according to the line gradient. The ranks correspond to the assessment expressions shown in Figure 2.7.1 and Table 2.7.1, using a number of stars for clarity.

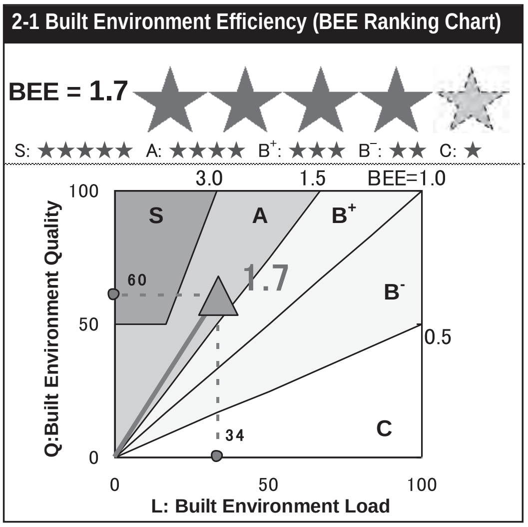


Figure 2.7.1: BEE Chart

Table 2.7.1: BEE Ranking according to the BEE value in CASBEE

Ranks	Valuation	BEE value, etc.	Indication
S	Excellent	BEE = 3.0 or more and Q = 50 or more	★★★★★
A	Very Good	BEE = 1.5-3.0 BEE = 3.0 or more and Q is less than 50	★★★★
B+	Good	BEE = 1.0-1.5	★★★
B-	Fairy Poor	BEE = 0.5-1.0	★★
C	Poor	BEE = less than 0.5	★

2.7.2. Radar Chart of 6 major categories

The points for the six major categories from Q1 to LR3 are shown together in a radar chart (Figure 2.7.2) on the upper right of the second column, to give an immediate clear presentation of the characteristics of environmental considerations in the target building.

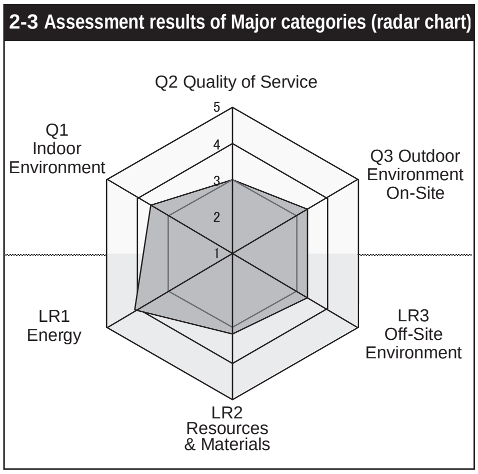


Figure 2.7.2: Rader Chart of 6 major categories

2.7.3. LCCO$_2$ emission bar chart (for housing and building scale)

Lifecycle CO_2 is presented as a global warming impact chart in CASBEE for housing and buildings.

Since 2008, CASBEE has included LCCO$_2$ assessment, which evaluates CO_2 emissions during the entire building life cycle from construction and operation to demolition and disposal. A new “Standard Calculation” method automatically provides a simplified estimation of LCCO$_2$ based on data already entered in a CASBEE spreadsheet. The feature is especially beneficial to assessors who are not familiar with the LCCO$_2$ evaluation. Additionally, the “Individual Calculation” method can be selected for buildings with more extensive CO_2 reduction measures.

In the 2010 edition, LCCO$_2$ performance is indicated more precisely by awarding 1 to 5 green stars based on LCCO$_2$ emissions together with the existing BEE assessment (e.g., S: 5 red stars). Specifically, the emissions rate (%) for the assessment target is evaluated relative to the LCCO$_2$ emission level of a reference building (one that satisfies evaluation standards for building owners according to the Energy Conservation Law).

The reference values and $LCCO_2$ for the evaluated building are indicated on a bar chart. The emission rate (%) for the assessment subject is displayed, relative to the reference value of $LCCO_2$ emission as 100%.

1. Reference value ($LCCO_2$ emissions of a standard building that satisfies the standard for building owners as referred to in the Energy Conservation Law)
2. $LCCO_2$ emissions of subject building: assessment of building-related initiatives (e.g., energy efficiency improvement, use of ecological materials and extended building lifespan)
3. Assessment of above initiatives + other on-site measures (e.g., on-site solar power generation)
4. Assessment of above initiatives + off-site measures (e.g., procurement of green power certificates and carbon credits)

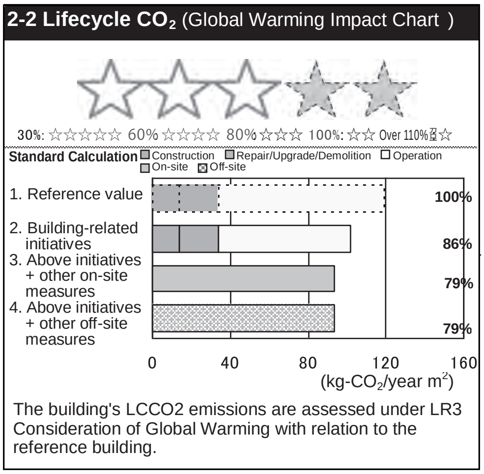


Figure 2.7.3: $LCCO_2$ emission bar chart

2.7.4. Bar charts of credits

Assessment results for Q (Environmental quality) are presented as a bar chart per medium-level categories on the upper column for each major category. And the assessment results for LR (Environmental load reduction) are presented likewise.

Figure 2.7.4 shows an assessment result for CASBEE–Building presenting assessment results of Q1 Indoor Environment, Q2 Quality of Service and Q3 Outdoor Environment on Site on the upper column, and R1 Energy, LR2 Resources and Materials and LR3 Off-site Environment on the lower column.

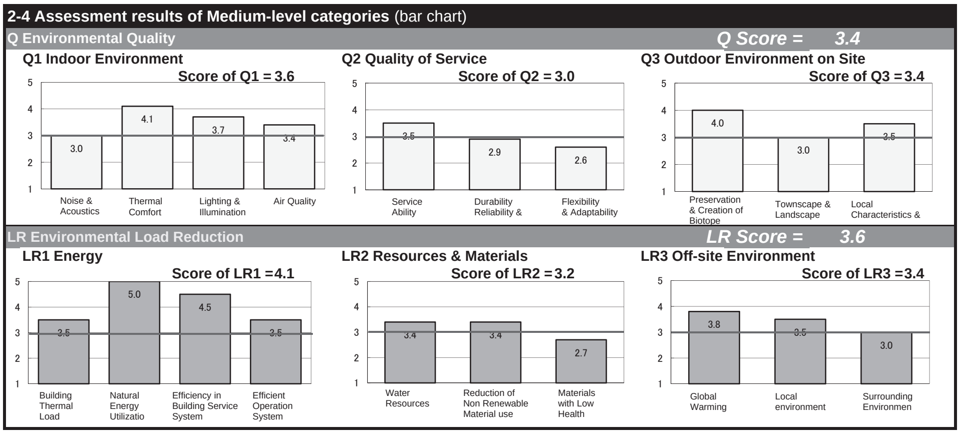


Figure 2.7.4: Bar charts of credits

2.8. Input operation & output results

2.8.1. Composition of the Assessment Tools

CASBEE has been developed to allow simple data entry from general-purpose spreadsheet software for various usage of assessment results. This section explains CASBEE assessment software of CASBEE for New Construction as an example to present a basic assessment process of CASBEE in practice.

There are the Main Sheet and Score Entry Sheet for data entry and the Score Sheet and Assessment Results Sheet for output. The basic information on the building (building type, floor area, etc.), necessary for assessment, is entered on the Main Sheet. The scoring criteria for the building under assessment are presented on the Score Entry Sheet, and the scoring results for each assessment item are input with reference to criteria. The Energy Calculation Sheet for data input for the LR1 Energy assessment, and the Consideration Record Sheet for detailed statements and the Emission Coefficient Sheet for $LCCO_2$ assessment are also available.

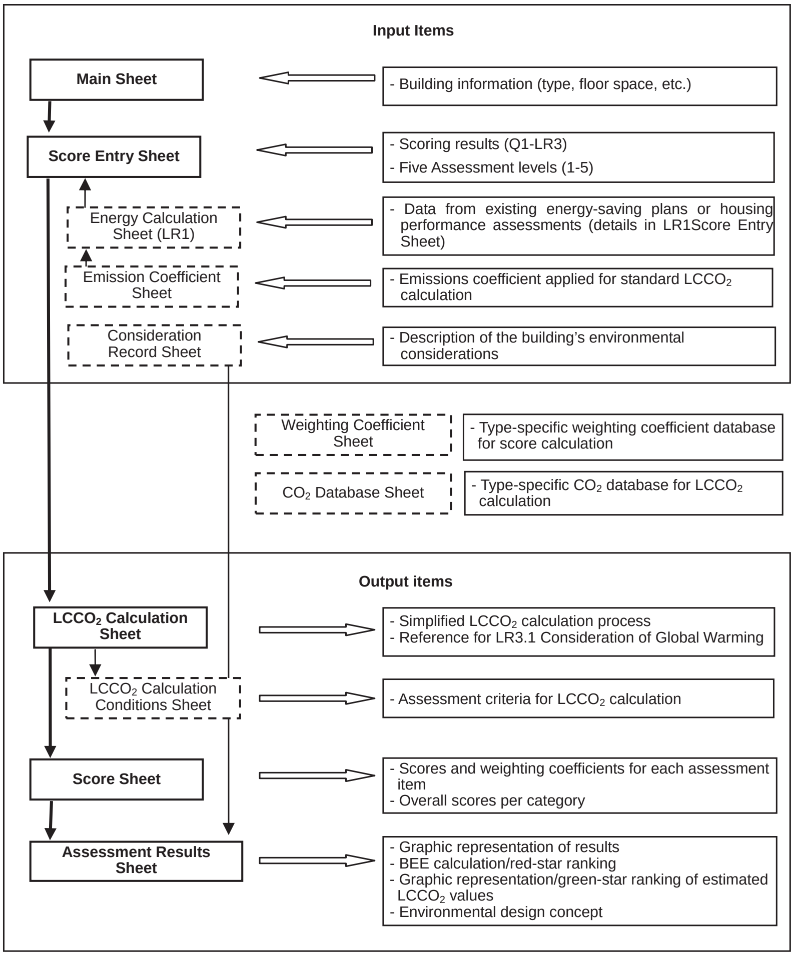
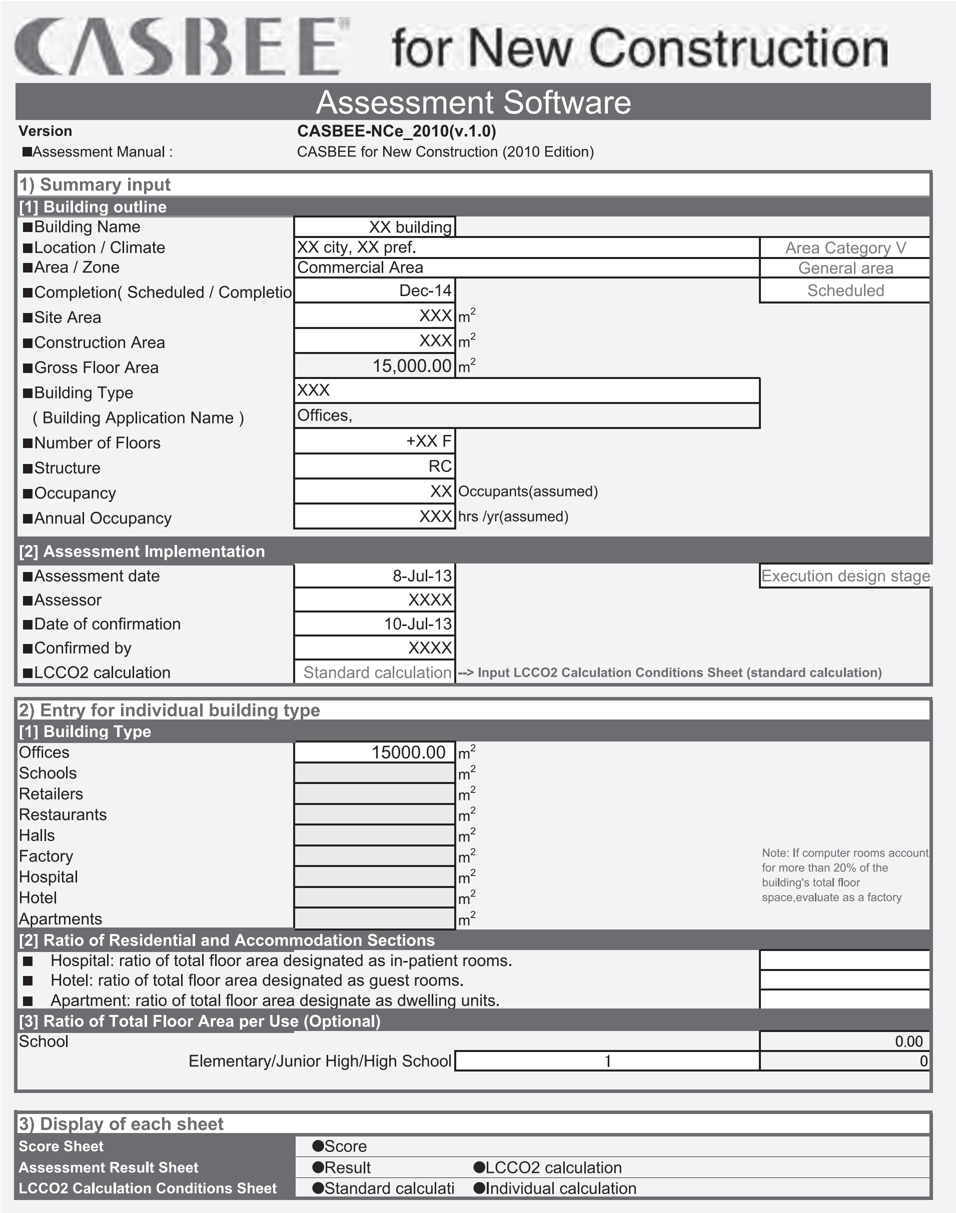


Figure 2.8.1: Assessment Sheet Overview

2.8.2. Input process

2.8.2.1 Main Sheet

Figure 2.8.2 shows the Main Sheet. The Main Sheet is the sheet where the assessor makes the first input. Enter the information necessary for the assessment, such as basic information on the subject building (name, type, size, etc.). For the assessment of residential-type buildings, enter the floor area ratio between <Entire Building and Common Properties> and <Residential and Accommodation Sections>.


CASBEE for New Construction

Assessment Software

Version	CASBEE-NCe_2010(v.1.0)
■Assessment Manual :	CASBEE for New Construction (2010 Edition)

1) Summary input

[1] Building outline			
■Building Name	XX building		
■Location / Climate	XX city, XX pref.		Area Category V
■Area / Zone	Commercial Area		General area
■Completion(Scheduled / Completio	Dec-14		Scheduled
■Site Area	XXX	m^2	
■Construction Area	XXX	m^2	
■Gross Floor Area	15,000.00	m^2	
■Building Type	XXX		
(Building Application Name)	Offices,		
■Number of Floors	+XX F		
■Structure	RC		
■Occupancy	XX	Occupants(assumed)	
■Annual Occupancy	XXX	hrs /yr(assumed)	

[2] Assessment Implementation			
■Assessment date	8-Jul-13		Execution design stage
■Assessor	XXXX		
■Date of confirmation	10-Jul-13		
■Confirmed by	XXXX		
■LCCO2 calculation	Standard calculation	--> Input LCCO2 Calculation Conditions Sheet (standard calculation)	

2) Entry for individual building type

[1] Building Type			
Offices	15000.00	m^2	
Schools		m^2	
Retailers		m^2	
Restaurants		m^2	
Halls		m^2	
Factory		m^2	Note: If computer rooms account for more than 20% of the building's total floor space,evaluate as a factory
Hospital		m^2	
Hotel		m^2	
Apartments		m^2	

[2] Ratio of Residential and Accommodation Sections

- ■ Hospital: ratio of total floor area designated as in-patient rooms.
- ■ Hotel: ratio of total floor area designated as guest rooms.
- ■ Apartment: ratio of total floor area designate as dwelling units.

[3] Ratio of Total Floor Area per Use (Optional)		
School		0.00
Elementary/Junior High/High School	1	0

3) Display of each sheet

Score Sheet	●Score	
Assessment Result Sheet	●Result	●LCCO2 calculation
LCCO2 Calculation Conditions Sheet	●Standard calculati	●Individual calculation

Figure 2.8.2: Main Sheet screen (date entry example)

The basic information entered in the Main Sheet is transferred to the Assessment Results Sheet.

Enter the average occupancy and the annual occupancy time where possible. These are for reference only and do not directly affect the CASBEE assessment.

Table 2.8.1: Entry items for Main sheet of CASBEE for New Construction

Entry item	Example	Entry item	Example
Building Name	XX building	Total floor area *2	(squre meter)
Location/Climate	XX city, XX pref.	Building type	Office, school, apartment
Area/Zone	Commercial area	(Building type) *3	City hall, college
Regional Category	Area category V *1	Number of floor	+XXF
Completion	2011.12	Structure	S
Site area	(square meter)	Average	(number of people)
Construction area	(square meter)	Annual occupancy time (in hours)	(hours)

*1 Select the regional category from among six regions (I to VI) in the Appendix Table I Evaluation Standards for Clients and Owners of Specified Buildings Concerning Rational Use of Energy in Housing (Ministry of Economy, Trade and Industry/Ministry of Land, Infrastructure, Transport and Tourism, 2009 Directive No.1). This is only applicable to apartments.

*2 Total floor area is automatically entered as the sum of the previously entered floor space in all usage areas.

*3 Building type is automatically entered from the types selected in the column for the usage-specific floor area, based on the CASBEE building-type categories. More specific information on the building type can be entered in the additional Building Type column above (optional).

2.8.2.2. Score Entry Sheet

The Score Entry Sheet is where the assessor records the actual scores, evaluating grades of level 1-5 for each assessment item on the sheet, according to the stated assessment criteria. There are individual Score Entry Sheets for each assessment category, Q1 to 3 and LR1 to 3.

1 Sonic Environment
1.1 Noise
1.1.1 Indoor Background Noise Level

Entire building and common properties Weighting coefficients(default)= 0.50						Residential and Accommodation Sections Weighting coefficients(default)= 0.00	
Level 3.0	Off, Hsp(Waiting Room), Htl, Apt, Fct	Sch(Universities, etc.), Hsp(Examining	Rtl, Rst	Hal	Sch(Elementary/Junior High/High Schools)	**Level 3.0**	Hsp, Htl, Apt
Level 1	50< [Background noise level]	45< [Background noise level]	55< [Background noise level]	40< [Background noise level]	60< [Background noise level]	**Level 1**	45< [Background noise level]
Level 2	(No corresponding level)	(No corresponding level)	(No corresponding level)	(No corresponding level)	50< [Background noise level] =<60	**Level 2**	(No corresponding level)
■Level3	45< [Background noise level] =<50	40< [Background noise level] =<45	50< [Background noise level] =<55	35< [Background noise level] =<40	45< [Background noise level] =<50	**■Level3**	40< [Background noise level] =<45
Level 4	40< [Background noise level] =<45	35< [Background noise level] =<40	45< [Background noise level] =<50	30< [Background noise level] =<35	35< [Background noise level] =<45	**Level 4**	35< [Background noise level] =<40
Level 5	[Background noise level] =<40	[Background noise level] =<35	[Background noise level] =<45	[Background noise level] =<30	[Background noise level] =<35	**Level 5**	[Background noise level] =<35

Figure 2.8.3: Score Entry Sheet

Table 2.8.2: Entry items for Score Sheet of CASBEE for New Construction

Element	Description
Scoring	Choose level 1-5 from pull-down menu.
Scoring Criteria	Display assessment criteria for each item.
Efforts to be evaluated	A scoring method used for some items. Points which should be considered for the environment are listed, and can be selected for scoring.
Weighting coefficients (default)	Displays weighting coefficients stipulated for the application (cannot be altered)

As shown in Figure 2.8.3, Score Entry Sheet displays a list of scoring criteria for each building type, and the assessor should assign points accordingly. The scoring criteria of "Entire Building and Common Properties" should be scored for all types in common. However, for residential building, the scoring criteria of "Residential and Accomodation Sections" should be scored as well.

Scoring criteria are set for levels 1-5, and the number for the level (e.g., "3" for level 3) should be chosen from the pull-down menu in the assessment column. If it is not possible to apply the scoring criteria as they stand, due to individual conditions in the target building, "Exclude" can be selected for some assessment items (items which can be excluded are listed in the commentary in the manual). If "Exclude" is selected, the excluded scoring items are assigned a weighting of "0" unless otherwise specified, and distributed according to the weighting of other scoring items.

When evaluating a building complex, enter the average of the levels (points) for all applicable building types, weighted for relative floor areas of each. Obtain the area-weighted average for each assessment item, and select the corresponding values from the pull-down list in the Score Entry Sheet. The averaged results are rounded to the nearest whole integer. For a more detailed assessment, the weighted averages in decimal form can be manually entered in the corresponding columns.

2.8.2.3. Consideration Record Sheet

State measurements considered in the Design for Environment, so that it is easy for a third party to gain an overview of environmental considerations in the evaluated building. The content of such statements is indicated in "3. Design consideration" in the Assessment Results Sheet. Make statements (free content) in each space for General, Q1-LR3 and Other in the Consideration Record Sheet. State the concept of the building as a whole in the General space, and make any statements related to assessment items in the relevant columns Q1-LR3. Use the Other column to describe other environment-oriented efforts not evaluated under Q1-LR3.

2.8.2.4. Emissions Coefficient Sheet

Select the appropriate CO_2 emissions coefficient for electricity use specific to the assessment objective. The assessment software for the 2010 edition allows use of the most recent actual emissions coefficient and alternative values. These values are based on Article 2-4 of the Ordinance on Calculation of Greenhouse Gas Emissions from Business Activities of Specified Emitters. The assessor may also choose and apply other appropriate emissions coefficients (optional). Figure 2.8.4 Emission Coefficient Sheet shows the coefficient selection form for electricity use.

Emissions Coefficient

Emissions coefficient for electricity use (standard calculation)

Name of PPS	Coefficient	
		t-CO_2/kWh

(1) Using a designated emissions coefficient:

	PPS/Reasons, etc.	Coefficient	
○			(t-CO_2/kWh)

(2) Using a coefficient based on the calculation method for greenhouse gas emissions as referred to in the Basic Law for Prevention of Global Warming:

A: Electricity supplied by general and specified power producers/suppliers (PPS)

	Name of PPS	Coefficient	
○			(t-CO_2/kWh)

B: Other:

	PPS/Reasons, etc.	Coefficient	
○			(t-CO_2/kWh)

C: Alternative coefficient value

	Reasons, etc.	Coefficient	
○	Alternative value		(t-CO_2/kWh)

(3) Other:

	PPS/Reasons, etc.	Coefficient	
○			(t-CO2/kWh)

CO_2 Emission Coefficient per PPS published in 2008

Coefficient per PPS and alternative value based on Ordinance on Calculations of Greenhouse Gas Emissions

[1] Actual emissions coefficient

Hokkaido Electric Power Co., Inc.	0.000588	
Tohoku Electric Power Co., Inc.	0.000469	
Tokyo Electric Power Co., Inc.	0.000418	
Chubu Electric Power Co., Inc.	0.000455	
Hokuriku Electric Power Co., Inc.	0.000550	
Kansai Electric Power Co., Inc.	0.000355	
Chugoku Electric Power Co., Inc.	0.000674	
Shikoku Electric Power Co., Inc.	0.000378	
Kyushu Electric Power Co., Inc.	0.000374	
Okinawa Electric Power Co., Inc.	0.000946	
eREX Co., Ltd.	0.000462	
Eneserve Corp.	0.000422	
Ennet Corp.	0.000436	
F-Power Co., Ltd.	0.000352	
Oji Paper Co., Ltd.	0.000444	
Summit Energy Corp.	0.000505	
GTF Green Power Co., Ltd.	0.000767	
Showa Shell Sekiyu K.K.	0.000809	
Nippon Steel Engineering Co., Ltd.	0.000759	
Nippon Oil Corporation	0.000433	
Diamond Power Corp.	0.000482	
Japan Wind Development Co., Ltd.	0.000000	
Panasonic Corp.	0.000679	
Marubeni Corp.	0.000501	(t-CO_2/kWh)

[2] Alternative value

Alternative value	0.000561	(t-CO_2/kWh)

Figure 2.8.4: Emissions Coefficient Sheet

2. Basic Concept of CASBEE

2.8.3. Output results

2.8.3.1. Life Cycle CO_2 Calculation Sheet

Figure 2.8.5 shows the Life Cycle CO_2 (LCCO_2) calculation sheet. The sheet displays the automatic calculation process for LCCO_2 (the standard calculation) based on data entered in the Score Entry Sheet and the Energy Calculation Sheet.

Under each category of the building's life cycle stages (i.e., construction, maintenance/upgrade/demolition and operation), the reference value (for a building rated as level 3 in all assessment categories except Energy and equivalent to the evaluation standard for building owners as specified in the Energy Conservation Law) and the CO_2 emissions for the subject building are displayed in kg-CO_2/year-m^2.

CASBEE for New Construction (2010 Edition)	■Manual: CASBEE for New Construction (2010 Edition)
xx Building	■Software: CASBEE-nc_2010(v.1.5)

Life Cycle CO_2 Calculation Sheet (Standard Calculation)

1. CO_2 Emissions Related to Construction

1-1. Conversion of Assessment Results to CO_2 Emissions

Q2 2.2.1 Service Life of Structural Materials	Area/Total Floor Area	Level 3 (kg-CO_2/year m^2)	Level 4	Level 5	Score Results (Target)	CO_2 Emissions (Target, kg-CO_2/year m^2)	Score Results (Reference)	CO_2 Emissions (Reference, kg-CO_2/year m^2)
Office	1.00	13.57	13.57	13.57	3.0	13.57	3.0	13.61
School	0.00	10.21	10.21	10.21	3.0	10.21	3.0	10.24
Retailer	0.00	16.07	16.07	16.07	3.0	16.07	3.0	16.13
Restaurant	0.00	16.07	16.07	16.07	3.0	16.07	3.0	16.13
Hall	0.00	10.93	10.93	10.93	3.0	10.93	3.0	10.96
Factory	0.00	18.12	18.12	18.12	3.0	18.12	3.0	18.18
Hospital	0.00	10.36	10.36	10.36	3.0	10.36	3.0	10.39
Hotel	0.00	10.88	10.88	10.88	3.0	10.88	3.0	10.92
Apartment	0.00	15.88	8.04	5.45	3.0	15.88	3.0	15.93

	Target	Reference
Structure	S	
LR2 2.2 Use of Existing Structural Frame	0%	0%
LR2 2.3 Recycled Materials for Structural Components (Blast Furnace Cement)	5%	0%
1-2. Total	13.57	13.61

2. CO_2 Emissions Related to Maintenance & Demolition

2-1. Conversion of Assessment Results to CO_2 Emissions

Q2 2.2.1 Service Life of Structural Materials	Area/Total Floor Area	Level 3 (kg-CO2/year m^2)	Level 4	Level 5	Score Results (Target)	CO_2 Emissions (Target, kg-CO2/year m^2)	Score Results (Reference)	CO_2 Emissions (Reference, kg-CO2/year m^2)
Office	1.00	20.23	20.23	20.23	3.0	20.23	3.0	20.23
School	0.00	16.68	16.68	16.68	3.0	16.68	3.0	16.68
Retailer	0.00	12.20	12.20	12.20	3.0	12.20	3.0	12.20
Restaurant	0.00	12.20	12.20	12.20	3.0	12.20	3.0	12.20
Hall	0.00	17.39	17.39	17.39	3.0	17.39	3.0	17.39
Factory	0.00	13.62	13.62	13.62	3.0	13.62	3.0	13.62
Hospital	0.00	20.24	20.24	20.24	3.0	20.24	3.0	20.24
Hotel	0.00	18.11	18.11	18.11	3.0	18.11	3.0	18.11
Apartment	0.00	13.58	14.94	16.22	3.0	13.58	3.0	13.58
2-2 Total						20.23		20.23

3. CO_2 Emissions Related to Operation Energy

	KWh/year	Emission Coefficient	Reduction	Target (kg-CO2/year m^2)		Reference (kg-CO2/year m^2)
3-1 Building-related Initiatives (2)				68.21	Reference Value (1)	85.09
3-2 Above initiatives + other on-site measures (3)				59.70		
Solar Power Generation	110,000	0.418	45,980.00	8.51		

4. LCCO_2 Calculation (Standard Calculation)

	CO_2 Emissions (Target, kg-CO2/year m^2)	CO_2 Emissions (Reference, kg-CO2/year m^2)
Construction	13.57	13.61
Maintenance & Demolition	20.23	20.23
Operation	59.70	85.09
Total	**93.49**	**118.93**

Figure 2.8.5: LCCO_2 Calculation Sheet (output example)

2.8.3.2. Score Sheet

The Score Sheet is shown in Figures 2.8.6 and 2.8.7. The Score Sheet tabulates the results entered in the Score Entry Sheet. The corresponding weighting coefficients are applied to the score for each item, and the weighted values are combined. All scores, the total of each category from Q1 to Q3 (SQ1 to SQ3) and from LR1 to LR3 (SLR1 to SLR3), the combined total of all categories under Q (SQ) and the combined total of all categories under LR (SLR) are displayed automatically.

If the building under assessment is a residential-type building, the Score Sheet presents score results for <Entire Building and Common Properties> and for <Residential and Accommodation Sections> in parallel. The results are calculated as a weighted average according to the ratio of floor areas for each section to produce a score for the building as a whole. The scores weighted on a pro-rata basis entered in ratio of <Residential and Accommodation Sections> under building outline entry on the Main Sheet are displayed in the “Total” column as the final score for the evaluated building.

In the “Summary of Environmental Conscious Efforts in Design” column, state the specific details of the efforts on which the score is based, particularly for when over 3 points (level 3) is awarded.

CASBEE for New Construction (2010 Edition)

XX building

enter figures and comments.

☒Manual : CASBEE for New Construction (2010 Edition)

☒software : CASBEE-NCe_2010(v.1.0)

Score Sheet Execution design stage		Entire Building and Common Properties		Residential and Accomodation sections		
Concerned items	Summary of environmentally conscious efforts in design	Score	weighting coefficients	Score	weighting coefficients	Total
Q Environmental Quality of the building						**3.4**
Q1 Indoor Environment			**0.40**			**3.6**
1 Sonic Environment		**3.0**	0.15	-	-	3.0
1.1 Noise		**3.0**	0.40	-	-	
1 Background noise level		3.0	0.50	3.0	-	
2 Equipment noise		3.0	0.50	-	-	
1.2 Sound Insulation		**3.0**	0.40	-	-	
1 Sound Insulation of Openings		3.0	0.60	3.0	-	
2 Sound Insulation of Partition Walls		3.0	0.40	3.0	-	
3 Sound Insulation Performance of Floor Slabs (light-weight impact source)		3.0	-	3.0	-	
4 Sound Insulation Performance of Floor Slabs (heavy-weight impact source)		3.0	-	3.0	-	
1.3 Sound Absorption		**3.0**	0.20	**3.0**	-	
2 Thermal Comfort		**4.1**	0.35	-	-	4.1
2.1 Room Temperature Control		**4.0**	0.50	-	-	
1 Room Temperature setting	At 25 degree in summer, 22 degree in winter	5.0	0.30	3.0	-	
2 Variable Loads and Following-up Control		3.0	-	-	-	
3 Perimeter Performance	Double skin	5.0	0.20	3.0	-	
4 Zoned Control		3.0	0.30	-	-	
5 Temperature and Humidity Control		3.0	0.10	3.0	-	
6 Individual Control		-	-	3.0	-	
7 Allowance for After-hours Air Conditioning		3.0	0.10	-	-	
8 Monitoring Systems		3.0	-	-	-	
2.2 Humidity Control		**3.0**	0.20	**3.0**	-	
2.3 Type of Air Conditioning System	Floor vented system	**5.0**	0.30	**3.0**	-	
3 Lighting & Illumination		**3.6**	0.25	-	-	3.6
3.1 Daylighting		**5.0**	0.30	-	-	
1 Daylight Factor	25%	5.0	0.60	3.0	-	
2 Openings by Orientation		-	-	3.0	-	
3 Daylight Devices	Light shelf	5.0	0.40	3.0	-	
3.2 Anti-glare Measures		**3.0**	0.30	-	-	
1 Glare from Light Fixtures		3.0	0.40	3.0	-	
2 Daylight Control		3.0	0.60	**3.0**	-	
3 Reflection Control		3.0				
3.3 Illuminance Level		**3.0**	0.15	**3.0**	-	
3.4 Lighting Controllability		**3.0**	0.25	**3.0**	-	
4 Air Quality		**3.4**	0.25	-	-	3.4
4.1 Source Control		**3.0**	0.50	-	-	
1 Chemical Pollutants		3.0	0.33	3.0	-	
2 Asbestos		3.0	-	-	-	
3 Mites, Mold etc		3.0	0.33	3.0	-	
4 Legionella		3.0	0.33	3.0	-	
4.2 Ventilation		**3.0**	0.30	-	-	
1 Ventilation Rate		3.0	0.25	3.0	-	
2 Natural Ventilation Performance		3.0	0.25	3.0	-	
3 Consideration for Outside Air Intake		3.0	0.25	3.0	-	
4 Air Supply Planning		3.0	0.25	3.0	-	
4.3 Operation Plan		**5.0**	0.20	-	-	
1 CO_2 Monitoring	CO2 monitoring system	5.0	0.50	-	-	
2 Control of Smoking	Smoking prohibited in the building	5.0	0.50	-	-	
Q2 Quality of Service		–	**0.30**	-	-	**3.0**
1 Service Ability		**3.5**	0.40	-	-	3.5
1.1 Functionality & Usability		**3.6**	0.40	-	-	
1 Provision of Space & Storage		3.0	0.33	3.0	-	
2 Use of Advanced Information System	Power supply 40VA/m2 or higher	4.0	0.33	3.0	-	
3 Barrier-free Planning	Mobiilty guidance standards	4.0	0.33	-	-	
1.2 Amenity		**4.0**	0.30	-	-	
1 Perceived Spaciousness & Access to View		3.0	0.33	3.0	-	
2 Space for Refreshment	Provision of space for refreshment	5.0	0.33	-	-	
3 Décor Planning	Mockup verification	4.0	0.33	-	-	
1.3 Maintenance Management		**3.0**	0.30	-	-	
1 Design Which Considers Maintenance Management		3.0	0.50	-	-	
2 Securing Maintenance Management Functions		3.0	0.50	-	-	
2 Durability & Reliability		**2.9**	0.31	-	-	2.9
2.1 Earthquake Resistance		**3.2**	0.48	-	-	
1 Earthquake-resistance		3.0	0.80	-	-	
2 Seismic Isolation & Vibration Damping Systems	Vibration Damping Systems	4.0	0.20	-	-	
2.2 Service Life of Components		**3.0**	0.33	-	-	
1 Service Life of Structural Frame Materials		3.0	0.23	-	-	
2 Necessary Refurbishment Interval for Exterior Finishes		3.0	0.23	-	-	
3 Necessary Renew al Interval for Main Interior Finishes		3.0	0.09	-	-	
4 Necessary Replacement Interval for Air Conditioning and Ventilation Ducts		3.0	0.08	-	-	
5 Necessary Renewal Interval for HVAC and Water Supply and Drainage Pipes		3.0	0.15	-	-	
6 Necessary Renewal Interval for Major Equipment and Services		3.0	0.23	-	-	
2.4 Reliability		**2.2**	0.19	-	-	
1 HVAC System		1.0	0.20	-	-	
2 Water Supply & Drainage		1.0	0.20	-	-	
3 Electrical Equipment		3.0	0.20	-	-	
4 Support Method of Machines & Ducts		3.0	0.20	-	-	
5 Communications & IT Equipment		3.0	0.20	-	-	

Figure 2.8.6: Score Sheet (output example 1/2)

3 Flexibility & Adaptability		**2.6**	0.29	-	-	2.6
3.1 Spatial Margin		**3.0**	0.31	-	-	
1 Allowance for Floor-to-floor Height		3.0	0.60	3.0	-	
2 Adaptability of Floor Layout		3.0	0.40	3.0	-	
3.2 Floor Load Margin		**3.0**	0.31	3.0	-	
3.3 System Renewability		**2.0**	0.38	-	-	
1 Ease of Air Conditioning Duct Renewal		2.0	0.17	-	-	
2 Ease of Water Supply and Drain Pipe Renew al		2.0	0.17	-	-	
3 Ease of Electrical Wiring Renewal		1.0	0.11	-	-	
4 Ease of Communications Cable Renewal		3.0	0.11	-	-	
5 Ease of Equipment Renewal		1.0	0.22	-	-	
6 Provision of Backup Space		3.0	0.22	-	-	
Q3 Outdoor Environment on Site		–	**0.30**	-	-	**3.4**
1 Conservation & Creation of Biotope	Biotope	**4.0**	0.30	-	-	4.0
2 Townscape & Landscape		**3.0**	0.40	-	-	3.0
3 Local Characteristics & Outdoor Amenity		**3.5**	0.30	-	-	3.5
3.1 Attention to Local Charcter & Improvement of Comfort		**3.0**	0.50	-	-	
3.2 Improvement of the Thermal Environment on Site	Planting on site	**4.0**	0.50	-	-	
LR Environmental Load Reduction of the building		–	-	-	-	**3.6**
LR1 Energy		–	**0.40**	-	-	**4.1**
1 Building Thermal Load	PAL=270 MJ/yr-m2	**3.5**	0.30	-	-	3.5
2 Natural Energy Utilization		**3.0**	0.20	-	-	5.0
2.1 Dirct Use of Natural Energy		**3.0**	-	-	-	
2.2 Converted Use of Renewable Energy		**3.0**	-	-	-	
3 Efficiency in Building Service System	ERR=17.1	**4.5**	0.30	-	-	4.5
4 Efficient Operation		**3.5**	0.20	-	-	3.5
4.1 Monitoring	Introduction of BEMS	**4.0**	0.50	-	-	
4.2 Operation & Management System		**3.0**	0.50	-	-	
LR2 Resources & Materials		–	**0.30**	-	-	**3.2**
1 Water Resources		**3.4**	0.15	-	-	3.4
1.1 Water Saving		**3.0**	0.40	-	-	
1.2 Rainwater & Grey water		**3.6**	0.60	-	-	
1 Rainwater Use System	Rainwater use system	4.0	0.67	-	-	
2 Gray Water Reuse System		3.0	0.33	-	-	
2 Reducing Usage of Non-renewable Resources		**3.4**	0.63	-	-	3.4
2.1 Reducing Usage of Materials		3.0	0.07	-	-	
2.2 Continuing Use of Existing Structural Frame etc.		3.0	0.24	-	-	
2.3 Use of Recycled Materials as Structural Frame Materials	Blast fumace cement (concret)	5.0	0.20	-	-	
2.4 Use of Recycled Materials as Non-structural Materials	–	3.0	0.20	-	-	
2.5 Timber from Sustainable Forestry		3.0	0.05	-	-	
2.6 Efforts to Enhance the Reusability of Components and Materials		3.0	0.24	-	-	
3 Avoiding the Use of Materials with Pollutant Content		**2.7**	0.22	-	-	2.7
3.1 Use of Materials without Harmful Substances		3.0	0.32	-	-	
3.2 Elimination of CFCs and Halons		**2.6**	0.68	-	-	
1 Fire Retardant		2.0	0.33	-	-	
2 Foaming Agents (Insulation Materials, etc.)		3.0	0.33	-	-	
3 Refrigerants		3.0	0.33	-	-	
LR3 Off-site Environment		–	**0.30**	-	-	**3.4**
1 Consideration of Global Warming	Energy saving efforts	**3.8**	0.33	-	-	3.8
2 Consideration of Local Environment		**3.5**	0.33	-	-	3.5
2.1 Air Pollution		**3.0**	0.25	-	-	
2.2 Heat Island Effect	Planting on site	**4.0**	0.50	-	-	
2.3 Load on Local Infrastructure		**3.0**	0.25	-	-	
1 Reduction of Rainwater Discharge Loads		-	-	-	-	
2 Sewage Load Suppression		3.0	0.33	-	-	
3 Traffic Load Control		3.0	0.33	-	-	
4 Waste Treatment Loads		3.0	0.33	-	-	
3 Consideration of Surrounding Environment		**3.0**	0.33	-	-	3.0
3.1 Noise, Vibration & Odor		**3.0**	0.40	-	-	
1 Noise		3.0	1.00	-	-	
2 Vibration		-	-	-	-	
3 Odor		-	-	-	-	
3.2 Wind Damage & Daylight Obstruction		**3.0**	0.40	-	-	
1 Restriction of Wind Damage		3.0	0.70		-	
2 Sand and Dust		3.0	-			
3 Restriction of Daylight Obstruction		3.0	0.30		-	
3.3 Light Pollution		**3.0**	0.20	-	-	
1 Outdoor Illumination and Light that Spills from Interiors		3.0	0.70		-	
2 Measures for Reflected Solar Glare from Building Walls		3.0	0.30		-	

Figure 2.8.7: Score Sheet (output example 2/2)

2.8.3.3. Assessment Results Sheet

The Assessment Results Sheet is shown in Figure 2.8.8. The assessment results of Q (Environmental Quality of the building), LR (Environmental Load Reduction of the building), BEE (Building Environmental Efficiency) and $LCCO_2$ emission rates are shown in graph and numerical formats.

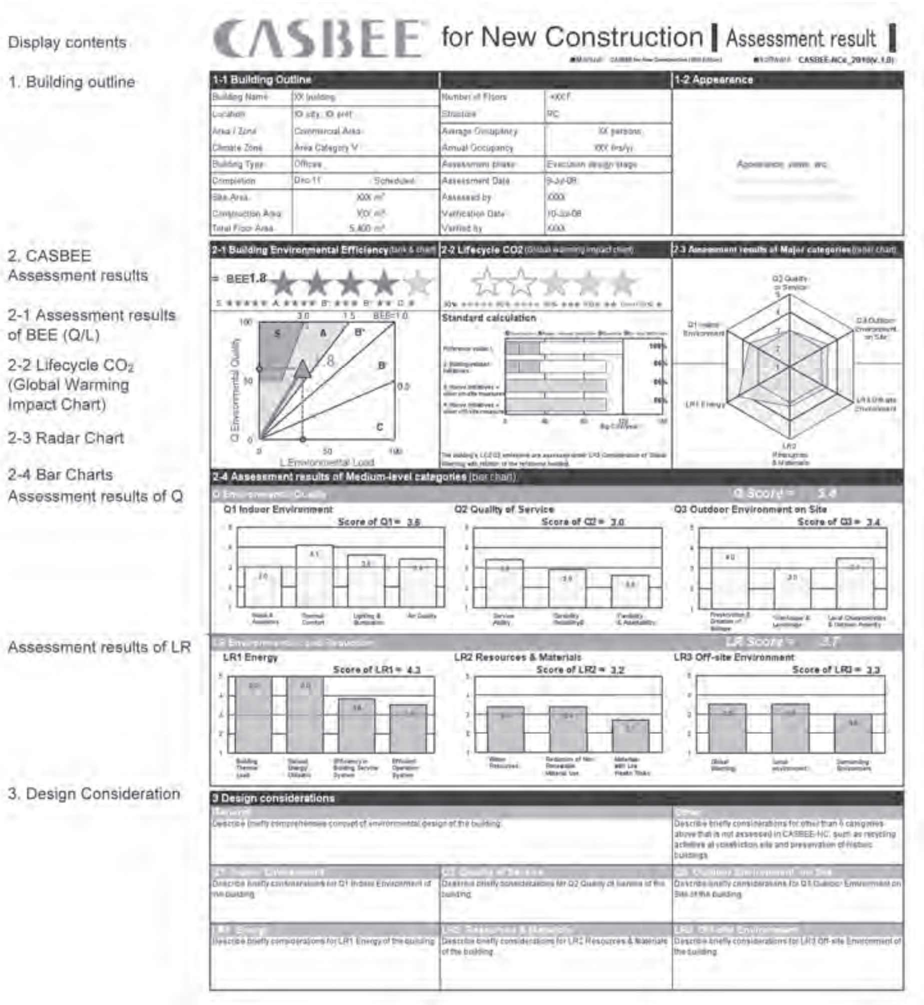


Figure 2.8.8: Assessment Result Sheet of CASBEE-NC (2010 edition) / Output example

<Column-3>

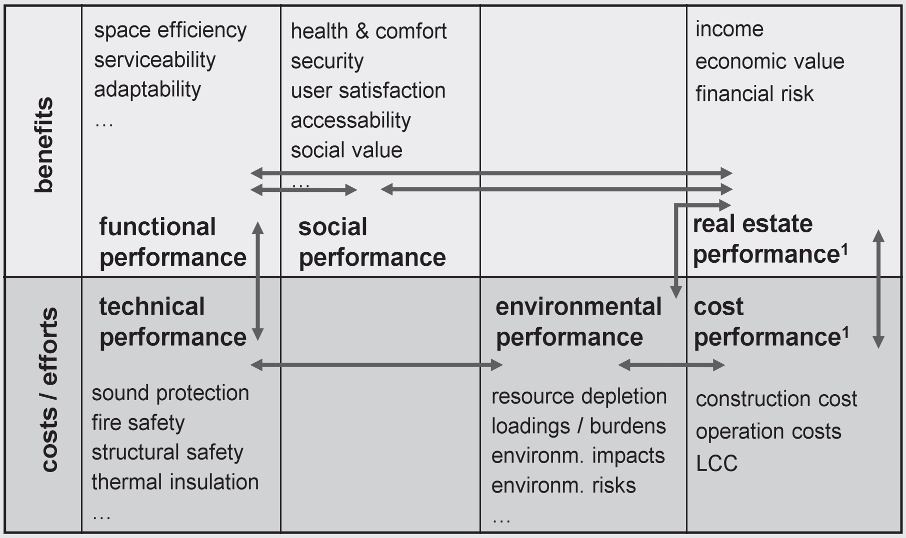
Assessment Systems and $LCCO_2$

Towards an integration of $LCCO_2$ into the environmental performance assessment

Thomas LÜTZKENDORF,
Professor, Karlsruhe Institute Technology, Germany

The way of approaching the design, implementation and management of buildings can have a significant impact on sustainable development. In doing so, the buildings affect the health and comfort of their users on the one hand and contribute with their urban design solutions to the quality of the built environment on the other hand. Thereby, they affect the quality of life, satisfaction and productivity of people. Then again, buildings cause significant energy and mass flows across their life cycle, leading to the depletion of resources and adverse effects on the environment. Therefore, already during the planning phase it is important to ensure that a high quality of use can be achieved with a minimum consumption of resources and reasonable effects on the environment.

To support the planning process tools are required that can describe and assess both the benefits and loads related to the building. Figure C3.1 presents a systematic approach developed by the author.



[1] as part of economic performance (and whole life cost WLC)

Figure C3.1: Concept of performance measurement and cost-benefit assessment [Lützkendorf]

Through the development and application of assessment tools, building optimization during the design phase can be achieved and the result of this assessment can be signaled at the time of completion of the building to third parties. Among others, this has a positive effect on motivating the investors, who are therefore enabled, if they wish to demonstrate their responsible business practices regarding the environment and society.

In Japan, 10 years ago a tool was developed and has been successfully used until now that fulfills this task; the Comprehensive Assessment System for Built Environment Efficiency (CASBEE). As the world's first and unique assessment system, it compares consistently the benefit categories (environmental quality of the building) with the load categories and the possibilities of its reduction (Environmental load reduction of the building). Therewith, the optimization task of securing and maximizing the building quality while minimizing resources consumption and environmental load, which is to be solved during the design, is represented and supported in an especially appropriate manner. In addition to that, for the task of description, evaluation and optimization of the built environment efficiency an excellent tool is made available. Since the environmental quality of the building affects the quality of life and satisfaction of the users, at the same time some aspects of the social dimension of sustainability are taken into account. A connection to the economic dimension is made beyond the actual system through a division of labor and an information exchange with the valuation (property appraisal) – see also section 3.4.1 in this book.

In recent years, the requirements in regard to the description and assessment of the environmental performance of buildings have evolved. A transition from a predominantly qualitative to a predominantly quantitative approach took place that takes into account the full life cycle and includes results of a life cycle assessment. Internationally led standards such as ISO 21931-1:2010 Sustainability in building construction – Framework for methods of assessment of the environmental performance of construction works – Part 1: Buildings and ISO 21929-1:2011 Sustainability in building construction – Sustainability indicators – Part 1: Framework for the development of indicators and a core set of indicators for buildings formulate requirements for assessing the environmental performance and provide criteria to be used. At the same time the assessment of the environmental performance was integrated into the sustainability assessment.

The developers of CASBEE have responded quickly to these new requirements. Already in 2008, a simplified method for evaluating $LCCO_2$ was introduced. This makes it possible to determine the CO_2 emissions in the life cycle of the building, resulting from the construction, maintenance, demolition and operation and to assess them by comparing them with a reference building. Through the preparation and publication of a calculation method, tool and database conditions for the calculation of $LCCO_2$ were created.

With the introduction of an $LCCO_2$ calculation the possibilities of CASBEE have once again been extended. On the one hand, the effects on the environment – here the contribution to global warming – can now be integrated into the assessment of environmental impact and improve the quality of the statement. On the other hand, the result of the determination and assessment of $LCCO_2$ can be presented separately. Thus, with this an important precondition is fulfilled, which is to show the carbon footprint of the building throughout its life cycle. This topic is currently connected with the development of the future ISO14067 greenhouse gases – the carbon footprint of products – requirements and guidelines for quantification and communication that are intensively discussed and attract considerable attention in the real estate industry. The developers of CASBEE made with the elaboration of low-carbon performance, which was introduced in 2010, is a major step in this direction.

The requirements regarding the quality of construction work continue to increase. This also impacts the required tools for planning and assessment. Also, after a successful 10-year period, new questions are being posed to CASBEE. For example, can a transition from an environmental performance assessment to a sustainability assessment be achieved? Should the determination of $LCCO_2$ be translated into an assessment of GWP? Can other impact categories such as ODP or ADP be integrated? The research project SuPerBuildungs (http://cic.vtt.fi/superbuildings/) was developed with the support of the author's recommendations for the further development of existing assessment systems.

The author of this article has for many years been in close contact with the developers and users of CASBEE. The further development of the CASBEE and BNB/DGNB systems, which are used in Japan and Germany, respectively, allows the continuous exchange of ideas as well as collegial-level cooperation.■

3. CASBEE Family of Tools

3.1. Overall Structure

3.2. CASBEE for Housing

3.3. CASBEE for Buildings

3.4. CASBEE for Market Promotion (CASBEE-MP)

<Column-4> Sustainable assessment as a tool for translating sustainability features into value

<Column-5> Linkage between environmental performance assessment and property appraisal

3.5. CASBEE for Urban Development (CASBEE-UD)

3.6. CASBEE for Cities (CASBEE-City)

<Column-6> Towards Green Cities

3.7. CASBEE Connector to BIM

3.1. Overall Structure

CASBEE is comprised of assessment tools tailored to different scales: construction (housing and buildings), urban (town development) and city management. These tools are collectively known as the CASBEE Family.

Scale	Tool	Edition	N	E	R
Housing scale	CASBEE Home (DH)	Standard ver.	○∗	○	
	CASBEE Dwelling Unit	Standard ver.	○		
	Health Checklist	Very brief ver.		○	

N: New Construction
E: Existing Building
R: Renovation

Scale	Tool	Edition	N	E	R	Site (Derivative tools)	Commercial interior (Derivative tools)	Temporal Use (Derivative tools)	Heat island (Derivative tools)	School (Derivative tools)
Building scale	CASBEE Building [Offices, Apartments, Schools, Retailers, Hospitals, Hotels, etc.]	Standard ver.	○	○	○	●	●	○	○	
		Brief ver.	○∗	○∗	○∗					○
	CASBEE Market Promotion	Very brief ver.		○						

Scale	Tool	Edition	Communities
Urban scale	CASBEE Urban Development	Standard ver.	○
		Brief ver.	○
	Community Health Checklist	Very brief ver.	○

Scale	Tool	Edition	Municipalities
City scale	CASBEE City	Professional ver.	○
		Standard ver.	○

○: Already developed
●: Under development
∗: Tools developed for wider dissemination nation-wide

Figure 3.1.1: Overall Structure of CASBEE Family

3.1.1 For housing scale

3.1.1.1. CASBEE for Home (Detached House)

1) CASBEE for New Detached House

This tool is used to assess the environmental performance of detached houses. The scoring criteria are simplified in anticipation of use by residents or small- and medium-sized building contractors.

CASBEE for New Detached Houses was developed in 2007. There are various stakeholders in the housing construction industry such as clients, architects, contractors, and builders. Therefore, “CASBEE for New Detached Houses” especially focuses on making its structure easy for users to understand. Among CASBEE tools, CASBEE for New Detached Houses was the first to introduce a new indicator of the five BEE ranks using the corresponding number of stars, in addition to the BEE chart. It includes 54 sub-criteria that have been modified from the other standards in Japan. These items for comprehensive assessment cover not only the house itself but also the outdoor space of the house, home appliances, information provided to the occupants from house suppliers, and the environmental strategies at the material production and construction stages.

2) CASBEE for Existing Detached Houses

This is a tool for the assessment of existing detached houses. It was developed to enable a resident, an architect, etc., to check the environmental performance of the house in which the resident is living, and to perform effective renovations.

3.1.1.2. CASBEE for Housing Unit

This assessment tool is for a unit in an apartment building.

It was developed as a tool that can be utilized when trading or renting a unit and by which the environmental performance of each unit of the apartment can be evaluated.

3.1.1.3. CASBEE Health Checklist

CASBEE Health Checklist is a type of software used to assess the health of residences.

Answering 50 questions allows residents to identify the aspects of their home that affect their health. The health ranking is also available for comparing the result with 6,000 other houses across Japan.

3.1.2 For building scale

3.1.2.1 CASBEE for Buildings

1) Basic CASBEE tools for buildings

a) CASBEE for New Construction (CASBEE-NC)

CASBEE-NC is mainly used by architects and engineers to increase the BEE value of a building during the design process. This can be used as a design support tool as well as a self-checklist. This tool, formerly called the DfE (Design for Environment) tool, makes assessments based on the design specifications and the anticipated performance. Rebuilding projects are also assessed by CASBEE-NC. At any phase of the Preliminary Design, Execution Design or Construction Completion, the environmental quality and performance of the building and its load reduction performance can be evaluated. As environmental performance and scoring criteria change over time, the results of assessments remain valid only for three years after the completion of construction.

b) CASBEE for Existing Building (CASBEE-EB)

CASBEE-EB targets a number of existing buildings with an operational record for at least one year after completion. The tool was also developed to be applicable to the asset value assessment. With this tool, the performance achieved at the time of assessment is evaluated. The result is valid for 5 years and should be updated using the latest version of the assessment tool, because the condition of the building may change over time. It can be used as a labeling tool to declare the environmental performance of buildings. CASBEE-EB is also utilized to support building maintenance. Building owners, such as real estate agencies and large enterprises, may use it as a self-evaluation tool for mid- to long-term management plans.

c) CASBEE for Renovation (CASBEE-RN)

CASBEE-RN was designed to evaluate the performance of existing buildings based on specifications for renovation and the predicted performance. It can be used in renovating existing buildings or making proposals for building-operation monitoring, commissioning and upgrade designs with a view to ESCO (Energy Service Company) projects. It is valid for three years after the completion of renovation work, and assessment should be repeated with the latest version of CASBEE-RN available. This tool can be used to evaluate the degree of improvement of environmental performance relative to the level preceding renovation. CASBEE-RN may also assess the improvement of specific performance in relation to the purpose of renovation. For instance, the BEE for energy saving can also be evaluated; this is determined by scores for the assessment categories especially related to energy saving renovation, such as Energy (LR1) and Indoor environment (Q1).

2) Brief version

Brief versions of CASBEE tools were developed to meet the growing need for a tool that can more easily set goals for BEE and prepare documents for submission to government agencies. Abridged versions are available for most CASBEE tools, such as CASBEE-NC, CASBEE-EB, CASBEE-RN and CASBEE-UD.

3) Locally Customized Edition for Municipalities

A flexible response to regional characteristics is a common feature of all the tools of the CASBEE family. CASBEE-NC (brief version) can be used by local authorities for construction administration. Local authorities using this tool can tailor it to local conditions, such as climate and prioritized policies. Changes are generally made by modifying the weighting coefficients. Building owners have to report the CASBEE assessment result to the local authority in the same way as an Energy Saving Plan and the building approval application. This system is introduced to the local authorities as a way to improve the environmental efficiency of buildings in the respective regions. One example is “CASBEE-Nagoya,” which began in April 2004 under the building environmental consideration system of the City of Nagoya .

4) Derivative Tools for Building Scale

a) CASBEE for Temporary Construction (CASBEE-TC)

CASBEE for Temporary Construction was developed as an extension to CASBEE-NC for evaluating temporary buildings constructed specifically for short-term use, such as expo pavilions. Buildings of this type have short-term lifecycles and therefore consideration should concentrate largely on material use and recycling in the construction and demolition phases. The scoring criteria and weighting reflect the features of temporary buildings.

b) CASBEE for Heat Island Relaxation (CASBEE–HI)

Assessment of the heat island effect is essential in major urban areas such as Tokyo and Osaka. CASBEE-HI is a tool aimed for more detailed quantitative assessment of heat island reduction measures in building design. In CASBEE-HI, the criteria deal with more detailed conditions in the outdoor thermal environment and heat island load on the surroundings. (These are also addressed in CASBEE-NC.)

c) CASBEE for Schools

CASBEE for Schools was developed to assess primary schools and junior high or high schools. In Japan, there are an enormous number of old school facilities built in the 1960s or earlier waiting for renovation. CASBEE for Schools is designed for use especially at the planning and operation stages of buildings. Main target users are administrative officers in charge of the planning of educational facilities. To promote eco-friendly schools, CASBEE for Schools was modified from the CASBEE abridged versions for easy assessment of the schools.

3.1.2.2 CASBEE for Market Promotion (CASBEE-MP)

Originally, the CASBEE tools were intended mainly for design support use and were not widely used to promote green buildings in the property market. Recently, UNEP-SBCI, United Nations Environment Programme - Sustainable Buildings and Climate Initiative, proposed global common metrics called "the Sustainable Building Index." A simple, comparable and compatible system is crucial to decision-making regarding investment in green buildings. For investors, it is also necessary to cover the common metrics proposed by UNEP-SBCI. Thus, we decided to have CASBEE tools connected with property appraisal.

With this in mind, a very simple version of CASBEE was developed and launched in Japan. This tool has two aspects: the evaluation of environmental performance and the disclosure of environmental performance value (Index). A clear indication of environmental performance value is required in the property market, and it is important to disseminate such ideas.

The five issues, namely energy/GHG, water, materials, biodiversity/sustainable site, and indoor environment, compose the main categories of the tool, which also includes five from the Sustainable Building Index. With 21 assessment items in total, each of the five categories contains the prerequisite item. In regard to energy/GHG, the item "Public transportation access" is taken into account. "Soil Environmental Quality / Regeneration of Brown Field Sites" and "Measures Regarding Risk of Natural Disaster" contribute to biodiversity/sustainable site, as assessment items related to the site quality.

3.1.3. For urban scale

1) CASBEE for Urban Development (CASBEE-UD)

CASBEE-UD covers groups of buildings; it considers the human effort involved and effects of groups of buildings that improve the environmental performance of an urban area as a whole. For convenience, CASBEE tools used for housing and buildings are referred to as "building-scale CASBEE" to distinguish them from CASBEE-UD. CASBEE-UD is based on the concept of building-scale CASBEE and is one of the expanded CASBEE tools, developed with reference to the Q3 (Outdoor Environment on Site) and LR3 (Off-site Environment) assessment items of CASBEE-NC. However, CASBEE-UD is developed for partial or whole groups of buildings and it focuses on the phenomena that can occur as a result of building conglomeration. It is also a standalone system, independent of the building-scale CASBEE. CASBEE-UD excludes the interior of buildings from assessment (although there are exceptions in some assessment items). Therefore, this configuration makes it possible to use CASBEE-UD to assess a development area as a whole, while building-scale CASBEE assesses the environmental performance of individual buildings within the designated area.

2) CASBEE Community Health Checklist

CASBEE Community Health Checklist is a type of software used to assess the healthiness of communities. The checklist conforms to the assessment system based on the International Classification of Functioning, Disability and Health (ICF) of the World Health Organization (WHO). Communities are evaluated from the viewpoints of both "removal of function-disabling factors" and "sufficiency of encouraging factors for activities and participation."

3.1.4. For city scale

3.1.4.1 CASBEE for Cities

Conducting city assessments and disclosing those results to the public are important for supporting citizens' understanding of the actual condition of their city. Such assessment and disclosure could introduce a market mechanism that can be expected to provide city governments with strong incentives to improve their city conditions and also recognize that local policy and strategy can be the most appropriate way to address specific urban and environmental problems.

CASBEE for Cities is a system for comprehensively evaluating the environmental performance of cities, using a triple bottom-line approach of "environment," "society" and "economy." We have developed this new tool with the cooperation of the Promotion Council of Low Carbon Cities (PCLCC) (Secretary: The Regional Revitalization Bureau of Cabinet Secretariat). The PCLCC consists of Eco-Model Cities and other local governments, government-related organizations, relevant ministries and agencies, private companies and other bodies in Japan.

CASBEE for Cities measures the current BEE of the city concerned and estimates the future BEE after the implementation of policies. By comparing the two values, CASBEE for Cities quantitatively evaluates (estimates) the effectiveness of city policies and presents the results in an easy-to-understand format. We hope this new tool will help administrative officers and other stakeholders to share a common understanding of the current state of cities and cooperate in setting and pursuing goals in order to create a low-carbon society.

3.1.5. Supporting Documents other than Assessment Tools

3.1.5.1. CASBEE BIM Guideline

Building Information Modeling (BIM), a three-dimensional digital representation constructed with a link to a database of project information, is one of the most powerful tools supporting Integrated Project Delivery (IPD). Gradually, it is getting widely used for building design and construction management, and affecting a wide range of job sectors in design and construction industries.

We have made guidelines for embedding CASBEE in BIM software, which describes the rules and methods for evaluation of CASBEE in the software. The first product to which the guidelines were applied was released in 2009. Autodesk Revit Extension for CASBEE is an extension module for the software, and it can automatically evaluate some assessment items of CASBEE that usually require laborious work from assessors. We hope that it can make CASBEE an easier and more powerful tool to use in building design and construction industries.

3.1.5.2. CASBEE Property Appraisal Manual

In current transactions in the property market, green buildings ranked high by CASBEE are not necessarily traded at better prices. This indicates that the assessment itself does not work as an incentive to promote the construction of green buildings in the market. One reason for this is that there have been no tools available for bridging the gap between CASBEE developed in the construction industry and the property appraisal system used in the property transaction market.

CASBEE Property Appraisal Manual has been developed to cope with this issue. In short, it is an appraisal support tool to measure the building's specifications and provisions for eco-friendliness, which affect the property value.

3.1.6. Assessment tools under development

3.1.6.1. CASBEE for Site Selection (CASBEE for Sites)

CASBEE for Sites is a support tool for building owners and planners when making preliminary planning for projects. Taking factors such as basic environmental influences into consideration, it helps to choose an appropriate site. It is included in CASBEE-MP as an assessment item for site evaluation.

3.1.6.2. CASBEE for Commercial Interiors (CASBEE for Tenants)

With regard to the construction areas executed by tenants, CASBEE for Tenants will be developed as a tool used to assess the environmental performance of the designated area in a building.

3.2. CASBEE for Housing

3.2.1. CASBEE for New Detached Houses

3.2.1.1. Outline of CASBEE for New Detached Houses

1) Objectives of CASBEE for New Detached Houses

Detached houses account for almost half of all the existing residences in Japan and approximately 500,000 houses are newly constructed every year. If these houses provide a better living environment, are used over a longer period and are built from the viewpoint of energy/resource conservation, the total environmental load on the country can be significantly reduced, simultaneously improving the quality of our residential lifestyle. The introduction of CASBEE for New Detached Houses is intended to increase the number of such superior houses available across the country.

In order to facilitate further reduction of CO_2 emissions from detached houses, stricter scoring criteria regarding CO_2 emissions have been introduced. In addition to the conventional ranking of the comprehensive assessment results, the tool has been equipped with a function to rate the Lifecycle CO_2 ($LCCO_2$) performance of detached houses.

2) What to evaluate

(1) Comprehensive environmental performance of detached houses

In CASBEE for New Detached Houses, the comprehensive environmental performance of detached houses is assessed separately from the two different viewpoints of Q (Quality: environmental quality of a detached house itself) and L (Load: house-induced environmental load on the outside). Either category (Q or L) consists of three sub-categories for assessment, as shown below. Each sub-category is evaluated based on the measures taken for the respective purpose.

Q (Assessment is conducted to measure how high the Q level is)
Q1: Provide a comfortable, healthy and secure indoor environment
Q2: Able to be used over a long period
Q3: Contribute to the townscape or ecosystem

L (Assessment is conducted to measure LR or environmental load reduction, by evaluating the measures taken for reducing L)
LR1: Conserve energy and water
LR2: Conserve resources and reduce waste
LR3: Contribute to the global, local and surrounding environment

All the sub-categories are assessed to determine the BEE score of a detached house, which is defined as [Quality of Environment (Q) / Load on Environment (L)]. The comprehensive environmental performance is rated based on the obtained BEE score (red-star ranking).

Because the assessment is conducted according to the above sub-categories, having a high rank in the comprehensive results attained by CASBEE for New Detached Houses means the house assessed is “a residence which assures comfort, health and security (Q1), is durable for long-term use (Q2), conserves energy and water (LR1), has been designed to reduce environmental load, (for example, less waste being produced at the construction or demolition stage; LR2), and contributes to the creation of a better local environment (Q3 and LR3)."

With regard to Q_H and L_H (the subscript H denotes "home," that is, these Q and L values are the results for detached houses), the spatial zones to be assessed are defined as in Figure 3.2.1.

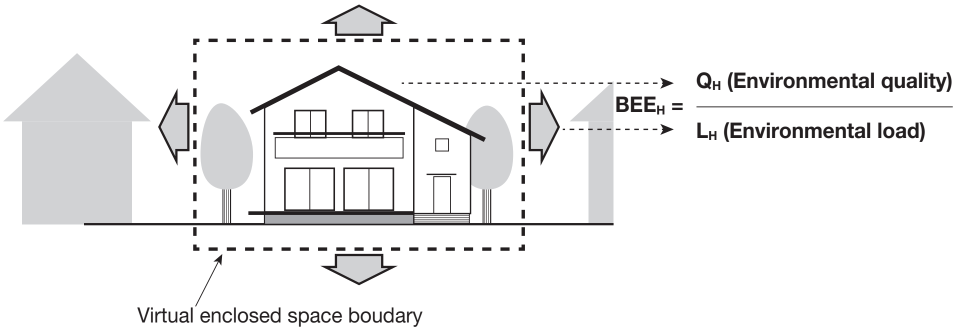


Figure 3.2.1: Defined space boundary for the assessment of Q_H and L_H

(2) Low-carbon performance for detached houses

In CASBEE for Homes (Detached Houses), which is a forerunner of CASBEE for New Detached Houses, the $LCCO_2$ assessment besides BEE, etc., was introduced to evaluate the low-carbon performance of a house throughout its lifecycle starting from construction through use as a residence until demolition/disposal. The results were displayed in a way that made it easy for building owners, architects, builders, etc., to understand the levels of their contribution toward the prevention of climate change.

In 2009, the Japanese Government announced a new target of "25% reduction of CO_2 emissions by 2020, compared with the 1990 level," increasing the importance of dealing with climate change issues in the country. In CASBEE for New Detached Houses, we reviewed the assessment method in order to encourage more initiatives to be taken for increased reduction of house-induced CO_2 emissions. The ranking based on the $LCCO_2$ assessment results (green-star ranking) has been newly introduced, thus enabling the tool to be used for the labeling of houses with superior low-carbon performance such as zero energy houses (ZEHs) and life cycle carbon minus (LCCM) houses.

3) Assessment principles

In CASBEE for New Detached Houses, the environmental performance of detached houses is assessed "comprehensively." Therefore, houses with a good balance in handling various relevant issues are ranked higher than those specializing in measures against a specific problem. There is no intention to deny the effect of focusing on selected issues, but we emphasize the importance of boosting environmental measures in general.

The subjects of CASBEE for New Detached Houses include not only the houses themselves, but also outdoor facilities, residents' choice of home appliances, the information provided to residents from house suppliers, maintenance plans or systems, and environmental strategies at the architectural components production and construction stages. Some are difficult for the house supplier to get involved directly in the decision-making process, but are nonetheless included for assessment as it is our principle to evaluate everything that can potentially have a considerable influence on the environment.

4) System for improved reliability of assessment results

Anyone can conduct the environmental performance assessment of detached houses using CASBEE for New Detached Houses. It therefore can be referred to as an assessment on a voluntary basis. However, the reliability of assessment results becomes crucial when they are presented and explained to other parties such as house buyers. As supporting systems to improve reliability, the "Accredited Professional for housing Registration system" and the "Certification System for Housing" have been established.

3.2.1.2. Assessment system of CASBEE for New Detached Houses

1) Basic assessment structure

(1) Comprehensive assessment of environmental performance

(1-1) Scoring of assessment items

In CASBEE for New Detached Houses, the comprehensive assessment of environmental performance of detached houses is conducted by separately evaluating Q (living environment quality in the house) and L (house-induced environmental load on the outside). Either category (Q or L) consists of three sub-categories called Major Items. Each "Major Item" employs a hierarchical system for more detailed categorization, which is comprised of one to three levels (Middle Items, Minor Items, and Scoring Items, respectively). The total number of 54 assessment items, all of which are assigned to the respective detailed categories, are marked in a range of one to five (the five being full scores). The scores attained from each level of hierarchy are separately processed to indicate which categories are handled well or poorly.

(1-2) Calculation of the BEE_H score

The scoring results are further processed separately for Q_H and L_H, and their final score is taken as points out of 100.

In CASBEE for New Detached Houses, any house with higher (points of) Q_H and lower (points of) L_H is valued highly. In assessment, this correlation between Q_H and L_H is indicated by the ratio given below (i.e., BEE_H). Therefore, the results of comprehensive environmental assessment are interpreted according to the level of the BEE_H score.

Built environment efficiency by CASBEE for New Detached Houses

[*The subscript H of BEE_H, Q_H and L_H represents "home," indicating these are assessment results of "Detached Houses" in the CASBEE family.]

$$\mathbf{BEE_H = Q_H/L_H}$$

BEE_H : Built environment efficiency of the house

Q_H : Quality of living environment of the house

L_H : House-induced load on the environment

When being plotted with Q_H on the Y-axis and L_H on the X-axis, the BEE_H score falls upon a point on the straight line with the slope of Q_H/L_H crossing the origin of the coordinate.

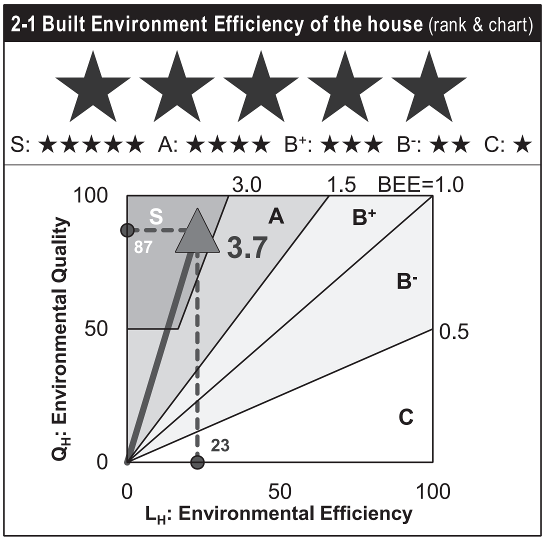


Figure 3.2.2: An example of how to rate the BEE_H score

(1-3) Ranking according to the BEE_H score

Based on the obtained BEE_H score, the rank of the detached house concerned is indicated by one of the five levels ranging from the highest "S (with five red stars)" down to the lowest "C (with a single red star)." The results are displayed using the proprietary software. Although these ranks with red stars are basically determined by the slope of BEE_H lines, the Q_H score has to reach at least 50 points to be ranked S. Figure 3.2.2 gives an example of an S-rank house (five red stars) with the BEE_H score being 3.7.

The assessment using the BEE_H scores is characterized by the results reflecting the correlation between Q_H and L_H, that is, with the doubled Q_H and the halved L_H, the BEE_H score quadruples.

For example, if less energy is used for heating and cooling, resulting in reduced environmental load but simultaneously leading to living in hot or cold conditions, the quality of the living environment will be degraded. The assessment result therefore is not so good. On the other hand, improved energy efficiency without compromising amenities or improved amenities without an increase in energy consumption can yield a better assessment result. Finally, better amenities with improved energy efficiency are valued even higher in this assessment system.

(2) Assessment of low-carbon performance

(2-1) Estimation of $LCCO_2$ emissions

When the assessment is conducted using CASBEE for New Detached Houses, CO_2 emissions throughout the house lifecycle consisting of construction, operation, repair, upgrade and demolition are also estimated as a measure against climate change, in addition to the BEE_H score. Whereas there are 54 assessment items in total, the scores attained from those related to house lifespan and energy conservation are automatically used for calculation. The result is compared with the "reference value," that is, the $LCCO_2$ emissions of a typical house being ranked Level 3 in all the relevant items, and is expressed as a percentage of the reference value (called the "emissions rate") to show how well the issue is addressed.

(2-2) Ranking according to the $LCCO_2$ performance
Based on the obtained emissions rate, the house concerned is assigned to one of the five ranks with the corresponding number of green stars. Below are the specific criteria used for the ranking according to the emissions rate.

Table 3.2.1: Ranking system based on the $LCCO_2$ emissions rate

Emissions rate	How to interpret from a low-carbon performance perspective	Rank
Above 100%	Not energy efficient	☆ (1 green star)
100% or below	≈ Generally acceptable, based on the current standards	☆☆ (2 green stars)
75% or below	≈ As good as actively taking initiatives for house/facility energy saving, improved durability, etc.	☆☆☆ (3 green stars)
50% or below	≈ As good as initiating general-scale photovoltaic power generation, plus taking most initiatives for house/facility energy saving, improved durability, etc.	☆☆☆☆ (4 green stars)
0% or below	≈ As good as initiating large-scale photovoltaic power generation, etc., (can be achieved, for example, by LCCM houses)	☆☆☆☆☆ (5 green stars)

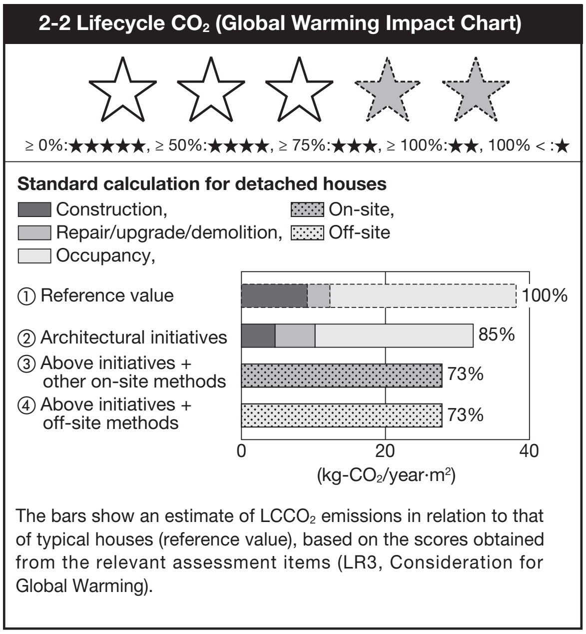


Figure 3.2.3: An example of ranking results based on the $LCCO_2$ emissions rate

(2-3) How to read the $LCCO_2$ results (Global Warming Impact Chart)
As shown in Figure 3.2.3, the $LCCO_2$ assessment results are indicated by a bar chart (Global Warming Impact Chart) with four discrete categories described below. The result of "④" (i.e., ③+ off-site methods) is used to determine the $LCCO_2$ performance rank (green-star ranking).

① Reference value: Emission levels at three stages of typical houses (i.e., “construction,” “repair/upgrade/demolition,” and “occupancy”) amount to the $LCCO_2$ emissions.

② Architectural initiatives: Based on the architectural initiatives taken for the house concerned (to achieve a long life and improved energy efficiency), $LCCO_2$ emissions are estimated according to the three stages of “construction,” “repair/upgrade/demolition” and “occupancy.”
③ ② + other on-site methods: In addition to ②, the effects of other on-site methods such as photovoltaic power generation are included in the estimation.

④ ③ + off-site methods: The effects of off-site methods such as purchased carbon credits and Renewable Electricity Certificates are included in the estimation.

(2-4) What are on-site and off-site methods?
a. On-site methods
In the 2010 edition, the effect of reduced impact due to photovoltaic power generation systems is assessed separately from the other on-site low-carbon initiatives taken for a house itself such as the realization of better thermal insulation and the installation of energy-saving facilities.

b. Off-site methods
As a measure against climate change, carbon offsetting through means of obtaining Renewable Electricity Certificates, carbon credits, etc., has been promoted. Use of these means can not be necessarily associated with the house or on-site environmental performance, but is nonetheless a valuable action to take for Japan’s commitment to mitigating climate change and should be encouraged. In the 2010 edition, therefore, these initiatives taken outside the premises (off-site) are defined as “off-site methods” and are also included in the $LCCO_2$ assessment. Specifically, such carbon offsetting means include the acquisition of Renewable Electricity Certificates or carbon credits by the owner/resident of a house, as well as the acquisition of carbon credits by the company that supplies power to the house.

(2-5) $LCCO_2$ “standard” and “independent” calculations for detached houses
In CASBEE for New Detached Houses, there are two options available for estimating $LCCO_2$ emissions: “standard calculation” in which $LCCO_2$ emissions are automatically estimated by the assessment software and “independent calculation” in which the assessors themselves perform the estimation.

a. Standard calculation for detached houses
Based on the scores attained from the relevant assessment items, $LCCO_2$ emissions are automatically calculated by the assessment software to evaluate the $LCCO_2$ performance.
The $LCCO_2$ performance results obtained by the standard calculation for detached houses are used to determine the BEE_H score, because the same assessment conditions have to be maintained. Therefore, the results obtained by the independent calculation are not usable for this purpose.
In the standard calculation, the effect of reduced CO_2 emissions owing to off-site methods is not counted. The result given in “④” (i.e., ③ + off-site methods) is the same as “③” (i.e., ②+ other on-site methods) and therefore, the green-star ranking excludes the effect

of off-site methods. This is because the off-site methods are not commonly taken for detached houses at present and for most users of CASBEE for New Detached Houses it is difficult to set the calculation conditions and interpret the result.

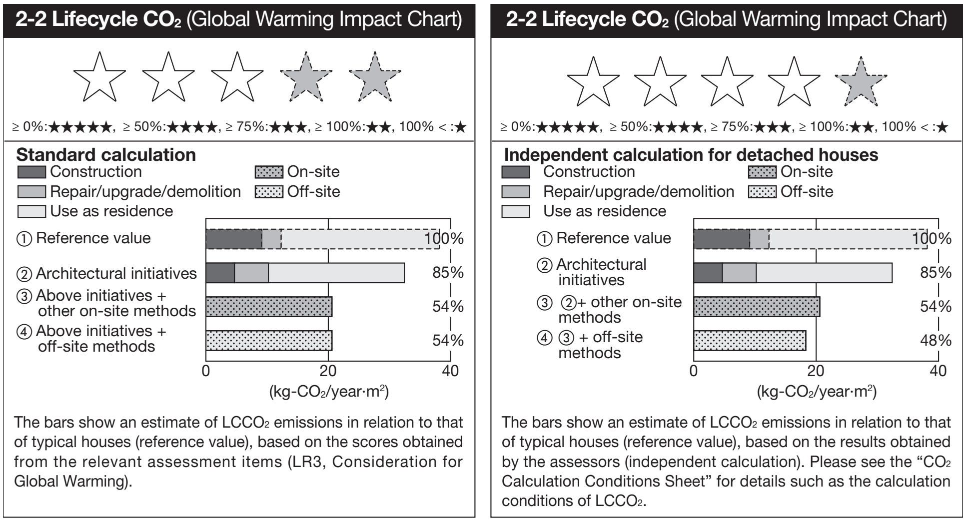
b. Independent calculation for detached houses
Without use of the assessment software, the assessors themselves perform the $LCCO_2$ estimation by other methods available such as life-cycle assessment (LCA) and input the results for the assessment of $LCCO_2$ performance.

However, the BEE_H score does not reflect these results. Even if the option for independent calculation is selected, the BEE_H score is calculated using the “standard calculation” results obtained through the automatic estimation by the assessment software.

In the independent calculation, the effect of reduced CO_2 emissions owing to off-site methods can be counted and be also included for the green-star ranking result.

Table 3.2.2: Summary of “standard calculation” and “independent calculation” for detached houses

	Standard calculation	Independent calculation
Calculation method	Using the scores attained from the $LCCO_2$-related assessment items, the assessment software automatically conducts the estimation to assess the $LCCO_2$ performance.	Without use of the assessment software, the assessors themselves conduct the estimation by other methods available such as LCA and input the results to assess the $LCCO_2$ performance.
The effect of off-site methods	The effect of off-site methods is not counted. Therefore, the same results are shown in “③” (i.e., ② + other on-site methods) and “④” (i.e., ③ + off-site methods).	The effect of off-site methods can be counted. It therefore is included for the calculation to obtain the result shown in “④” (i.e., ③ + off-site methods).
The BEE_H (red star) rank	The result of “③” (i.e., ② + other on-site methods) is used to determine the rank.	Despite the option for “independent calculation” being selected, the BEE score is determined based on the result of “③” (i.e., ② + other on-site methods) obtained through automatic estimation by the assessment software.
The $LCCO_2$ (green star) rank	The result of “④” (i.e., ③ + off-site methods) is used to determine the rank. However, as the result used is the same as “③” (i.e., ② + other on-site methods), the effect of off-site methods is not included for the assessment.	The result of “④” (i.e., ③ + off-site methods) is used to determine the rank. Therefore, the effect of off-site methods is included for the assessment.



[Standard calculation] [Independent calculation]

Figure 3.2.4: Difference between the global impact charts obtained by "standard" and "independent" calculations for new detached houses

2) Assessment items

(1) Conceptual foundation for scoring criteria

As mentioned earlier, CASBEE for New Detached Houses is characterized by the separate assessment of Q_H and L_H and the subsequent use of these Q_H and L_H values to determine the BEE_H score as the final indicator. The first step to evaluate L_H is to conduct the assessment in terms of LR_H (Load Reduction), that is, how much reduction of house-induced environmental load can be achieved. This is because, as a performance assessment system of houses, it is easier to understand when "the improved Q_H and LR_H values" are associated with better results, rather than "the improved Q_H value and the reduced L_H value" are considered better. Based on this concept, the result of each assessment item for Q_H and LR_H is expressed by one of the five levels (ranging from Level 5 down to Level 1) according to how well the issue concerned is addressed. Those assigned to higher levels attain higher scores. (In some assessment items, however, the two-, three- or four-level scale may be applied.)

Below is the conceptual foundation adopted when establishing the scoring criteria.

As an indicator of levels for scoring, typical detached houses currently constructed in Japan are basically assigned to Level 3.

However, Level 3 requires measures to be taken against some special issues, for which we think more public awareness is necessary, even if these are considered relatively advanced at present.

Assuming the minimum requirement for earning a score is "to comply with the Building Standard Law," the lowest level that can be assigned is determined accordingly (for example, if Levels 2 to 5 should be assigned to earn a score, Level 2 is set as the lowest level), and lower levels are not created because of their lack of legality.

Similarly, with regard to the frequently-cited "Japanese Housing Performance Indication Standard," its grades are also assigned to the scoring levels in such a way that typical detached houses are evaluated as Level 3.

Therefore, commonly constructed houses get Level 3 in almost all the assessment results and their BEE_H score approximates 1. Based on this concept, if the average levels of detached houses in Japan are improved in the future, the scoring criteria of CASBEE for New Detached Houses will also become stricter accordingly.

The calculation of BEE_H after obtaining the levels for scoring can be easily performed using the aforementioned assessment software.

(2) Contents of assessment items

The three Major Items of either Q_H or LR_H are as follows:

Q_H1 is devoted to the assessment regarding the “comfortable, healthy and secure indoor environment.” The measures taken are assessed in terms of “heat and cold,” “health, safety and security,” “brightness,” and “quietness.”

Q_H2 is devoted to the assessment of the “durability for long-term use.” The measures taken are assessed in terms of “basic performance for the duration of long-term use,” “maintenance and management,” and “service ability.”

Q_H3 is devoted to the assessment of “contribution toward the townscape or ecosystem.” The measures taken are assessed in terms of “consideration for townscape and view,” “creation of biological environment,” “local safety and security,” and “utilization of local resources and preservation of the architectural/dwelling cultural heritage.”

LR_H1 is devoted to the assessment of “energy and water conservation.” The measures taken are assessed in terms of “energy conservation by means of improvements to the house,” “energy conservation by means of improvements to facilities,” “water conservation,” and “improvements to the maintenance, management and operation system.”

LR_H2 is devoted to the assessment regarding the “conservation of resources and reduction of waste.” The measures taken are assessed in terms of “use of resource-saving materials and less waste-producing materials,” “waste reduction at the production/construction stages,” and “recyclability.”

LR_H3 is devoted to the assessment of “contribution toward the global, local and surrounding environment.” The measures taken are assessed in terms of “consideration for the global environment,” “consideration for the local environment,” and “consideration for the surrounding environment.”

Given below is the list of assessment items.

Table 3.2.3: List of assessment items of CASBEE for New Detached Houses

*Weighting coefficients are given in angle brackets (< >).

Q_{H}1: Provision of comfortable, healthy and secure indoor environment		
Medium Item	**Minor Item**	**Scoring Item**
1. Heat/Cold <0.50>	1.1 Basic performance <0.50>	1.1.1 Securing/maintaining of thermal insulation performance <0.65>
		1.1.2 Insulation control <0.35>
	1.2 Abatement of summer heat <0.25>	1.2.1 Ventilation and release of hot air <0.50>
		1.2.2 Appropriate cooling system <0.50>
	1.3 Abatement of winter cold <0.25>	1.3.1 Appropriate heating system <1.00>
2. Health, safety and security <0.30>	2.1 Measures against chemical pollutants <0.33>	
	2.2 Appropriate ventilation system <0.33>	
	2.3 Precautions against crime <0.33>	
3. Brightness <0.10>	3.1 Use of daylight <1.00>	
4. Quietness <0.10>		

Q_{H}2: Durability for long-term use		
Medium Item	**Minor Item**	**Scoring Item**
1. Basic performance for the duration of long-term use <0.50>	1.1 Skeleton <0.30>	
	1.2 External wall materials <0.10>	
	1.3 Roof materials and flat roofs <0.10>	
	1.4 Precautions against natural disasters <0.30>	
	1.5 Precautions against fire <0.20>	1.5.1 Fireproof structure <0.65>
		1.5.2 Early detection of fire <0.35>
2. Maintenance and management <0.25>	2.1 Easiness of maintenance and management <0.65>	
	2.2 Maintenance/management plans and system <0.35>	
3. Service ability <0.25>	3.1 Room layout and size <0.50>	
	3.2 Barrier-free measures <0.50>	

Q_H3: Contribution towards the townscape or ecosystem		
Medium Item	Minor Item	Scoring Item
1. Consideration for townscape and view <0.30>		
2. Creation of biological environment <0.30>	2.1 On-site greening <0.65>	
	2.2 Securing of natural habitat for living organisms <0.35>	
3. Local safety and security <0.20>		
4. Utilization of local resources and preservation of the architectural/dwelling cultural heritage <0.20>		

LR_H1: Energy and water conservation		
Medium Item	Minor Item	Scoring Item
1. Energy conservation by means of improvements to the house <0.35>	1.1 Thermal load control <0.50>	
	1.2 Utilization of natural energy <0.50>	
2. Energy conservation by means of improvements to facilities <0.40>	2.1 Air-conditioning systems <0.27>	2.1.1 Heating equipment <0.80>
		2.1.2 Cooling equipment <0.20>
	2.2 Hot-water supply facilities <0.37>	2.2.1 Hot-water suppliers <0.80>
		2.2.2 Thermal insulation of bathtub <0.10>
		2.2.3 Hot water-saving equipment and piping system <0.10>
	2.3 Lighting, kitchen and household appliances <0.25>	
	2.4 Ventilation equipment <0.05>	
	2.5 Facilities for efficient use of energy <0.06>	2.5.1 Home cogeneration system <1.00>
		2.5.2 Photovoltaic power generation system
3. Water conservation <0.15>	3.1 Water-saving facilities <0.75>	
	3.2 Use of rainwater <0.25>	
4. Improvements to the maintenance, management and operation system <0.10>	4.1 Information about the way of living in a detached house <0.50>	
	4.2 Energy management and control <0.50>	

LR_H2: Conservation of resources and reduction of waste		
Medium Item	Minor Item	Scoring Item
1. Use of resource-saving materials and less waste-producing materials <0.60>	1.1 Structural frames <0.30>	1.1.1 Wooden house <->
		1.1.2 Steel house <->
		1.1.3 Concrete house <->
	1.2 Ground reinforcing materials and foundation work <0.20>	
	1.3 Exterior materials <0.20>	
	1.4 Interior materials <0.20>	
	1.5 Outdoor facility materials <0.10>	
2. Waste reduction at the production/construction stages <0.30>	2.1 Production stage (structural frame materials) <0.33>	
	2.2 Production stage (other materials) <0.33>	
	2.3 Construction stage <0.33>	
3. Recyclability <0.10>	3.1 Provision of information on materials used <1.00>	

LR_H3: Contribution towards the global, local and surrounding environment		
Medium Item	Minor Item	Scoring Item
1. Consideration for the global environment <0.33>	1.1 Consideration for global warming <1.00>	
2. Consideration for the local environment <0.33>	2.1 Reduction of load on the local infrastructure <0.50>	
	2.2 Protection of the existing natural environment <0.50>	
3. Consideration for the surrounding environment <0.33>	3.1 Reduction of noise, oscillation, and release of exhaust or heat <0.50>	
	3.2 Improvement of the surrounding thermal environment <0.50>	

The environmental performance of houses is not necessarily assessable quantitatively. Some assessment items such as thermal insulation performance and earthquake resistance performance can be calculated, while others are evaluated, for example, based on the number of measures taken for environmental issues. These assessment items do not cover all the aspects of environmental performance.

(3) Conceptual foundation for weighting

Considering the varying importance among assessment items, "weighting coefficients" have been introduced to the scoring system. The weighting coefficients of Major Items (Q_H1, Q_H2, Q_H3, LR_H1, LR_H2 and LR_H3) were determined according to the results obtained by a statistical method of the analytic hierarchy process (AHP). In this edition, the weighting coefficients of Q_H1, Q_H2 and Q_H3 are 0.45, 0.30 and 0.25, respectively, whereas those of LR_H1, LR_H2 and LR_H3 are 0.35, 0.35 and 0.30, respectively. On the other hand, the weighting coefficients of Medium, Minor and Scoring Items, which are positioned lower in the categorization hierarchy, were determined through discussions with experts in the respective fields. In table 3.2.3, the weighting coefficients used in this edition are given in angle brackets.

The determination of weighting coefficients is based not only on the scientific perspectives, but also on how various interested parties involved such as building owners, house suppliers and related officials value the assessment items. Such values will change as the situation or other factors change, and therefore we consider it necessary to revise the weighting coefficients accordingly.

*A questionnaire regarding the relative importance among Major Items was completed by the parties with a vested interest in CASBEE for New Detached Houses (building owners, house suppliers, related officials, academic authorities, etc.). The results were statistically processed to determine the weighting coefficients. Therefore, the obtained weighting coefficients reflect their differences in values from different perspectives.

3.2.1.3. Utilization of CASBEE for New Detached Houses

1) Who uses it?

The expected users of CASBEE for New Detached Houses include building owners, house buyers, architects, house suppliers, municipalities, non-profit organizations (NPOs) and financial institutions.

2) When or how to use, and why?

Because of the diversity of ideas and measures regarding the environment of detached houses, it is not easy for the aforementioned interested parties to share the same values. This is a source of difficulty in realizing a DfE (Design for Environment) tool for detached houses and improving the popularity of such houses.

CASBEE for New Detached Houses is a tool developed to encourage the interested parties to share the same environmental values. It enables the environmental quality/performance and the measures to reduce environmental loads, which should be taken into consideration when a detached house is constructed, to be rated on the uniform scale among the interested parties. The following are the five major examples for utilization.

(1) Use as an environmentally friendly design tool when a new house is constructed
Using CASBEE for New Detached Houses to comprehensively evaluate the environmental performance of the house being designed, designers can check the environmental performance targets that have been set and the levels that their design can achieve, thus enabling them to design a house with adequate environmental consideration.

(2) Use as a communication tool among building owners, architects, builders, etc.
CASBEE for New Detached Houses is expected to be mainly used by building owners, designers and builders when they discuss the design and measures for better environmental performance of the detached house. Not only house specifications but also the information provided to the occupants and their choice of electrical appliances, etc., are included for the assessment. Therefore, imagining the future life in the house, building owners and designers can discuss the environmental performance that is optimum for the house.

Other examples include house suppliers using it to establish common understanding at the design stage and designers using it as a means of clarifying the purpose/intention of their design to builders.

(3) Use as a tool for environmental performance labeling
When house suppliers or other organizations such as municipalities and NPOs intend to sell or popularize houses with superior environmental performance, the presentation of the ranking results by CASBEE for New Detached Houses can make it easier for consumers to understand the environmental performance of detached houses.

(4) Use as standard indicators in housing policy
Because CASBEE for New Detached Houses assesses a wide range of house environment-related measures, municipalities can use it to indicate standard levels when they make guidelines on house/residential area improvements in their administrative regions. In addition to the comprehensive assessment of performance, some assessment items with increased importance in a specific area can be prioritized and emphasized in the result display. For example, Aichi Prefecture has adopted its tailored version, CASBEE-Aichi for Detached Houses. The nationwide application of CASBEE is exemplified by the "leading projects for housing/building energy conservation."

(5) Use by private financial institutions, etc.
Because CASBEE for New Detached Houses assesses a wide range of house environment-related measures, financial institutions can use it to set requirements to obtain advantageous financing conditions such as better interest rates for their customers (e.g., those who are planning to buy a house). As the housing $LCCO_2$ performance is assessed and displayed, utilization from a viewpoint of measures against climate change is also possible.

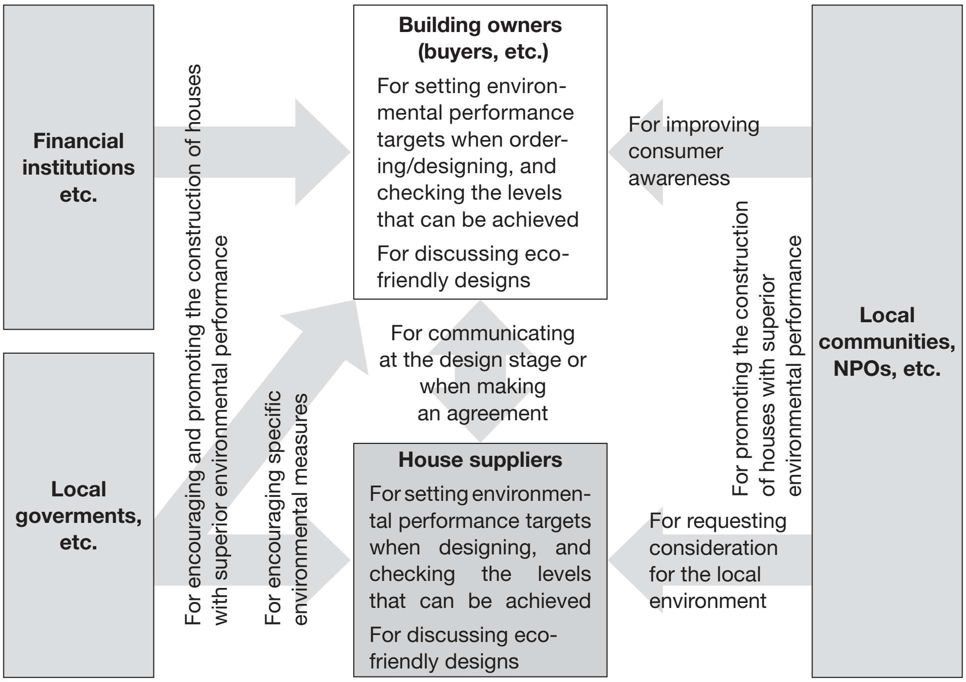


Figure 3.2.5: CASBEE for New Detached Houses – users and utilization examples

3) Rules for the presentation of assessment results

In CASBEE for New Detached Houses, a variety of subjects (not only house specifications but also location, planning, outdoor facilities, residents' choice of home appliances, etc.) are included for the assessment. Therefore, the final assessment can be conducted only when all the conditions are finalized, that is, after the residents move into the constructed house. The conduct of assessment, however, may be requested prematurely even if not all conditions are determined (e.g., at the early stage of design). For this reason, CASBEE for New Detached Houses accepts the provisional conditions for assessment.

There is, of course, the possibility for the results obtained at this stage to vary later. Therefore, when the assessment results of CASBEE for New Detached Houses are presented to a third party, it is necessary to clearly note at which stage assessment was conducted and what conditions were used for the assessment, in addition to the results. Especially if the results are meant to be seen by any third persons via a publication such as brochures and fliers, at least an additional comment such as "The assessment results are based on the assumed conditions such as land use, family members, their way of living, and outdoor facilities" should be accompanied by the results in order not to give readers the wrong impression.

3.2.2. CASBEE for New Housing Units

3.2.2.1. Outline of CASBEE for New Housing Units

1) Objectives of CASBEE for New Housing Units

Considering an apartment building as a whole, the environmental performance of a housing complex can be assessed by "CASBEE-NC."

However, when it comes to housing units within a complex, the conditions are not uniform. Specifically, the configuration of openings and areas in contact with the outside air depends on the position of a unit on the floor (corner or middle) and the floor number of the unit in the apartment building. Such differences also create differences in factors such as natural lighting, ventilation, and thermal insulation performance. The same can be applied to facility specifications. Therefore, even being located within the same apartment building, each unit is unique and it can be problematic if their environmental performances are evaluated collectively.

Furthermore, housing complexes are generally traded per housing unit, not by the whole apartment building. For trading of units, the CASBEE assessment can be utilized to add extra value from the environmental viewpoint. As mentioned above, however, the results of CASBEE-NC are not always suitable for this purpose because the assessment is conducted in terms of environmental performance of the whole apartment building.

When a housing unit is evaluated, it is considered more appropriate to conduct the assessment based on the concept of CASBEE for Housing series.

To deal with such background issues, "CASBEE for New Housing Units" is intended to assess the environmental performance of housing complexes from the CASBEE for Housing series perspectives, thus enabling each of the housing units to be evaluated separately.

2) What to evaluate

(1) Comprehensive environmental performance of housing units

In CASBEE for New Housing Units, the comprehensive environmental performance of each housing unit of a complex is assessed separately from the two different viewpoints of Q (Quality: environmental quality of a housing unit itself) and L (Load: housing unit-induced environmental load on the outside). Either category (Q or L) consists of three sub-categories for assessment, as shown below. Each sub-category is evaluated based on the measures taken for the respective purpose.

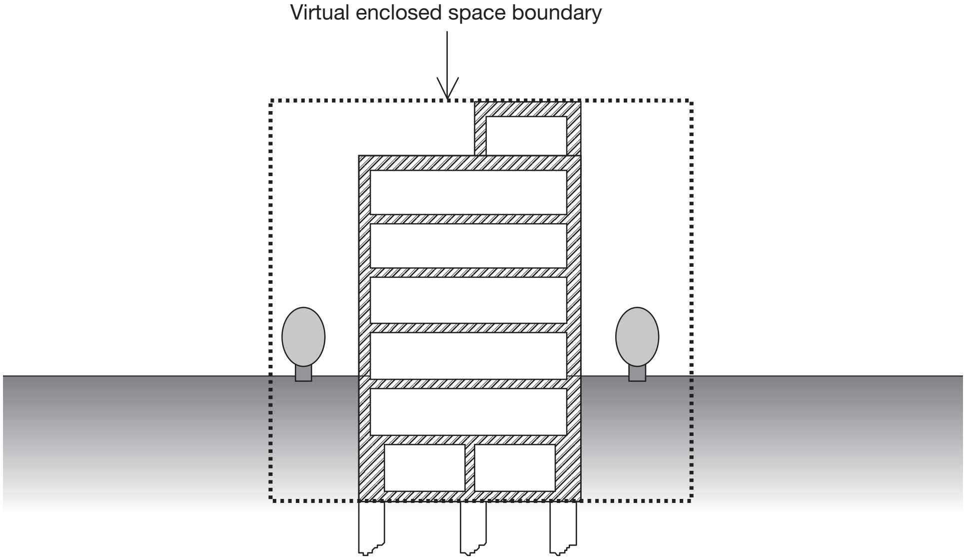
Q (Assessment is conducted to measure how high the Q level is)
$Q_{HU}1$: Provide comfortable, healthy and secure indoor environment
$Q_{HU}2$: Able to be used over a long period
$Q_{HU}3$: Contribute to the surroundings of a housing unit

L (Assessment is conducted to measure LR or environmental load reduction, by evaluating the measures taken for reducing L)
$LR_{HU}1$: Conserve energy and water
$LR_{HU}2$: Conserve resources and reduce waste
$LR_{HU}3$: Contribute to the global/local environment and the surroundings of a housing unit

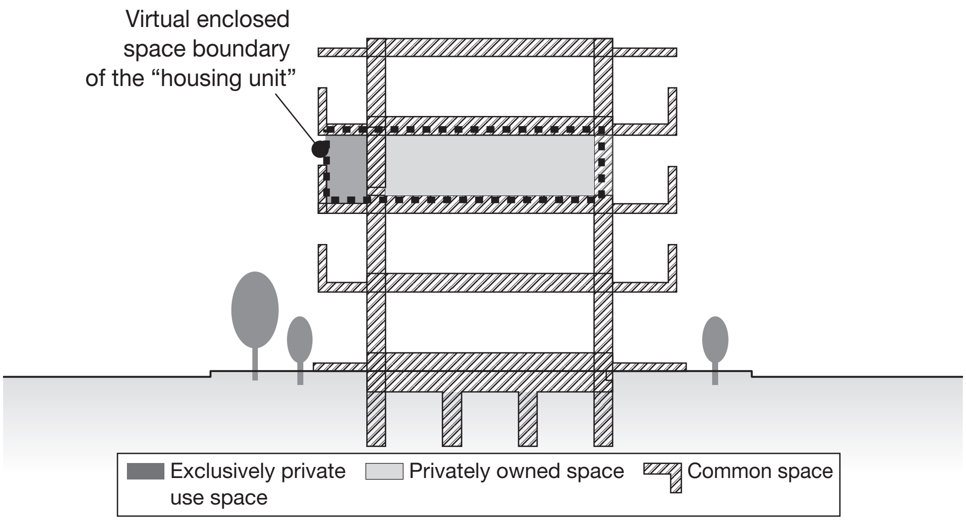
Because the assessment is conducted according to the above sub-categories, being high in rank in the comprehensive results attained by CASBEE for New Housing Units means that the housing unit assessed is "a residence that assures comfort, health and security ($Q_{HU}1$), is durable for long-term use ($Q_{HU}2$), conserves energy and water ($LR_{HU}1$), has been designed to reduce environmental load (for example, less waste being produced at the construction or demolition stage; $LR_{HU}2$), and contributes to the creation of a better local environment ($Q_{HU}3$ and $LR_{HU}3$)."

With regard to Q_{HU} and L_{HU}, the spatial zones to be assessed are defined as in Figure 3.2.6.

In CASBEE for New Housing Unit, the virtual enclosed space boundary is, in principle, defined as the contour of "privately owned area + exclusively private use area." However, the performance of common space that directly affects the performance of the housing unit concerned is included for the assessment of the performance. Influence on neighboring units (including those on the same floor as well as on the upper and lower floors) is also evaluated.



(a) CASBEE-NC



(b) CASBEE for New Housing Units

Figure 3.2.6: Conceptual differences in virtual enclosed space boundary between CASBEE-NC and CASBEE for New Housing Units

(2) Low-carbon performance of housing units

In CASBEE for New Housing Units, in addition to BEE, etc., the $LCCO_2$ assessment is conducted to evaluate the low-carbon performance of a housing unit during its lifecycle starting from construction through use as a residence until demolition/disposal. The rank of a housing unit based on the $LCCO_2$ performance results is displayed (green-star ranking).

In the $LCCO_2$ assessment of CASBEE for New Housing Units, the following assessment methods used in the conventional CASBEE series have been adopted.

<CO_2 emissions at the operation stage>
Same assessment method as CASBEE for Detached Houses
<CO_2 emissions at the construction, upgrade or demolition/disposal stage>
Same assessment method as CASBEE for New Constructions (Housing Purposes)

(3) Assessment principles
In CASBEE for New Housing Units, the environmental performance of a housing unit in a complex is assessed “comprehensively.” Therefore, housing units with a good balance in handling various relevant issues are ranked higher than those specializing in measures against a specific problem.

The subjects of assessment include not only the unit itself, but also outdoor facilities, residents’ choice of home appliances, data management regarding the unit and facilities, maintenance plans and conditions of their execution, and the past strategies such as resource conservation at the production stage of architectural components or on the building site during new construction or renovation. Some are difficult for the housing supplier to get involved directly in decision-making, but are nonetheless included for assessment as it is our principle to evaluate everything that can have potentially considerable influence on the environment.

In addition to the units in a newly constructed housing complex, the existing or renovated units can also be assessed.

(4) Regarding the assessment items
Since the Great East Japan Earthquake, people are keener than ever before to adopt measures against natural disasters. In CASBEE for New Housing Units, the assessment of such precautionary measures has been added. Specific examples include: Q_{HU}1.2.5 Preparation for evacuation, Q_{HU}2.1.3.2 Precautions against other disasters, and Q_{HU}3.2 Safety and security of the surroundings of the housing unit.

3.2.2.2. Assessment system of CASBEE for New Housing Units

1) Basic assessment structure

(1) Comprehensive assessment of environmental performance
(1-1) Scoring of assessment items
In CASBEE for New Housing Units, as described in the previous section, the comprehensive assessment of environmental performance of a housing unit is conducted by separately evaluating Q (living environment quality in the housing unit) and L (housing unit-induced environmental load on the outside). Either category (Q or L) consists of three sub-categories called Major Items. Each “Major Item” employs a hierarchical system for more detailed categorization, which is comprised of one to three levels (Middle Items, Minor Items, and Scoring Items, respectively). The total number of 54 assessment items, all of which are assigned to the respective detailed categories, are marked in a range of one to five (the five being the full scores). The scores attained from each level of hierarchy are separately processed to indicate which categories are handled well or poorly.

(1-2) Calculation of the BEE_{HU} score
The scoring results are further processed separately for Q_{HU} and L_{HU} and their final score is taken as points out of 100.

In CASBEE for New Housing Units, any unit with higher (points of) Q_{HU} and lower (points of) L_{HU} is valued highly. In assessment, this correlation between Q_{HU} and L_{HU} is indicated by the ratio given below (i.e., BEE_{HU}). Therefore, the results of comprehensive environmental assessment are interpreted according to the level of the BEE_{HU} score.

$$\mathbf{BEE_{HU} = Q_{HU}/L_{HU}}$$

BEE_{HU}	:	Environmental efficiency of the housing unit
Q_{HU}	:	Quality of living environment in the housing unit
L_{HU}	:	Housing unit-induced load on the environment

[*The subscript HU of BEE_{HU}, Q_{HU} and L_{HU} represents “housing unit,” indicating that these are assessment results of CASBEE for “Housing Units.”]

When being plotted with Q_{HU} on the Y-axis and L_{HU} on the X-axis, the BEE_{HU} score falls upon a point on the straight line with the slope of Q_{HU}/L_{HU} crossing the origin of the coordinate (Figure 3.2.7 gives an example of the BEE_{HU} score = 62/47 = 1.3)

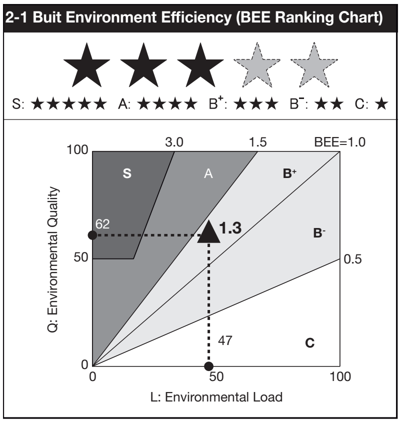


Figure 3.2.7: An example of how to rate the BEE_{HU} score

(1-3) Ranking according to the BEE_{HU} score

Based on the obtained BEE_{HU} score, the rank of a housing unit is indicated by one of the five levels ranging from the highest “S (with five red stars)” down to the lowest “C (with a single red star).” The results are displayed using the proprietary software. Although these ranks with red stars are basically determined by the slope of BEE_{HU} lines, the Q_{HU} score has to reach at least 50 points to be ranked S. Figure 3.2.7 gives an example of a B^+rank housing unit (three red stars) with the BEE_{HU} score being 1.3.

The assessment using the BEE_{HU} scores is characterized by the results reflecting the correlation between Q_{HU} and L_{HU}, that is, with the doubled Q_{HU} and the halved L_{HU}, the BEE_{HU} score quadruples.

For example, if less energy is used for heating and cooling to result in reduced environmental load but the reduction is a result of living in hot or cold conditions, the quality of living environment will be degraded. The assessment result therefore is not so good. On the other hand, improved efficiency without compromising amenities or improved amenities without an increase in energy consumption can yield a better assessment result. Finally, better amenities with improved energy efficiency are valued even higher in this assessment system.

(2) Assessment of low-carbon performance

(2-1) Estimation of $LCCO_2$ emissions

As in the case of CASBEE-NC, when the assessment is conducted using CASBEE for New Housing Units, CO_2 emissions throughout the housing unit lifecycle consisting of construction, operation, repair, upgrade and demolition are also estimated as a measure against climate change, in addition to the BEE_{HU} score. Whereas there are 52 assessment items in total, the scores attained from those related to housing unit lifespan and energy conservation or the other data necessary for assessment are automatically used for calculation. The result is compared with the “reference value,” that is, the $LCCO_2$ emissions of a typical housing unit in a newly constructed complex and is expressed as a percentage of the reference value (called the “emission rate”) to show how well the issue is addressed.

(2-2) Ranking according to the $LCCO_2$ performance

Based on the obtained emission rate, the housing unit concerned is assigned to one of the five ranks with the corresponding number of green stars. Below are the specific criteria used for the ranking according to the emission rate.

Table 3.2.4: Ranking system based on the $LCCO_2$ emission rate

Emission rate	How to interpret from a low-carbon performance perspective	Rank indication
Above 100%	Not energy efficient	☆ (1 green star)
100% or below	≈ Satisfies the current energy-saving standards	☆☆ (2 green stars)
80% or below	≈ Saves 30% of energy at the operation stage	☆☆☆ (3 green stars)
60% or below	≈ Saves 50% of energy at the operation stage	☆☆☆☆ (4 green stars)
30% or below	≈ Achieves net zero energy consumption at the operation stage	☆☆☆☆☆ (5 green stars)

(2-3) How to read the $LCCO_2$ results (Global Warming Impact Chart)

The $LCCO_2$ performance results are indicated by a bar chart (Global Warming Impact Chart) with four discrete categories described below. The result of “④” (i.e., ③ + off-site methods) is used to determine the $LCCO_2$ performance rank (green-star ranking).

① Reference value: Emission levels at three stages of typical housing units (i.e., “construction,” “repair/upgrade/demolition,” and “operation”) amount to the $LCCO_2$ emissions.

② Architectural initiatives: Based on the architectural initiatives taken for the housing unit concerned (to achieve a longer lifespan and improved energy efficiency), $LCCO_2$ emissions are estimated according to the three stages of “construction,” “repair/upgrade/demolition” and “operation.”

③ ② + other on-site methods: In addition to ②, the effects of other on-site methods such as photovoltaic power generation are included in the estimation.

④ ③ + off-site methods: The effects of off-site methods such as purchased carbon credits and Renewable Electricity Certificates are included in the estimation.

(2-4) What are on-site and off-site methods?

a. On-site methods

The effect of reduced impact due to photovoltaic power generation systems is assessed separately from the other on-site low-carbon initiatives taken for a housing unit itself such as the realization of better thermal insulation and the installation of energy-saving facilities.

b. Off-site methods

As a measure against climate change, carbon offsetting through means of obtaining Renewable Electricity Certificates, carbon credits, etc., has been promoted. Use of these means cannot be necessarily associated with the housing unit or on-site environmental performance, but is nonetheless a valuable action to take for Japan's commitment to mitigating climate change and should be encouraged. Therefore, these initiatives taken outside the premises (off-site) are defined as "off-site methods" and are also included in the $LCCO_2$ assessment. Specifically, such carbon offsetting means include the acquisition of Renewable Electricity Certificates or carbon credits by the owner/resident of a housing unit, as well as the acquisition of carbon credits by the company that supplies power to the housing unit.

(2-5) $LCCO_2$ "standard" and "independent" calculations for housing units

In CASBEE for New Housing Units, there are two options available for estimating $LCCO_2$ emissions: "standard calculation" in which $LCCO_2$ emissions are automatically estimated by the assessment software and "independent calculation" in which the assessors themselves perform the estimation.

2) Assessment items

(1) Conceptual foundation for scoring criteria

As mentioned earlier, CASBEE for New Housing Units is characterized by the separate assessment of Q_{HU} and L_{HU} and the subsequent use of these Q_{HU} and L_{HU} values to determine the BEE_{HU} score as the final indicator. The first step to evaluate L_{HU} is to conduct the assessment in terms of LR_{HU} (Load Reduction), that is, how much reduction of housing unit-induced environmental load can be achieved. This is because, as a performance assessment system of housing units, it is easier to understand when "the improved Q_{HU} and LR_{HU} values" are associated with better results, rather than "the improved Q_{HU} value and the reduced LR_{HU} value" are considered better. Based on this concept, the result of each assessment item for Q_{HU} and LR_{HU} is expressed by one of the five levels (ranging from Level 5 down to Level 1) according to how well the issue concerned is addressed. Those assigned to higher levels attain higher scores. (In some assessment items, however, the two-, three- or four-level scale may be applied.)

Below is the conceptual foundation adopted when establishing the scoring criteria.

As an indicator of levels for scoring, typical housing units in a complex currently constructed in Japan are basically assigned to Level 3.

However, Level 3 requires measures to be taken against some special issues, for which we think more public awareness is necessary, even if these are considered relatively advanced at present.

In the assessment of new construction, if the setting of levels is based on the assumption that the minimum requirement for earning a score is "to comply with the Building Standard Law," the lowest level that can be assigned is determined accordingly.

When the “Japanese Housing Performance Indication Standard” is used as the minimum requirement for earning a score in the level setting, its grades are assigned to the scoring levels in such a way that typical housing units of the current standards are evaluated as Level 3.

Therefore, if the subject of assessment is an existing housing unit with equivalent performance of a typical unit of the current standards, almost all the assessment results are given as Level 3 and the BEE_{HU} score approximates 1. Based on this concept, if the average levels of housing units in newly constructed complexes in Japan are improved in the future, the assessment criteria of CASBEE for New Housing Units will also become stricter accordingly.

(2) Contents of assessment items

The three Major Items of either Q_{HU} or LR_{HU} are as follows:

$Q_{HU}1$ is devoted to the assessment regarding the “comfortable, healthy and secure indoor environment.” The measures taken are assessed in terms of “heat and cold,” “health, safety and security,” “brightness,” “quietness,” and “extra features.”

$Q_{HU}2$ is devoted to the assessment of the “durability for long-term use.” The measures taken are assessed in terms of “basic performance for the duration of long use,” “maintenance and management,” and “functionality.”

$Q_{HU}3$ is devoted to the assessment of “contribution toward the surroundings of the housing unit.” The measures taken are assessed in terms of “consideration for the housing unit and its surroundings,” and “safety and security of the surroundings of the housing unit.”

$LR_{HU}1$ is devoted to the assessment of “energy and water conservation.” The measures taken are assessed in terms of “comprehensive energy conservation,” “energy conservation by means of improvements to equipment,” “water conservation,” and “improvements to the maintenance, management and operation system.”

$LR_{HU}2$ is devoted to the assessment regarding the “conservation of resources and reduction of waste.” The measures taken are assessed in terms of “use of resource-saving and less waste-producing interior materials,” “waste reduction at the production and construction stages,” and “recycling and appropriate arrangement.”

$LR_{HU}3$ is devoted to the assessment of “contribution towards the global/local environment and the surroundings of the housing unit.” The measures taken are assessed in terms of “consideration for the global environment,” “consideration for the local environment,” and “consideration for the surrounding environment.”

The list of assessment items is given from the next page onwards.

The environmental performance of housing units is not necessarily assessable quantitatively. Some assessment items such as thermal insulation performance and earthquake resistance performance can be calculated, while others are evaluated, for example, based on the number of measures taken for environmental issues. These assessment items do not cover all the aspects of environmental performance.

Table 3.2.5: List of assessment items of CASBEE for New Dwelling Units

*Weighting coefficients are given in angle brackets (< >).

Q_{HU}1: Provision of comfortable, healthy and secure indoor environment			
Medium Item	Minor Item	Scoring Item	Note*
1. Heat/cold <0.40>	1.1 Basic performance <0.50>	1.1.1 Securing/maintaining of thermal insulation performance <0.65>	DH (revised)
		1.1.2 Insulation control <0.35>	DH
	1.2 Abatement of summer heat <0.25>	1.2.1 Ventilation and release of hot air <0.50>	DH (revised)
		1.2.2 Appropriate cooling system <0.50>	DH
	1.3 Abatement of winter cold <0.25>	1.3.1 Appropriate heating system <1.00>	DH
2. Health, safety and security <0.25>	2.1 Measures against chemical pollutants <0.20>		DH
	2.2 Appropriate ventilation system <0.20>		DH
	2.3 Measures against dew and mold <0.20>		NC (revised)
	2.4 Precautions against crime <0.20>	2.4.1 Measures against crime for the housing unit <0.50>	New
		2.4.2 Measures against crime for the common space <0.50>	New
	2.5 Preparation for evacuation <0.20>	2.5.1 Evacuation from the housing unit to the outside <0.50>	New
		2.5.2 Evacuation via the balcony/front door to a safer place <0.50>	New
3. Brightness <0.05>	3.1 Use of daylight <1.00>		DH
4. Quietness <0.25>	4.1 (Tentative) Background noise level and sound insulation at openings <0.10>		NC (revised)
	4.2 Sound insulation of partition walls <0.30>		NC (revised)
	4.3 Sound insulation of floor slabs <0.40>	4.3.1 Sound insulation against light impact sounds <0.50>	NC (revised)
		4.3.2 Sound insulation against heavy impact sounds <0.50>	NC (revised)
	4.4 Measures against equipment noises, etc. <0.20>		NC (revised)
5. Extra features <0.05>	5.1 Consideration for view, space, convenience, etc. <1.00>		New

Q$_{HU}$2: Durability for long-term use			
Medium Item	**Minor Item**	**Scoring Item**	**Note**
1. Basic performance for the duration of long use <0.50>	1.1 Building framework <0.25>		DH (revised)
	1.2 Interior versatility <0.25>		New
	1.3 Precautions against natural disasters <0.30>	1.3.1 Improvement of earthquake resistance (incl. seismic isolation and vibration damping) <0.80>	DH
		1.3.2 Precautions against other disasters <0.20>	New
	1.4 Precautions against fire <0.20>	1.4.1 Fireproof structure <0.60>	DH
		1.4.2 Early detection of fire (for own housing unit) <0.20>	DH
		1.4.3 Early detection of fire (for other housing units, etc.) <0.20>	New
2. Maintenance and management <0.25>	2.1 Easiness of maintenance and management <0.65>	2.1.1 Maintenance and management of the housing unit <0.30>	New
		2.1.2 Adaptability of facility and equipment<0.70>	DH (revised)
	2.2 Maintenance/management plans and system <0.35>		New
3.Functionality <0.25>	3.1 Size and space <0.50>	3.1.1 Housing unit size and room configuration<0.60>	New
		3.1.2 Spatial capacity for equipment <0.40>	New
	3.2 Barrier-free measures <0.50>	3.2.1 Barrier-free measures in the exclusively private use space <0.50>	DH
		3.2.2 Barrier-free measures in the common space <0.50>	New

Q$_{HU}$3: Contribution towards the surroundings of the housing unit			
Medium Item	**Minor Item**	**Scoring Item**	**Note**
1. Consideration for the housing unit and its surroundings <0.70>	1.1 Measures for corridors, balconies, etc. <0.50>		New
	1.2 Greening in the private/ exclusive use or common space <0.50>		New
2. Safety and security of the surroundings of the housing unit <0.30>	Measures for the common space <0.70>		New
	2.2 Measures from the operational perspective <0.30>		New

3. CASBEE Family of Tools

LR_{HU}1: Energy and water conservation			
Medium Item	Minor Item	Scoring Item	Note
1. Comprehensive energy conservation <0.75>	1.1 Energy conservation by the building framework and equipment <0.80>		New
	1.2 Energy conservation by kitchen and household appliances <0.10>		DH (revised)
	1.3 Other energy-saving methods <0.10>		New
2. Water conservation <0.15>	2.1 Water-saving equipment <1.00>		DH (revised)
3. Improvements to the maintenance, management and operation system <0.10>	3.1 Information about the way of living in the housing unit <0.50>		DH (revised)
	3.2 Energy management and control <0.50>		DH (revised)

LR_{HU}2: Conservation of resources and reduction of waste			
Medium Item	Minor Item	Scoring Item	Note
1. Use of resource-saving and less waste-producing interior materials <0.60>	1.1 Interior materials <1.00>		DH (revised)
2. Waste reduction at the production and construction stages <0.30>	2.1 Production stage <0.25>		DH
	2.2 Construction stage <0.25>		DH
	2.3 Continued use of the existing structural frame, etc. <0.25>		NC
	2.4 Use of recycled materials for the structural frame <0.25>		NC
3. Recycling and appropriate arrangement <0.10>	3.1 Avoidance of use of pollutant-containing materials <0.80>		NC
	3.2 Provision of information of materials used <0.20>		DH

LR_{HU}3: Contribution towards the global/local environment and the surroundings of the housing unit			
Medium Item	Minor Item	Scoring Item	Note
1. Consideration for the global environment <0.33>	1.1 Consideration for global warming <1.00>		DH (revised)
2. Consideration for the local environment <0.33>	2.1 Reduction of load on the local infrastructure <1.00>		DH (revised)

LR$_{HU}$3: Contribution towards the global/local environment and the surroundings of the housing unit			
Medium Item	Minor Item	Scoring Item	Note
3. Consideration for the surrounding environment <0.33>	3.1 Reduction of noise, oscillation, odor, and release of exhaust or heat <1.00>		DH (revised)

* The relevant assessments are given in the column for notes.
DH: CASBEE for New Detached Houses (2010 edition), NC: CASBEE for New Construction (2010), DH (revised): modified from CASBEE for New Detached Houses (2010), NC (revised): modified from CASBEE for New Construction (2010), and New: newly-added assessment

(3) Conceptual foundation for weighting

Considering the varying importance among assessment items, "weighting coefficients" have been introduced to the scoring system.

In CASBEE for New Housing Units, the housing unit concerned and its surrounding structural frame are mainly evaluated. As these are especially relevant to the results of Q$_{HU}$1 and LR$_{HU}$1, the assessments are considered more important than in the case of CASBEE for Detached Houses and the weighting coefficients of Major Items in CASBEE for New Housing Units were determined accordingly.

Specifically, the weighting coefficients of Q$_{HU}$2, Q$_{HU}$3, LR$_{HU}$2 and LR$_{HU}$3 were reduced by a factor of 2, compared with those of CASBEE for Detached Houses.

The weighting coefficients of Medium, Minor and Scoring Items, which are positioned lower in the categorization hierarchy, were determined through discussion with experts in the respective fields.

[Determination of the weighting coefficients of Major Items]

Use the weighting coefficients of Major Items in CASBEE for New Detached Houses, which are also intended for the assessment of residences like CASBEE for New Housing Units, as the base for calculation. Therefore, we can assume Q$_{HU}$1:Q$_{HU}$2:Q$_{HU}$3 = 0.45:0.30:0.25 and LR$_{HU}$1:LR$_{HU}$2:LR$_{HU}$3 = 0.35:0.35:0.30.

Reduce the weighting coefficient of Q$_{HU}$2, Q$_{HU}$3, LR$_{HU}$2 and LR$_{HU}$3 by a factor of 2. The results are Q$_{HU2}$:Q$_{HU}$3 = 0.150:0.125 and LR$_{HU}$2:LR$_{HU}$3 = 0.175:0.150.

Correct the weighting coefficients of Q$_{HU}$1 and LR$_{HU}$1 so that the total of the weighting coefficients of three Major Items in each category amounts to 1.00 (i.e., Q$_{HU}$1 + Q$_{HU}$2 + Q$_{HU}$3 = LR$_{HU}$1 + LR$_{HU}$2 + LR$_{HU}$3 = 1.00).

Thus obtain Q$_{HU}$1: Q$_{HU}$2: Q$_{HU}$3 = 0.725: 0.150: 0.125 and LR$_{HU}$1: LR$_{HU}$2: LR$_{HU}$3 = 0.675: 0.175: 0.150.

3.2.3. CASBEE Health Checklist

3.2.3.1. Outline

"CASBEE Health Checklist" is a simple diagnostic tool designed for residents themselves to check the negative health effects of their residences. It is intended to prompt awarenss of potential health-related problems in the living environment, producing changes in their living practices at residences or a reason for taking action such as renovation and renewal in consultation with experts.

The health checklist is comprised of 50 simple questions related to current environmental conditions experienced in their residences. The diagnosis is made based on the answers to these questions. Questions are given in such a way that the results are independent of user's knowledge on housing specifications. Residents can answer by reflecting on past experiences during ordinary days as in a question like "In summer, are there occasions when you feel hot because the air conditioning (for cooling) is not effective?" The obtained results indicate not the assessment of "housing performance" but the examination of "living environment that may affect residents' health." The living environment is a consequence of "housing performance" and "residents' living practices," but the exact causes are not identified by CASBEE Health Checklist. The emphasis should be placed on the checklist being a tool to raise awareness that can lead to the improvement of residential conditions. If changes in the living practice can not improve the situation, residents are advised to consult with experts (such as architects and building contractors) because there may be a problem with the residence itself.

3.2.3.2. Questions in the checklist

In order to make it easy to recall their living contidions each season, 50 questions are grouped into eight categories by rooms and areas (Table 3.2.6). For each specified space, in association with scenes from everyday life, questions are asked about six elements related to residence health: thermal environment, acoustic environment, light environment, hygiene, safety and security (Table 3.2.7).

Table 3.2.6: List of specified rooms/areas, and their assigned scores

Room/area	Score
[1] Living room	21
[2] Bedroom	21
[3] Kitchen	15
[4] Bathroom, dressing room, washroom	21
[5] Toilet	9
[6] Entrance hall	9
[7] Corridors, stairs, storage	21
[8] Surroundings of the residence	15
[9] Design for nursing care	Reference

Table 3.2.7: List of elements of health and their assigned scores

Element of health	Score
[1] Thermal environment	36
[2] Acoustic environment	6
[3] Light environment	12
[4] Hygiene	27
[5] Safety	45
[6] Security	6

Table 3.2.8: CASBEE Health Checklist – Assessment items

Room/area		Question	Check	Element of health (*3)
[1] Living room	1	In summer, are there occasions when you stay in the room with all the windows closed without switching on an air-conditioner or electric fan?		(T)
	2	In summer, are there occasions when you feel hot because the air conditioning for cooling is not effective?		(T)
	3	In winter, are there occasions when you feel cold because the air conditioning for heating is not effective?		(T)
	4	Are there occasions when you are bothered by indoor/outdoor sounds or vibrations even after the windows and doors are closed?		(T)
	5	At night, are there occasions when you feel it is dark because of insufficient lighting?		(T)
	6	Are there occasions when smells linger in the room?		(T)
	7	Are there occasions when you slip on the floor?		(SF)
[2] Bedroom	8	In summer, are there occasions when you can not sleep because it is hot?		(T)
	9	In summer or during the rainy season, are there occasions when you can not sleep because it is humid and damp?		(T)
	10	In summer, are there occasions when you sleep with the windows closed without switching on an air-conditioner or electric fan?		(T)
	11	In winter, are there occasions when you can not sleep because it is cold?		(T)
	12	In winter, are there occasions when you find your nose/throat dry when you wake up?		(T)
	13	Are there occasions when you cannot sleep because you are bothered by indoor/outdoor sounds or vibrations even after the windows and doors are closed?		(A)
	14	At night, are there occasions when you can not sleep because your surroundings are too bright?		(L)
[3] Kitchen	15	Are there occasions when steam or smells linger in the room while cooking?		(H)
	16	Is there mold on/around the kitchen counter? (*1)		(H)
	17	Are there occasions when you find a foul taste or odor in tap water?		(H)
	18	Are there occasions when you have to take an unnatural posture because of mismatched layouts (e.g., too narrow or too high)?		(SF)
	19	Are there occasions when you feel it is dangerous because you may get burnt?		(SF)

*1 & 2: The options for answers to these marked questions are different from the rest.
*1: Excessively (0 point); partially (1 point); scarcely (2 points); and not at all (3 points).
*3: The abbreviations of elements of health represent: T (thermal environment), A (acoustic environment), L (Light environment), H (hygiene), SF (safety), and SC (security).

Room/area		Question	Check	Element of health (*3)
[4] Bathroom, dressing room and washroom	20	In winter, are there occasions when you feel the dressing room is cold?		(T)
	21	In winter, are there occasions when you feel the bathroom is cold?		(T)
	22	Is there mold? (*1)		(H)
	23	Are there occasions when you smell odors?		(H)
	24	Are there occasions when you feel it is dangerous because you may trip over a step?		(SF)
	25	Are there occasions when you slip on the floor of the bathroom?		(SF)
	26	Are there occasions when you lose your balance when getting in/coming out of the bathtub?		(SF)
[5] Toilet	27	In winter, are there occasions when you feel the toilet is cold?		(T)
	28	Are there occasions when you feel foul odors lingering?		(H)
	29	Are there occasions when you have to take an unnatural posture because of mismatched layouts (e.g. too narrow or too high)?		(SF)
[6] Entrance hall	30	Are there occasions when you feel it is dangerous because you may trip over a step?		(SF)
	31	Are there occasions when you lose your balance while putting on your shoes?		(SF)
	32	Are there occasions when you feel it is dark near your feet even after the light is turned on?		(L)
[7] Corridors, stairs and storage	33	In winter, are there occasions when you come out of a room and feel cold?		(T)
	34	Are there occasions when you stumble upon a step while entering/coming out of a room?		(SF)
	35	Are there occasions when you feel it is dark near your feet while walking even after the light is turned on?		(L)
	36	Are there occasions when you slip while walking?		(SF)
	37	Are there occasions when you feel it is dangerous because the stairs are too steep?		(SF)
	38	Are there occasions when the storage smells of mold or chemical substances?		(H)
	39	Are there occasions when indoor breeding of insects occurs?		(H)

*1 & 2: The options for answers to these marked questions are different from the rest.
*1: Excessively (0 point); partially (1 point); scarcely (2 points); and not at all (3 points).
*3: The abbreviations of elements of health represent: T (thermal environment), A (acoustic environment), L (Light environment), H (hygiene), SF (safety), and SC (security).

Room/area		Question	Check	Element of health (*3)
[8] Surroundings of the residence	40	Are there occasions when you slip or stumble around your home?		(SF)
	41	Are there occasions when you feel it is dangerous while opening/closing the gate, shutters, etc.?		(SF)
	42	Are there occasions when you feel anxious about the precautions against crime?		(SC)
	43	Are there occasions when you are at home and feel anyone can easily see you from the outside?		(SC)
	44	Are there occasions when you slip on the floor of the veranda or terrace?		(SF)
[9] Design for nursing care	45	Are the corridors and doorways wide enough for the easy use of wheelchairs? (*2)		–
	46	Is there also a slope wherever there is a step, so that wheelchairs can be used easily? (*2)		–
	47	Is the layout arranged in a suitable way so as not to have to use the stairs for everyday life? (*2)		–
	48	Is the toilet large enough for a helper to assist without difficulty? (*2)		–
	49	Is the bathroom large enough for a helper to assist without difficulty? (*2)		–
	50	Is the number of plugs available in rooms sufficient so that nursing equipment can also be used? (*2)		–

*1 & 2: The options for answers to these marked questions are different from the rest.
*2: Yes; No; Not sure. (These are not subject to scoring.)
*3: The abbreviations of elements of health represent: T (thermal environment), A (acoustic environment), L (Light environment), H (hygiene), SF (safety), and SC (security).

Each question asks about the frequency of "environmental conditions that may affect resident's health." As an indicator of the degree of influence on health, scores are assigned according to answers to the questions: 1 point for "Frequently," 2 points for "Sometimes," 3 points for "Rarely," and 4 points for "Not at all." All the obtained scores are added up and thus, lower total scores indicate higher health risks.

Considered from the perspective of the elderly, six out of 50 questions are related to the "design for nursing care," but the total scores do not reflect these results. This is because the requirements differ depending on the individual's condition. These items are intended to give residents an opportunity to examine their home in terms of suitability for nursing care.

3.2.3.3. Assessment results

The assessment using CASBEE Health Checklist can be conducted at the following website: http://www.jsbc.or.jp/CASBEE/health_check/index.html

A list of 50 questions is given based on the rooms/areas, and answers to questions such as "Frequently" and "Not at all" can be selected from the pull-down menu.

The assessment results are also displayed either according to rooms or elements of health. With the given radar charts, it is possible to identify the rooms/elements that require special attention for improvement (Figure 3.2.8).

The results can also be compared with the average scores obtained through the survey of 6,000 residences across Japan. The ranking results provide the relative position of the resident's home regarding the living environment (Figure 3.2.9). It is also possible to show the rankings based on rooms/elements of health. These help residents to interpret the results.

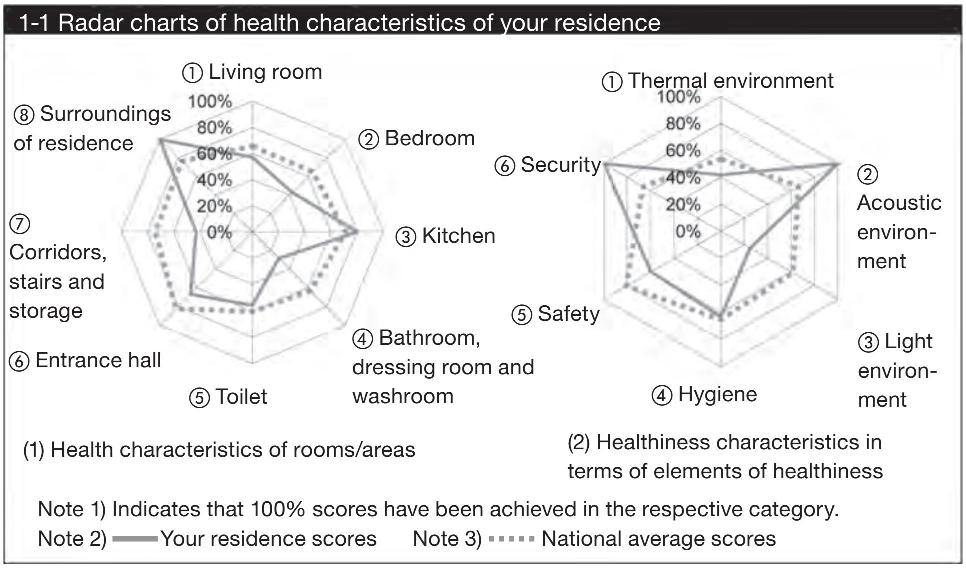


Figure 3.2.8: Checklist diagnosis results – radar charts of health characteristics

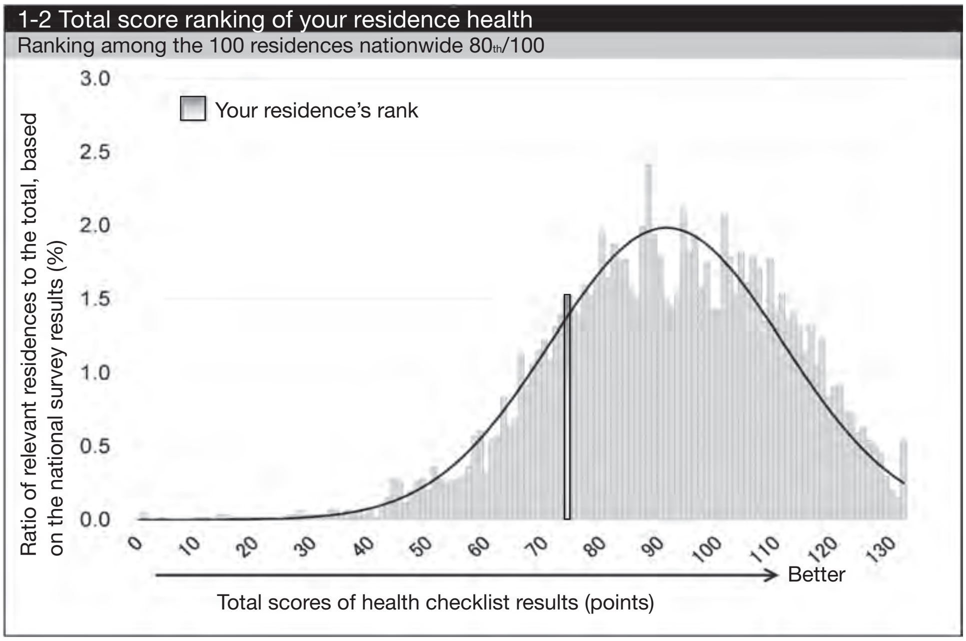


Figure 3.2.9: Checklist diagnosis results – total score rankings

The past survey results have demonstrated that residents staying in the living environment with higher total scores in the health checklist give statistically higher points on the subjective well-being*. It is highly probable that improved total scores can lead to better health conditions of the assessor and his/her family (Figure 3.2.10).

* Expressed as points out of 100, regarding the perception of own health. This indicator has been introduced to the "Japanese Comprehensive Survey of Living Conditions (by the Ministry of Health, Labour and Welfare)" since 1986. Positive perception of subjective well-being is known to be associated with higher survival rates.

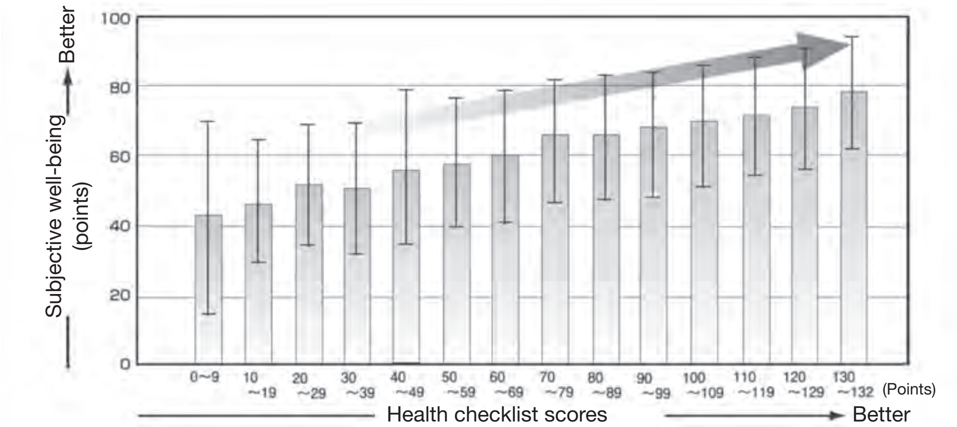


Figure 3.2.10: Relationship between the total scores of health checklist and the perception of subjective well-being (Questionnaire participants: 6,000. Surveyed by JSBC)

The analytical results about the influence of the living environment on health are presented using the incidence rate of common colds (which people most frequently come down with), as an example. Compared with the residences with poor thermal insulation performance (built based on the standards before 1980), those with better thermal insulation performance (built in compliance with the 1999 standards) significantly improved the scores for the element of "warmness" by 2.9 points (Figure 3.2.11).

Based on these data, logistic regression analysis was conducted regarding the relationship between "warmness" scores and the incidence rate of common colds. The analysis results indicate that, among males in their 30s or 40s living in the temperate-climate regions (III to V), the incidence rate of common colds in winter was reduced by 18.4% when residences with the pre-1980 standards were renovated according to the 1999 standards of thermal insulation (Figure 3.2.12).

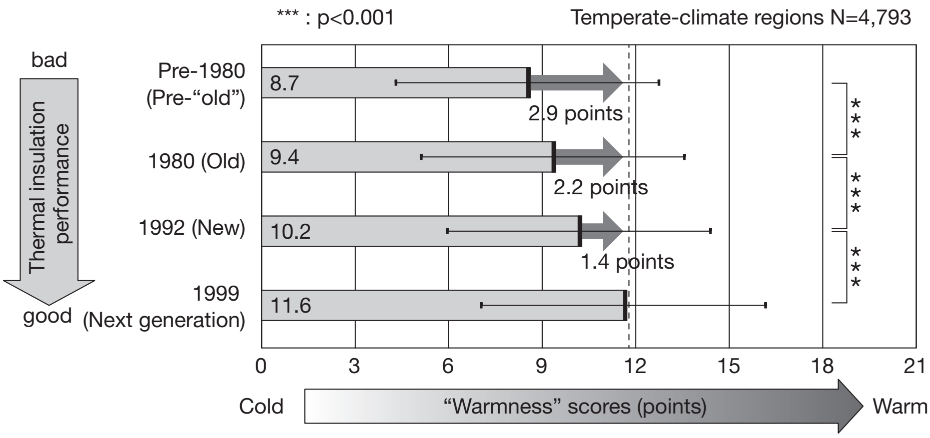


Figure 3.2.11: Relationship between the thermal insulation performance of residences and scores for the element of “warmness”

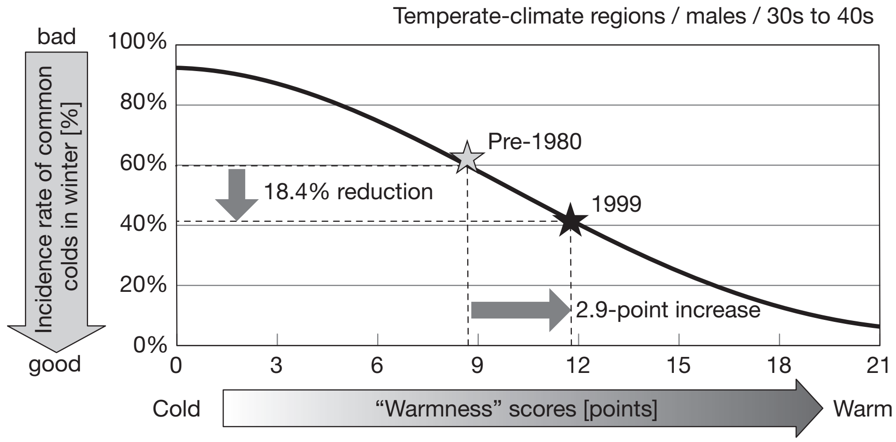


Figure 3.2.12: Beneficial effect of thermal insulation renovation on the incidence rate of common colds in winter

For residents who are considering renovation, etc., a book titled “Guidebook for Housing that Promotes Health and Well-Being – 9 Keywords for Residents to Live Healthily” was published by IBEC (available in Japanese). It gives health-related measures that can be introduced at residences and is suitable for non-professionals. For professionals in design or construction, “Housing that Promotes Health and Well-Being – 9 Keywords – Design Guide Map” (published by Kenchikugijutsu, Inc.) is available (also in Japanese).

In summary, CASBEE Health Checklist is intended to improve the health of Japanese residences by encouraging residents to perform self-diagnosis, and become aware and deal with housing-related issues (e.g., by changing their way of living or renovating their residences).

3.3. CASBEE for Buildings

Corresponding to the building lifecycle, CASBEE for Buildings is composed of four assessment tools, CASBEE for Pre-design, CASBEE for New Construction, CASBEE for Existing Building and CASBEE for Renovation, to serve at each stage of the design process (Figure 3.3.1). “CASBEE Family” is the collective name for these four tools and the expanded tools for specific purposes, which are listed below. Each tool is intended for a separate purpose and target user, and is designed to accommodate a wide range of uses (offices, schools, apartments, etc.) in the evaluated buildings.

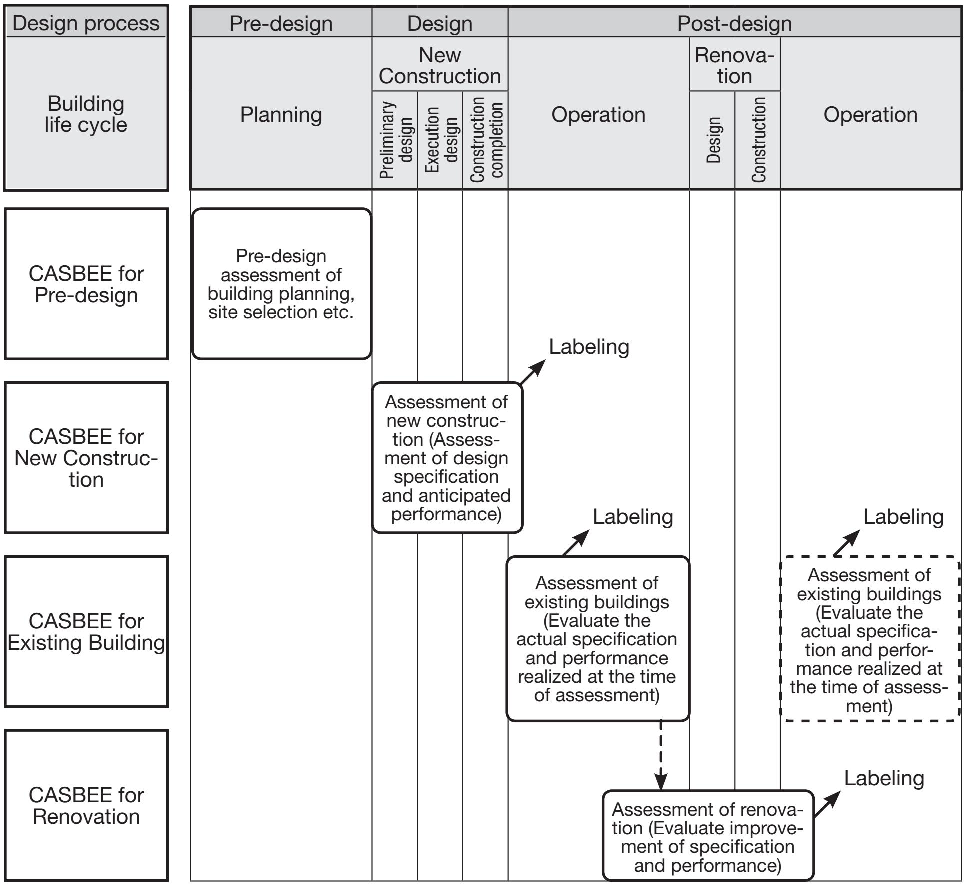


Figure 3.3.1: CASBEE overall composition

3.3.1. CASBEE for New Construction (CASBEE-NC)

3.3.1.1. The position of CASBEE-NC within the four basic tools

CASBEE for Buildings offers four basic tools for the planning, construction, existing building and renovation stages of a building’s life cycle. CASBEE-NC is a tool for use when buildings are newly constructed. Therefore, the system is able to make assessments at each stage of building design and construction (i.e., Preliminary Design, Execution

Design, and Construction Completion) on the basis of target performance, design specifications and anticipated performance, enabling consideration of improvements at each stage. As CASBEE-NC performs predictive assessments based on design specifications, the results remain valid for three years after the completion of construction. After that period, if necessary, the building concerned should be re-evaluated using the latest edition of CASBEE for Existing Buildings.

3.3.1.2. Assessment targets of CASBEE-NC

CASBEE-NC evaluates Q (environmental quality) and LR (environmental load reduction) based on design specifications of a building to be constructed. It also covers assessment of remodeling (i.e., new construction involving partial reuse of existing buildings) and reconstruction.

3.3.1.3. When and how to use CASBEE-NC

The following are the four main examples for utilization of CASBEE-NC.

(1) Design for Environment (DfE) tool for building designers

Building designers can use CASBEE-NC at the design stage to check environmental performance, set various goals, establish consensus with parties involved in design (e.g., architecture, structure and facility service system) and demonstrate design performance to the client.

(2) Environmental performance labeling tool

Third-party certification (labeling) by experts based on the CASBEE assessment results can also be used for property value assessment from an environmental perspective. (See Section 4.2)

(3) Construction administration tool

Used as a PR tool for construction and environmental administration, CASBEE-NC can be a construction administration tool that enables a building's environmental attributes to be publicized.

(4) Selection of contractors for design competitions, proposals and PFI projects

Clients from public or private sectors can use the tool to indicate overall environmental performance targets to participating designers, assigning high grades to the designs that deliver optimal environmental efficiency within a budget. It can also be used for both domestic and overseas projects.

3.3.1.4. Points to be noted on CASBEE-NC

(1) Assessment at Preliminary Design, Execution Design, and Construction Completion Stages

It is important to start making efforts to produce environmentally conscious designs from the preliminary design stage. Detailed specifications are determined at the execution design/construction stages during which design details are finalized. In the process, changes may be made to the original specifications. Therefore, CASBEE-NC can be used for assessment in three phases:

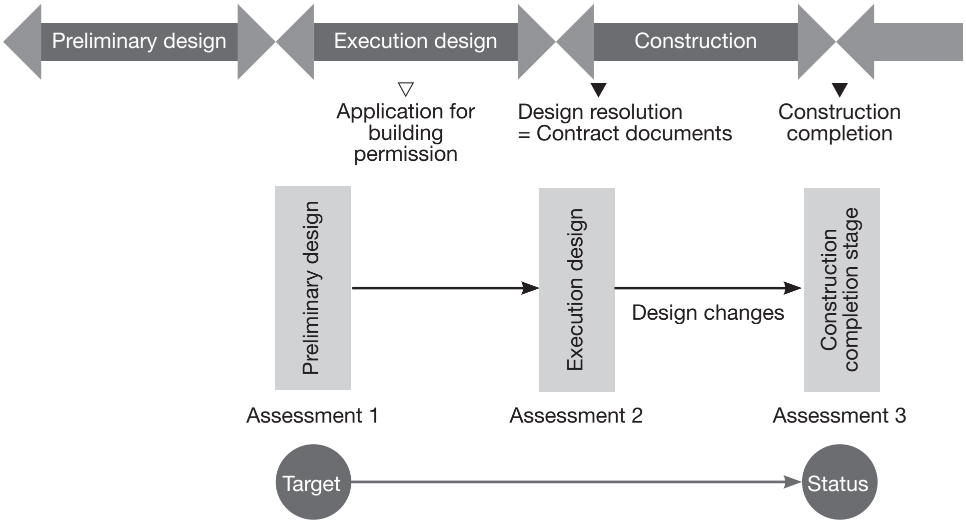


Figure 3.3.2: Assessment stages of CASBEE for New Construction

(2) Use of existing assessment systems
The evaluation criteria make maximum use of existing, established evaluation methods, such as the energy-saving standards and the Housing Performance Indication System, and aim for conformity with those methods, in order to save time and work in the evaluation process.

(3) Provision of a simplified edition
We have produced a simplified edition that can be used to make assessments in a short period. It can be used for purposes such as the following:
- Simplified setting of the Built Environment Efficiency level (as a tool for forming consensus between owners, designers and builders, etc.).
- Setting environmental design targets and evaluating attainment (as a proposal management tool etc. under ISO14001).
- Preparing documents for submission to government agencies, etc. (building environmental plans, etc.).

(4) Provision of an assessment system for buildings intended for short-term use
In some cases, buildings are constructed to be used for a short period of time, such as exhibition facilities, theaters and commercial facilities. Environmental consideration in such buildings differs from those intended for permanent use. Therefore, different assessment criteria are necessary. We have developed CASBEE for Temporary Construction to cover such buildings.

3.3.1.5. Assessment items of CASBEE for NC

Table 3.3.1: Assessment items included in Q (Environmental Quality of the building)

Q1. Indoor Environment	1. Sound Environment	1.1 Noise
		1.2 Sound Insulation
		1.3 Sound Absorption
	2. Thermal Comfort	2.1 Room Temperature Control
		2.2 Humidity Control
		2.3 Type of Air Conditioning System
	3. Lighting & Illumination	3.1 Daylight
		3.2 Anti-glare Measures
		3.3 Illuminance Level
		3.4 Lighting Controllability
	4. Air Quality	4.1 Source Control
		4.2 Ventilation
		4.3 Operation Plan
Q2. Quality of Service	1. Service Ability	1.1 Functionality & Usability
		1.2 Amenity
		1.3 Maintenance Management
	2. Durability & Reliability	2.1 Earthquake Resistance
		2.2 Service Life of Components
		2.4 Reliability
	3. Flexibility & Adaptability	3.1 Spatial Margin
		3.2 Floor Load Margin
		3.3 System Renewability
Q3. Outdoor Environment on Site	1. Preservation & Creation of Biotope	
	2. Townscape & Landscape	
	3. Local Characteristics & Outdoor Amenity	3.1 Attention to Local Character & Improvement of Comfort
		3.2 Improvement of the Thermal Environment on Site

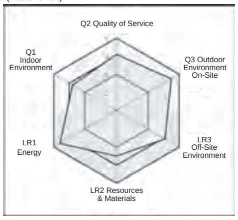
Table 3.3.2: Assessment items included in LR (Environmental Load Reduction of the building)

LR1 Energy	1. Building Thermal Load	
	2. Natural Energy Utilization	
	3. Efficiency in Building Service System	
	4. Efficient Operation	4.1 Monitoring
		4.2 Operation & Management System
LR2 Resources & Materials	1. Water Resources	1.1 Water Saving
		1.2 Rainwater & Greywater
	2. Reducing Usage of Non-renewable Resources	2.1 Reducing Usage of Materials
		2.2 Continuing Use of Existing Structural Frames etc.
		2.3 Use of Recycled Materials as Structural Frame Materials
		2.4 Use of Recycled Materials as Non-structural Materials
		2.5 Timber from Sustainable Forestry
		2.6 Efforts to Enhance the Reusability of Components and Materials
	3. Avoiding the Use of Materials with Pollutant Content	3.1 Use of Materials without Harmful Substances
		3.2 Elimination of CFCs and Halons
LR3 Off-site Environment	1. Consideration of Global Warming	
	2. Consideration of Local Environment	2.1 Air Pollution
		2.2 Heat Island Effect
		2.3 Load on Local Infrastructure
	3. Consideration of Surrounding Environment	3.1 Noise, Vibration & Odor
		3.2 Wind/Sand Damage & Daylight Obstruction
		3.3 Light Pollution

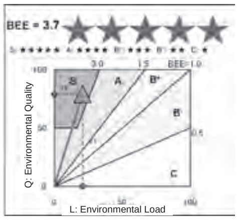
3.3.1.6. Example of CASBEE-NC evaluation

Assessment Result:Rank S (BEE：3.7)

Evaluation Results of Environmental Functions (Radar chart)



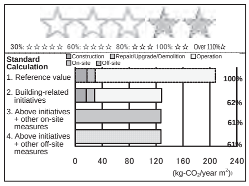
Building Environmental Efficiency (BEE)

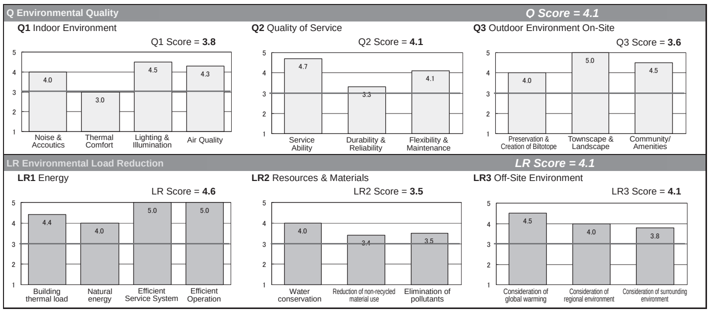


Assessment Summary
This building is situated on an exceptional location on the Kusatsu side of Omi Ohashi Bridge, across from Otsu on Lake Biwa. It was designed as an "eco shopping mall" that coexists with the local communities and blends in with the surrounding nature.
The exterior of the building was designed to fit the landscape of Lake Biwa and rustic scenery of the surrounding area, and energy efficiency was incorporated in the interior design features such as an environmentally friendly lighting system.
Furthermore, a variety of environmental technologies, including an ice thermal storage system, natural energy, and greenery utilization, were introduced. The mall also promotes the importance of environmental efforts among visitors by offering information on its initiatives through eco-info terminals and panel displays.
Also, BEMS-based optimal operation of the building and life cycle planning was included in the building design.

Building outline
Building type(s): Retailers (restaurants/movie theaters)
Location: Kusatsu City, Shiga Prefecture
Site area: 41,915.96 m2
Total floor area: 165,238.10 m2
Floors: 6 floors (above ground) & 1 floor (basement)

LCCO2 (Global Warming Impact Chart)





Assessment results for CASBEE-NC_2010 (Ver.1.0)

Design Consideration

Items considered in planning		Key environmental measures
General	The building, designed as an "eco shopping mall" which fits the landscape of Lake Biwa, contributes to global environment protection through CO_2 emissions reduction.	- Landscape consideration
Q1 Indoor Environment	Measures for energy conservation and improvement of the thermal environment include the combined use of central and individual A/C systems. Light wells are used for daylight utilization. Smoking sections are completely closed off.	- Light wells, occupancy sensors for stairs and washrooms - Use of materials with low chemical content. - Interior design for enhanced ease of cleaning and maintenance
Q2 Quality of Service	Ample floor and ceiling heights were provided. For improvement in reliability, multiple devices were installed as backup for equipment failure. Also, the high level of maintenance management, as well as ease of equipment upgrade, was achieved.	- Universal design - Electricity and communication systems placed on the 2nd floor or above.
Q3 Outdoor Environment On Site	The site has an extensive green area with native trees. The low-rise building design, locally-available materials and reduced light level for signs and illumination systems were incorporated in order to enhance integration with the surrounding landscape. Also, biotopes were created in order to contribute to biological resources.	- Restoration of the on-site rice field using natural resources such as flora and topsoil harvested prior to construction. - Local forest thinning from Shiga Prefecture area, art objects using subsoil from Lake Biwa - Eco-stations
LR1 Energy	Reduction of solar radiation load was achieved by establishment of a non-air-conditioned area around the building and installation of smaller windows with the exception of the north side of the building. A large temperature difference A/C system with ice thermal storage and a high-efficiency lighting system were used as energy efficiency measures. Furthermore, 200 kW solar panels were installed.	- Large temperature difference A/C system with ice thermal storage - High-efficiency lighting, LED - Solar power generation - Energy data collection and commissioning using BEMS
LR2 Resources & Materials	Recycled materials, forest thinning and laminated lumber were used extensively. The water resource management system uses groundwater and rainwater.	- Louvers with recycled lumber, recycled interlocking blocks - Use of groundwater and rainwater
LR3 Off-site Environment	Segregated garbage collection is established. Ample parking space and multiple entrance/exit points are provided in order to reduce traffic congestion. Also, the water processing capacity at the facility exceeds the level set under the sewage discharge standards.	- On-site bus depots for public transportation - Rooftop and wall greenery (moss tiles) - Kitchen water processing system

Figure 3.3.3: An example of CASBEE-NC evaluation

3.3.2. CASBEE for Existing Buildings (CASBEE-EB)

3.3.2.1. The position of CASBEE-EB within the four basic tools

CASBEE-EB is an assessment tool for existing buildings at the operation stage.

Whereas CASBEE-NC is used for the assessment of design specifications and anticipated performance, CASBEE-EB evaluates the specifications and performance achieved at the time of assessment, specifically based on the operational records of one or more years after the completion of construction.

It is becoming increasingly necessary for the existing building stock to undergo renovations for realization of better energy efficiency. Improvements to eco-friendliness or CO_2 reduction are required through major renovation work, etc. It is therefore necessary to make the tools for existing buildings or renovation better known to the public so that they can be utilized more frequently. The assessment of environmental performance of existing buildings (using CASBEE-EB) or renovated buildings (using CASBEE-RN) is conducted from the perspective of a building being an asset, and the results can be used to decide whether an existing building of interest needs to be renovated.

As the environmental performance of a building changes because of repair work or deterioration with time, etc., and building usage may also change, the results of CASBEE-EB assessment are valid for five years after the assessment. After that period, the building concerned should be accordingly re-evaluated using the latest edition of CASBB-EB available.

3.3.2.2. Assessment targets of CASBEE-EB

CASBEE-EB evaluates Q (environmental quality) and LR (environmental load reduction) of existing buildings.

Owing to its assessment system, CASBEE-EB can deal with not only the buildings designed/constructed with use of CASBEE-NC but also any of the large stock of existing buildings.

What is assessed is the present performance of an existing building that has passed several stages such as new construction, repair and renovation. Therefore, the obtained results are the performance levels at the very moment that can be achieved as an outcome of past upgrading and deterioration. Remodeling (i.e., new construction involving partial reuse of existing buildings) and reconstruction should be assessed using CASBEE-NC.

3.3.2.3. When and how to use CASBEE-EB

(1) Use as an environmental performance labeling tool

Based on the assessment results, experts issue authorized third-party certificates (labeling), which can be used in property value assessment of buildings from an environmental perspective, etc.

(2) Use as a tool to indicate environmental performance

The CASBEE-EB results can be used as an indicator of building environmental performance and may be useful on occasions such as producing an advertisement to attract tenants.

(3) Use for the mid- to long-term planning of facility management

Real estate agencies or companies that own many facilities can use CASBEE-EB for self-evaluation of buildings under their management or ownership, making mid- to long-term plans for facility management. Specific renovation plans should be assessed using CASBEE-RN.

(4) Use in the property appraisal system

CASBEE-EB can be useful for the property appraisal system because it associates the environmental performance assessed with the property values.

3.3.2.4. Points to be noted on CASBEE-EB

(1) Assessment criteria of CASBEE-EB

The criteria to be used are those prescribed at the time of assessment, not the criteria when a building concerned was constructed. The CASBEE assessment criteria will be accordingly updated with technical innovation or conceptual change regarding environment. It is necessary for the assessment to be conducted based on the latest criteria available at the time of assessment.

(2) CASBEE-EB assessment based on operational records

In CASBEE-EB, the building performance that can be achieved at the time of assessment is in principle evaluated within the parameters of operational records and measured data. However, considering the feasibility of conduct of assessment in a practical sense, a framework for the assessment has been established as follows:

a. If the performance at the time of assessment can be evaluated based on the design drawings and specifications etc., the criteria of CASBEE-NC can be used for the assessment.

b. When measurement is difficult, the assessment item concerned is evaluated using the criteria of CASBEE-NC. The same can be applied to cases in which prediction based on the design specifications is considered more accurate than measurement.

c. When deterioration of buildings with time should be included for consideration, assessment will be performed accordingly.

d. In principle, if measurement is considered simpler and more accurate than prediction, measurement is conducted (e.g. luninance setting levels, background noise, etc.).

e. If the data measured in accordance with laws (such as the Act on Maintenance of Sanitation in Buildings, and pollution control ordinances) are available, these can be used.

f. It is very important to appropriately operate and manage a building to allow it to function at the maximum performance levels. Therefore, with regard to operation/management-related assessment items such as tolerability and durability, the requirements for better assessment results include the submission of recorded data and information to prove that the management levels are sufficiently high.

g. In the assessment of buildings of the typical performance levels or below (i.e., Level 3 or lower), requirements such as the submission of large amounts of data/information and the undertaking of laborious measurements can be exempted, and the criteria of CASBEE-NC can be used to the extent possible.

(3) Provision of a brief version of CASBEE-EB

A brief version of CASBEE-EB, which requires only a short time to conduct the assessment, has become available. The positioning of CASBEE-EB (brief version) is the same as CASBEE-EB. Unlike CABEE-EB, however, CASBEE-EB (brief version) exhibits the following characteristics, making assessment relatively easy.

a. Assessment item Q1 (indoor environment), for which measured data had to be assessed, has been omitted.

b. With regard to thermal or air environment, if the regularly measured data on the indoor environment in accordance with the Act on Maintenance of Sanitation in Buildings are available, these can be used for the assessment.

c. In CASBEE-EB, the acquisition of better assessment results, especially regarding LR1 (3.Efficiency in building service system) requires energy consumption data of each of the facilities for air-conditioning, ventilation, lighting, hot water supply, and elevators. However, as it is very difficult to obtain such measurement data if a building is not equipped with the building energy management system (BEMS), a simplified assessment method has been adopted.

3.3.2.5. Assessment items of CASBEE-EB

Table 3.3.3: List of assessment items for Q (environmental quality of buildings)

Q1. Indoor environment	1. Sound environment	1.1 Noise
		1.2 Sound insulation
		1.3 Sound absorption
	2. Thermal environment	2.1 Room temperature control
		2.2 Humidity
		2.3 Air-conditioning system
	3. Lighting and illumination	3.1 Use of daylight
		3.2 Anti-glare measures
		3.3 Illuminance level
		3.4 Lighting control
	4. Air quality	4.1 Source control
		4.2 Ventilation
		4.3 Operation plan
Q2. Quality of service	1. Service ability	1.1 Functionality and usability
		1.2 Amenities and comfort
		1.3 Maintenance management
	2. Durability and reliability	2.1 Earthquake resistance and seismic isolation
		2.2 Service life of components
		2.3 Renewal with suitable frequency
		2.4 Reliability
	3. Adaptability and upgrading	3.1 Spatial margin
		3.2 Floor load margin
		3.3 System upgrading
Q3. Outdoor environment (on-site)	1. Preservation of biological environment	
	2. Consideration for townscape and view	
	3. Consideration for regional characteristics and amenities	3.1 Consideration for regional characteristics and provision of improved comfort
		3.2 Improvement of thermal environment on-site

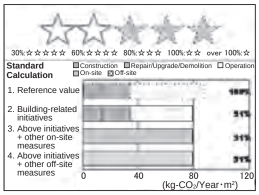
3.3.2.6. Example of CASBEE-EB evaluation

Assessment Results: Rank A (BEE：2.1)

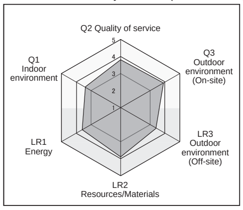
Assessment Summary
This building, a branch office, is situated in front of park with water pond. The plan considerd the linkage between the bulding openspace and the park. It facilitate gallery and tea room for public use. Office rooms spread out large column less space that provides frexibility. Refresh spaces in stairway are also encouradge communications between workers.
<Confort indoor environment>
Offices are conditioned by floor HVAC system, PMV contrall, VAV, semi-indirect lighting and task-ambient lighting. Pre-wireing is also considerd for futer upgrading.
<Energy>
It introduced the hybrid heat sorce system with gas and electricity for efficient energy use. Heat strage is low water level temperature stratification type. Operation of the system considers thermal loads and energy saving continuously.

Building Outline
Building type(s): Ofiice
Location: Fukuoka City
Site area: 1,751 m2
Total floor area: 10,632 m2
Floors: 11 floors (above ground) & 1 floor (basement)
Completion: April 1992

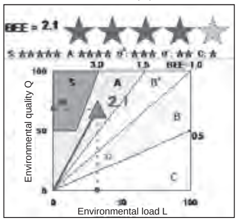
Lifecycle CO_2 (Climate change impact chart)

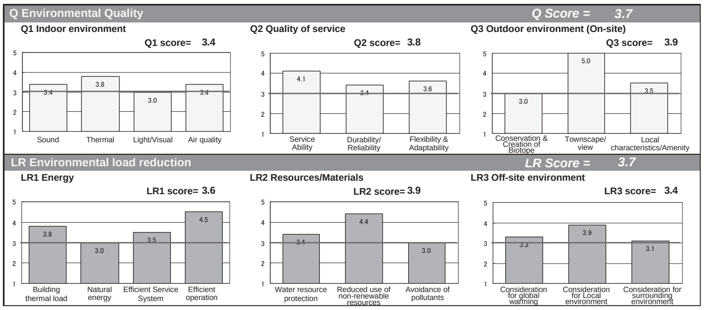


Assessment of major items (Radar chart)



Built Environment Efficiency (BEE rank & chart)





Assessment results for CASBEE-NC_2010 (ver1.0)

Design Consideration

Items considered in planning		Key environmental measures
General	Human Creative Office.	
Q1 Indoor environment	Confort environment for occupants	Floor HVAC, zone contrall, task-ambient lighting
Q2 Quality of Service	Large column less space that provides frexibility. It gives enough ceiling hight, floor hight for confort	Confertable apace (ceiling hight 2.9m, floor hight 3.9m)
Q3 Outdoor Environment on Site	Linkage between the bulding openspace and the park. Gallery and tea room for public use.	Consideration for town scape and land scape
LR1 Energy	Hybrid heat sorce system with gas and electricity for efficient energy use. water heat strage. Operation fot energy saving continuously	Hybrid heat sorce system + water heat strage, VAV, VWV, task-ambient lighting. Himan sensor for light contrall.
LR2 Resources & Materials	Water conservation	Water saving toilet, Blast furnace cement, reuse of existing structure underground
LR3 Off-site Environment		Low NOx equipment, heat exaust from roof top.

Figure 3.3.4: An example of CASBEE-EB evaluation

3.3.3. CASBEE for Renovation (CASBEE-RN)

3.3.3.1. The position of CASBEE-RN within the four basic tools

CASBEE-RN is a tool for the assessment of the renovation of existing buildings at the operation stage.

In CASBEE-RN, the performance after renovation is predicted. The assessment results are valid for three years after the completion of renovation. After that period, the building concerned should be accordingly re-evaluated using the latest edition of CASBEE-EB available.

It is becoming more necessary for the existing building stock to undergo renovations for realization of better energy efficiency. Improvements to eco-friendliness or CO_2 reduction are required through major renovation work, etc. It is therefore needed to make the tools for existing buildings or renovation more known to the public so that these can be utilized more frequently. The assessment of environmental performance of existing buildings (using CASBEE-EB) or renovated buildings (using CASBEE-RN) is conducted from the perspective of a building being an asset, and the results can be used to decide whether an existing building of interest needs to be renovated.

3.3.3.2. Assessment targets of CASBEE-RN

CASBEE-RN evaluates Q (environmental quality) and LR (environmental load reduction) of renovated existing buildings.

According to the purpose of assessment, the relevant performances between pre- and post-renovation can be compared (optional).

Functional upgrading after the commencement of building operation is described by various terms such as repair, upgrading, renewal, renovation and retrofitting. The Building Standard Law of Japan gives definitions of terms such as large-scale repair. In CASBEE-RN, these are collectively handled as renovations.

Specifically, CASBEE-RN covers a wide range of renovations as mentioned below.

a. Functional improvement of building service systems, and energy-saving measures (e.g., switch to high-efficiency heat sources or high-efficiency lighting systems, and adoption of clean energy use)

b. Improvement of interior functions (e.g., installation of OA raised access floors, removal of asbestos, and measures against VOCs or volatile organic compounds)

c. Improvement of building envelope functions (e.g., improvement of durability or thermal insulation performance, and provision of rooftop greenery)

d. Improvement of the whole building functions (e.g., retrofitting)

e. Change of building usage (e.g., conversions)

Note 1) Earthquake-resistant renovations are evaluated according to assessment item Q2 (quality of service; earthquake resistance)

Note 2) Simple repair for maintaining the present functioning levels is not assessed by CASBEE-RN. However, remodeling (i.e., new construction involving partial reuse of existing buildings) can be evaluated by CASBEE-RN.

Note 3) In the case of building extension work, CASBEE-NC can also be used for the assessment of the extended area if it can be evaluated separately from the existing area. If not, CASBEE-RN should be used to assess the whole building.

3.3.3.3. When and how to use CASBEE-RN

The four main examples for utilization of CASBEE-RN are as follows:

a. Use as a Design for Environment (DfE) tool at the renovation planning stage
CASBEE-RN can be used, for example, to examine the renovation design from the environmental performance perspective, to set target levels, to establish consensus among the design divisions involved (regarding architecture, structure and building service system) and to indicate performance at design phase to clients.

b. Use as an environmental performance labeling tool
Based on the assessment results of environmental performance after renovation, experts issue authorized third-party certificates (labeling), which can be used in property value assessment of renovated buildings from an environmental perspective, etc.

c. Use as a tool to evaluate the improvement of environmental performance efficiency after renovation
CASBEE-RN can be used to assess the beneficial effect of renovation on environmental performance efficiency, whereby renovation for environment improvement can be promoted.

d. Use as a tool to evaluate renovations from the energy-saving perspective
CASBEE-RN can be used to specifically assess the energy-saving performance that can be improved by renovation, whereby acquisition of better energy efficiency in existing buildings can be promoted as a measure against climate change.

3.3.3.4. Assessment criteria of CASBEE-RN

(1) Fundamental principles
The fundamental principles of CASBEE-RN assessment criteria are as follows:

a. The existing part is evaluated based on the latest assessment criteria, not the then criteria when the building to be renovated was constructed.

b. In principle, the measured data assessment by CASBEE-EB is considered as pre-renovation assessment.

c. In principle, the post-renovation assessment is conducted based on the design specifications and anticipated performance in accordance with the CASBEE-NC assessment framework.

d. The part that is not subject to renovation is assessed by CASBEE-EB.

e. Because some of the assessment items or criteria are different between the predictive assessment of CASBEE-NC and the CASBEE-EB assessment based on the operational records, adjustments were made in order to enable the performance improvement before/after renovation to be evaluated (e.g., in some assessment items, one tool's criteria were adjusted to the other's).

f. In some cases, a building for renovation is such an old construction that it is difficult to get sufficient data to evaluate its performance, and therefore simple assessment has been made acceptable. However, appropriate pre-renovation assessment is essential when it comes to the items allocated to the assessment of performances improved by renovation. Limited but thorough research and collection of necessary data is a prerequisite.

(2) Change of building usage
If the renovation involves change of building usage, pre-renovation assessment should be conducted based on the usage before renovation. Likewise, conduct of post-renovation assessment should be in accordance with the usage after renovation.

3.3.3.5. Assessment of performance improvement as a result of renovation

The improvement of BEE by renovation (ΔBEE) is accordingly estimated using the following equation:

ΔBEE = BEE (post-renovation) – BEE (pre-renovation)

For example, if the BEE (pre-renovation) score of a building is 0.9 (B- rank) and the BEE (post-renovation) score is raised to 1.8 (A rank) as a result of renovation, ΔBEE will be 0.9.

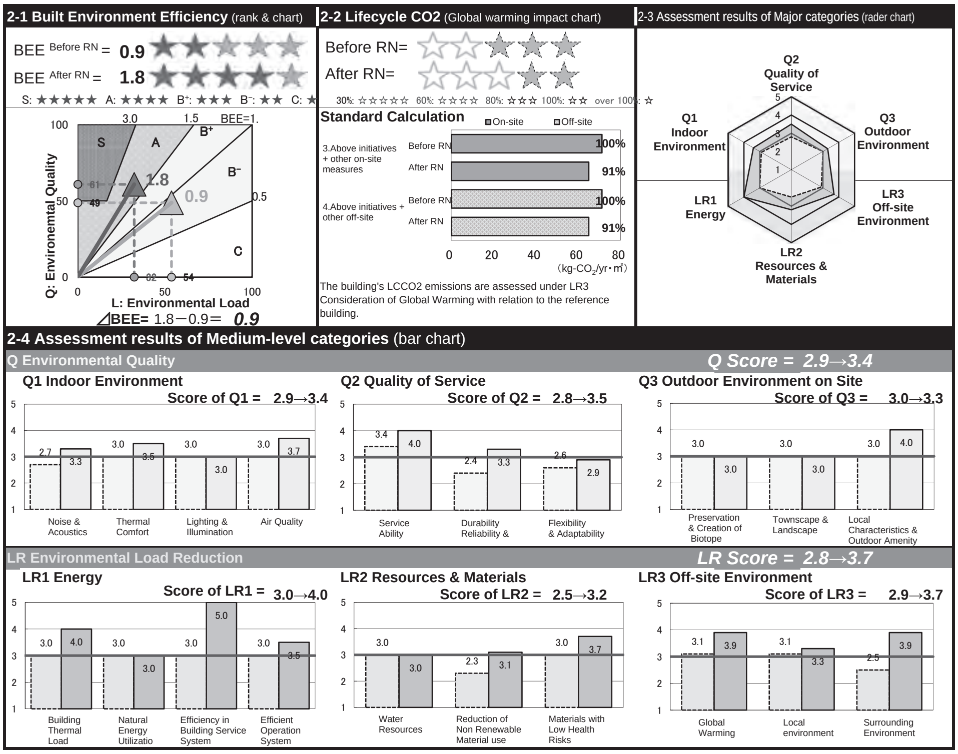


Figure 3.3.5: Assessment of performance improvement as a result of renovation

3.3.3.6. Assessment of renovation specifically from an energy-saving perspective

As a measure to reduce climate change, energy conservation of existing buildings has become a crucial issue.

Although the indoor environment having been improved by renovation may increase energy consumption, provision of better thermal insulation contributes to a better indoor thermal environment as well as more energy saving. For renovation, therefore, simultaneous assessment of improvement from the viewpoints of energy saving and indoor environment is important and, in the assessment of CASBEE-RN, use of the following indicators has been made possible.

The built environment efficiency of renovation for better energy-saving performance (BEE_{ES}) is defined by the equation below. The improvement of BEE_{ES} is assessed as ΔBEE_{ES}. (ES stands for energy saving.)

$BEE_{ES} = Q_{ES} / L_{ES}$

$\Delta BEE_{ES} = BEE_{ES}$ (post-renovation) – BEE_{ES} (pre-renovation)

Where Q_{ES} and L_{ES} are provisionally calculated as shown below:

$Q_{ES} = 25 \times (SQ1 - 1)$ (SQ1: Score of Q1 or indoor environment)

$L_{ES} = 25 \times (5 - SLR1)$ (SLR1: Score of LR1 or energy)

3.3.3.7. Points to be noted on CASBEE-RN

(1) Assessment of environmental actions taken in the process of renovation

In CASBEE-RN, environmental actions in the process of renovation are not included for the assessment of post-renovation environmental performance of buildings.

For example, recycling of waste produced during renovation work is an important issue in terms of consideration for the environment, but it does not improve the building's post-renovation performance. In order to maintain the compatibility with the results of CASBEE-EB assessment after renovation, the Q, LR or BEE score does not reflect such effects.

(2) Assessment of the extended area

If it is possible to evaluate the extended area separately from the existing area, CASBEE-NC can also be used for the assessment of the extended area. If not, CASBEE-RN should be used to assess the whole building.

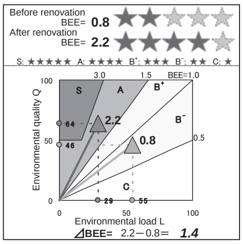
(3) Change of building usage

If the renovation involves change of building usage, a pre-renovation assessment should be conducted based on the usage before renovation. Likewise, the conduct of post-renovation assessment should be in accordance with the usage after renovation.

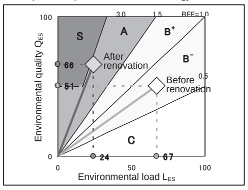
3.3.3.8. Example of CASBEE-RN evaluation

Assessment Results: After Renovation: Rank A (BEE:2.2) Before Renovation: Rank B$^-$ (BEE:0.8)

Built Environment Efficiency (BEE rank & chart)



Energy Saving Assessment by BEE_{ES}



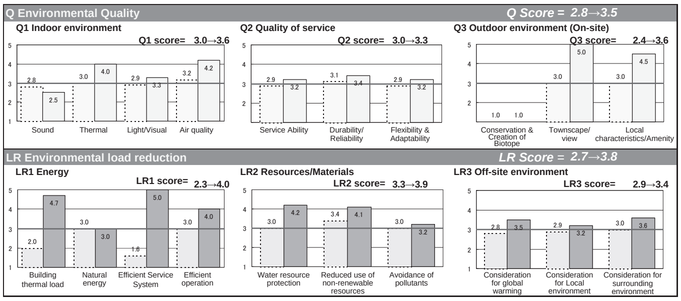
Assessment Summary

This building as a hospital had been build for over 40 years, is converred for community welfare facility of the prefecture. This conversion plan considerd number of measures not only for reinforcement of structure and upgrading but also for improvement of indoor quality, service quality, outdoor environment, energy saving and recycling of materials.

It resulted improvement of overall BEE score, and BEE_{ES} that increased from 0.8 to 2.7 through renovation also reduced CO2 emmission significantry.

Building Outline
Building type(s): Office (after renovation)
Hospital (before renovation)
Location: Okayama City, Okayama Prefecture
Site area: 14,703.98 m2
Total floor area: 20,816.11 m2
Floors: 7 floors (above ground) & 1 floor (basement)
Completion: 2005 (Renovation)
1961 (Completion)

Renovation outline
Structure: Using existing structures
Exteriors: renovated overall
Interiors: renovated overall
Equipments: renovated overall



Assessment results obtained by CASBEE-RN_2010v1.0

Design Consideration

Items considered in planning		Key environmental measures
General	Conversion from Old hospital into new office imcorperate with seismic retrofitting, machine replacement.	seismic retrofitting, machine replacement for energy saving
Q1 Indoor environment	Zone contrall by introducing Individual HVAC. Shading by reinforcement frame.	Zone contrall for air condition, day light contrall
Q2 Quality of Service	Improved duration by seismic retrofitting	Structureal reinforcement by outer frame
Q3 Outdoor Environment on Site	Improvement of Outdoor thermal environment by “Cool bond”	Cool Pond
LR1 Energy	Shading by reinforcement outer frame. Iced thermal strage. BEMS	Shading by reinforcement outer frame.PV panel. Iced thermal strage. BEMS
LR2 Resources & Materials	Rainwater usage. Reuse of Existing structure.	Rainwater usage. Reuse of Existing structure.
LR3 Off-site Environment	No change	

Figure 3.3.6: An example of CASBEE-RN evaluation

3.3.4. CASBEE for Heat Island Relaxation (CASBEE-HI)

3.3.4.1. Background of CASBEE-HI development

In Japan, temperature in urban areas is rising several times faster than the average increase of temperature on a global scale, because of the influence of the heat island phenomenon. In a scorching summer like recent years, an extra temperature rise induced by the heat island effect can have a huge detrimental influence. Effective measures are needed urgently. In response to such a situation, the government formulated the "Outline of the Policy Framework to Reduce Urban Heat Island Effects" in March 2004, and four months later announced the "Guidelines on Architectural Design for Mitigation of Urban Heat Island Effects" under the name of the Director General of the Housing Bureau of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT). In accordance with the guidelines, CASBEE-HI was developed and released in July 2005 as a tool to evaluate building-related initiatives for the mitigation of heat island phenomenon.

In the year following its development and release, CASBEE-HI went through minor revisions. Although direct use of CASBEE-HI for local government ordinances, etc., still remains limited, its assessment criteria are rare standards applicable to the assessment of building-related initiatives combating heat island effects and are used as a reference domestically and overseas, especially in hot and humid places such as Taiwan and Hong Kong.

3.3.4.2. Positioning of CASBEE-HI

CASBEE-HI was developed from the viewpoint of augmenting the contents of assessment items related to the mitigation of heat island effects in other CASBEE tools such as CASBEE-NC, specifically Q3 (Outdoor environment (on-site)) – "3.2 Improvement of thermal environment on site" and L3 (Off-site environment) – "2.2.2. Mitigation of thermal environment deterioration." The comprehensive assessment of buildings is conducted using CASBEE-NC etc., whereas CASBEE-HI is specifically applicable to the assessment of architectural design made for mitigating heat island effects.

3.3.4.3. What to evaluate by CASBEE-HI

1) Subjects of assessment

In other CASBEE tools such as CASBEE-NC, the BEE score is determined by the numerator Q consisting of the following three categories (Q1: Indoor environment, Q2: Quality of service, and Q3: Outdoor environment (on-site)) and the denominator L consisting of the following three categories (L1: Energy, L2: Resources and materials, and L3: Off-site environment). Of these categories, Q3 and L3 include the contents related to the heat mitigation effects on hot outdoor environments and heat island loads, based on which CASBEE-HI conducts more detailed assessment. As the assessment items such as indoor thermal environment and energy consumption are evaluated by CASBEE-NC, etc., these are not included for the assessment of CASBEE-HI.

2) Configuring of the virtual enclosed space boundary surrounding the site

In CASBEE-HI, an urban area is defined as an aggregate of individual buildings and the concept of a Virtual Enclosed Space (V.S.) that surrounds the site has been introduced as in the case of CASBEE-NC, etc. (Figure 3.3.7). The inside of V.S. is considered as a spatial area under control of the architects' design and therefore, in this area, how the building is designed greatly affects the mitigation of hot environments or reduction of thermal loads on the outside. In this virtual enclosed space boundary defined as V.S., Q_{HI} (i.e., Quality:

quality of thermal environment in areas where people are present such as pedestrian areas) is assessed from the viewpoint of mitigating effects on hot environments. With regard to the outside of V.S., on the other hand, L_{HI} (i.e., Load: thermal environmental loads on the outside or heat island loads on the outside of V.S.) is assessed from the viewpoint of producing the least impact on the outside. L_{HI} reduction is defined as LR_{HI} or load reduction for heat island reduction.

The spatial area that is subject to the assessment of Q_{HI} (i.e., mitigating effects on a hot environment inside V.S.) is up to 2 or 3 meters above ground where people are present, such as pedestrian areas. It also includes all the outdoor areas inside V.S. where people are present (outdoor activity spaces) such as rooftop gardens and pilotis.

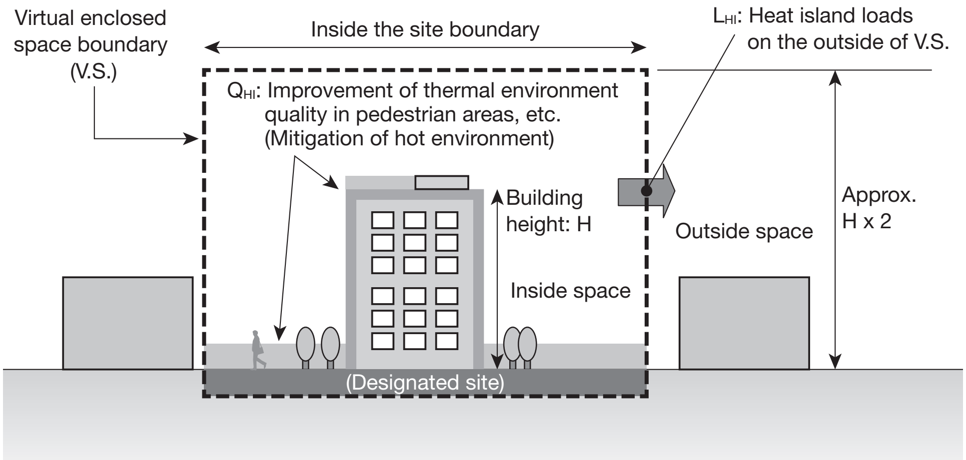


Figure 3.3.7: Definition of the virtual enclosed space boundary for assessment

3.3.4.4. Examination of the virtual enclosed space from three different perspectives in the assessment of CASBEE-HI

The effectiveness of measures against heat island effects is considered to vary depending on the location of a building of interest. It therefore is necessary to develop an assessment method that can deal with the characteristics of any location. The CASBEE-HI framework enables [1] regional characteristics and [2] neighboring block conditions around the designated site to be taken into consideration, before [3] possible measures for mitigation are discussed at the architectural planning level.

[1] Consideration of regional characteristics
The wind or temperature in any local area exhibits strong individuality. Needless to say, regarding variations in cities, even within the same city, environmental factors such as wind differ greatly. In the assessment system for mitigation of heat island effects, local climate characteristics, especially those regarding wind, should be taken into consideration. In CASBEE-HI, the “Extensive Wind Characteristics Database” covering all the regions in Japan has been made available as a reference, allowing assessors to conduct the assessment with understanding of the wind environment in an area of their interest.

[2] Consideration of the neighboring block conditions around the designated site (examining the location from the perspective of the wind environment)

Various conditions can characterize the neighboring blocks around the designated site (examining the location in terms of the wind environment). There may be a wide street in front, a large park or empty space upwind, or a skyscraper in the adjacent block. Such neighboring conditions influence environmental factors such as wind velocity and temperature of air flowing into the designated site. As shown in Table 3.3.5, locations are classified into three categories by the air temperature and condition of wind blowing into the designated site, based on which the assessment can be performed accordingly.

For areas within the wards of Tokyo or Osaka city, the “Block-Level Wind Characteristics Database” is available for understanding the wind environment around a designated site in detail and can be used when selecting an applicable category of location.

[3] Consideration at the construction planning level
Using the assessment sheet, measures to be considered for the mitigation of heat island effects are examined and evaluated in the process of architectural planning. CASBEE-HI assesses these measures at this planning level.

Table 3.3.5: Classification of locations from the viewpoint of wind environment

		Temperature of inflowing air	
		Good (cool)	Hot (hot air)
Upwind condition	Many blockages upwind	—	Location [1] E.g., urban areas with fewer empty spaces
	Fewer blockages upwind	Location [2] E.g., on the waterfront or upwind large green spaces or parks	Location [3] E.g., upwind large empty spaces or highways

3.3.4.5. Indicators used for CASBEE-HI assessment

In order to comprehensively assess the mitigating effects on a hot environment during the daytime in summer and the cooling effects on air temperature during the nighttime (for infrequent occurrence of sultry nights, generally called “tropical nights” in Japan), the BEE_{HI} score is determined using integrated values of L_{HI} and Q_{HI} that cover the entire day. L_{HI} is assessed in terms of increase in air temperature outside V.S. (Figure 3.3.7) and environmental impact that increases the standard new effective temperature (SET*), whereas Q_{HI} is evaluated in terms of SET* in spatial areas up to 2 or 3 meters above ground where people are present (outdoor activity spaces such as pedestrian areas) inside V.S. and during the hours when people are there. Because SET* is included for assessment, not only the sensible heat emission that is increased by the execution of construction plans at the designated site but also the increase in latent heat emissions and decrease in wind velocity are considered as relevant impact factors. By defining the spatial area to be assessed for Q_{HI} as outdoor activity spaces such as pedestrian areas, the results can reflect differences in the position of exhaust heat release from building services or green areas.

3.3.4.6. CASBEE-HI assessment tool

1) Outline

Ideally, a detailed numerical analysis on climate should be performed for an accurate BEE_{HI} calculation. In a practical sense, however, it is difficult to perform such an analysis on every occasion at the planning stage of construction. As in the case of CASBEE-NC, etc., an assessment method is needed that enables simple estimation of BEE_{HI} scores. In CASBEE-HI, an assessment sheet is used to allow assessors to evaluate/check relevant values such as BEE_{HI} scores at the planning stage. In this assessment method, the heat island load (L_{HI}) is not obtained directly. Instead, its reducing effect, that is, LR_{HI} (load reduction for heat island reduction) is first assessed to calculate the L_{HI} value.

2) CASBEE-HI users (assessors)

Like other CASBEE tools such as CASBEE-NC, expected users of CASBEE-HI include a wide range of parties involved in construction projects such as construction clients, architects and municipalities.

3) Buildings to be assessed by CASBEE-HI (categorized into 18 groups)

As in the case of CASBEE-NC, etc., the buildings to be evaluated by CASBEE-HI consist of two types: non-residential (mainly used for offices, schools, retailers, restaurants, hospitals, hotels, halls and factories) and residential (apartments). These buildings are categorized into 18 groups according to the building usage, location, and legal floor area ratio[Note)] (Figure 3.3.8). Multi-purpose facilities (i.e., buildings with combined purpose for non-residential and residential use) can also be evaluated.

Note) The legal floor area ratio is a ratio of floor to site area, which is specified by the city planning in a relevant district. However, relaxation measures applicable to each city planning within the parameters of the Building Standard Law (e.g., relaxation of the floor-space ratio owing to a secured public open space in accordance with the Planned Development Design System, and a floor area ratio increased in accordance with the Exceptional Floor Area Ratio District System) are not included.

Non-residential use		Location [1]*		Legal floor area ratio: above 400%
	X	Location [2]	X	Legal floor area ratio: between 200% and 400%
Residential use		Location [3]		Legal floor area ratio: 200% or below

(* See Table 3.3.5 for the details of classified locations)

Figure 3.3.8: Classification of buildings to be assessed by CASBEE-HI

4) Assessment items

The assessment items of CASBEE-HI are listed in Table 3.3.6. The Major Items are in five categories: [1] Flow of air, [2] Shade, [3] Ground surface coverage around the building (inside V.S.), etc., [4] Exterior materials, and [5] Release of exhaust heat from the building services.

Table 3.3.6: Assessment Items of CASBEE-HI

<table>
<tr><th>Major Item</th><th>Middle Item</th><th colspan="2">Minor Item</th></tr>
<tr><td rowspan="5">1. Flow of air</td><td rowspan="2">Q_{HI}-1: Creation of a path of air flowing into pedestrian areas inside V.S., etc., to mitigate hot environment</td><td colspan="2">[1] Understand wind characteristics in the surroundings of V.S. and make suitable plans about the building layout and configuration to create a path of air flowing into pedestrian areas inside D.S., etc.</td></tr>
<tr><td colspan="2">[2] Secure the downwind flow of air by disposing of empty spaces such as passages and greenery (e.g., lawn, grass and shrubs) in a suitable way.</td></tr>
<tr><td rowspan="3">LR_{HI}-1: Consideration to allow the flow of air into downwind areas to reduce the thermal impact on the outside of V.S.</td><td colspan="2">[1] In planning the building layout/configuration, do not block the downwind flow of air.</td></tr>
<tr><td colspan="2">[2] Decrease the building area exposed in the prevailing wind direction in summer.</td></tr>
<tr><td colspan="2">[3] Determine a suitable building height, configuration and distance from other buildings to let air resume flowing downwind.</td></tr>
<tr><td>2. Shade</td><td>Q_{HI}-2: Formation of the shade in summer to mitigate hot environment in pedestrian areas inside V.S., etc.</td><td colspan="2">[1] Plant middle/high trees or construct pilotis, eaves or pergolas, to allow more areas to be in shade.</td></tr>
<tr><td rowspan="4">3. Ground surface coverage around the building (inside V.S.), etc.</td><td rowspan="2">Q_{HI}-3: Securing of green or water surface areas, etc., inside V.S. to mitigate hot environment in pedestrian areas inside V.S., etc.</td><td colspan="2">[1] Secure green or water surface areas to prevent increase in temperature (e.g., the ground surface or the near ground surface temperature).</td></tr>
<tr><td colspan="2">[2] Keep the paved area inside V.S. as small as possible.
Especially in the areas under strong influence of direct sunlight (e.g., south or west to the building), avoid the construction of large paved areas such as a parking lot.</td></tr>
<tr><td rowspan="2">LR_{HI}-3: Selection of suitable materials for ground surface coverage to reduce the thermal impact on the outside of V.S.</td><td rowspan="2">[1] Select suitable materials for ground surface coverage.</td><td>A. Secure green or water surface areas, or select coverage materials with high water retention.</td></tr>
<tr><td>B. Select coverage materials with high solar reflectance.</td></tr>
<tr><td rowspan="5">4. Exterior materials</td><td rowspan="2">Q_{HI}-4: Selection of suitable exterior materials, etc., to mitigate hot environment in pedestrian areas inside V.S., etc.</td><td colspan="2">[1] Provide as much greenery as possible on the rooftop (where people are allowed to enter).</td></tr>
<tr><td colspan="2">[2] Select suitable materials for exterior walls.
Especially in areas under strong influence of direct sunlight (e.g., the southern or eastern wall of the building), take suitable measures such as arranging as much greenery as possible.</td></tr>
<tr><td rowspan="3">LR_{HI}-4: Selection of suitable exterior materials, etc., to reduce the thermal impact on the outside of V.S.</td><td rowspan="2">[1] Select high reflective materials and arrange as much greenery as possible on the rooftop, etc.</td><td>A. Provide as much greenery as possible on the rooftop, etc.</td></tr>
<tr><td>B. Select high reflective roof materials.</td></tr>
<tr><td colspan="2">[2] Select suitable materials for exterior walls.</td></tr>
</table>

Major Item	Middle Item	Minor Item
5. Release of exhaust heat from the building services	Q_{HI}-5: Determination of a suitable position for releasing exhaust heat from the building services, etc., to mitigate the hot environment in pedestrian areas inside V.S., etc.	[1] Release the exhaust heat produced by air-conditioners in operation from a higher position of the building.
		[2] Release the high-temperature exhaust heat produced by combustion facilities in operation from a higher position of the building.
	LR_{HI}-5: Reduction of exhaust heat released from the building services into air	[1] Prevent thermal loss via windows or exterior walls of the building and take measures for efficient use of energy necessary for air-conditioners, etc., to reduce exhaust heat released into air. Reduction of building thermal loads: Reduce exhaust heat released from air-conditioners (for cooling) in operation, by blocking direct sunlight (e.g., with middle/high trees, eaves or louvers) or providing better thermal insulation. Building service system with higher efficiency: Introduce energy-saving air-conditioners, lighting equipment, ventilators and elevators. Use of natural energy (utilization of natural energy potential in the surroundings of the building): Reduce the exhaust heat emission by utilizing natural ventilation. Reduce the exhaust heat emission by utilizing daylight. Use of unused energy (utilization of urban exhaust heat emissions in the surroundings of the building): Reduce the exhaust heat emission by utilizing exhaust heat released from garbage incinerators. Reduce the exhaust heat emissions by utilizing the remaining heat available at sewage treatment plants. Utilize seawater, river water, groundwater, etc. Introduce high-efficiency infrastructures. Utilize district heating/cooling systems (the exhaust heat released from a district heating/cooling plant in the process of cooling a building of interest is included in the estimation of exhaust heat released from the building).
		[2] Prevent increase in air temperature by lowering the temperature of exhaust heat released from the building services, etc.
		[3] Shift the peak time for exhaust heat release. Although there is a thermal storage system, etc., this item is subject only to the daytime assessment (not applicable to the all-day assessment).

The Middle Items are determined in accordance with the Major Items and regarded as the fundamental principles that should be taken into consideration at the architectural planning stage. These are separately assessed from the viewpoints of Q_{HI} (i.e., mitigating effects on the hot environment in the outdoor areas inside V.S. such as pedestrian areas) and LR_{HI} (i.e., reduction of heat island loads on the outside of V.S.). The Minor Items offer important initiatives to be considered at the architectural planning stage in order to achieve the goals given by the Middle Items.

5) Assessment results

The summary of assessment results is given in the “Score Sheet” and the “Assessment Result Sheet.”

Based on the scoring results of assessment items, the score of each Middle Item is calculated and then multiplied by a weighting coefficient specified by the respective category according to location and legal floor area ratio. The Q_{HI} and LR_{HI} scores are then calculated.

In the “Assessment Result Sheet,” the results are presented by radar charts, bar charts and numerical values according to the assessment item of either Q_{HI} (mitigating effects on hot environment inside V.S.) or LR_{HI} (reduction of heat island loads on the outside of V.S.). The result of BEE_{HI} score is shown by a numerical value and a graph. These help to comprehensively understand the characteristics of a building of interest and also examine them from multilateral perspectives.

The BEE_{HI} score is defined as Q_{HI}/L_{HI} and calculated using the following equation where SQ_{HI} represents the Q_{HI} score (score of Q category for heat island reduction) and SLR_{HI} represents the LR_{HI} score (score of LR category for heat island reduction).

$$BEE_{H} = \frac{Q_{HI}\text{: Mitigating effect on hot environment}}{L_{HI}\text{: Heat island load}} = \frac{25\times(SQ_{H}-1)}{25\times(5-SLR_{HI})} \quad (1)$$

Based on the coordinates of BEE_{HI} score determined when plotting it with Q_{HI} on the Y axis and L_{HI} on the X axis, the BEE_{HI} ranking (i.e., building ranking regarding the mitigation of heat island effects) is expressed as one of the five levels ranging from the highest S rank down to the lowest C rank.

6) Assessment Results

CASBEE HI — **Assessment result**

■Assessment Manual CASBEE-HI(2010 edition) ■Software CASBEE-HI_2010(v1.0)

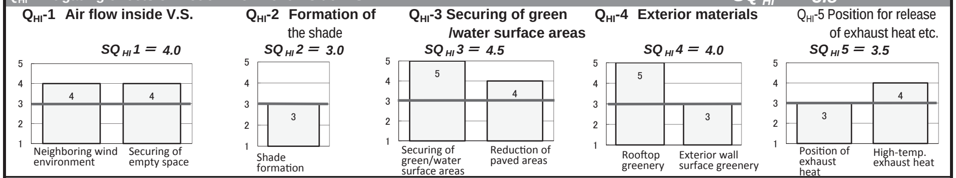
Assessment date	2014/2/8	Assessed by	○○○	Verification	2014/2/20	Verified by	○○○

(1) Building Outline

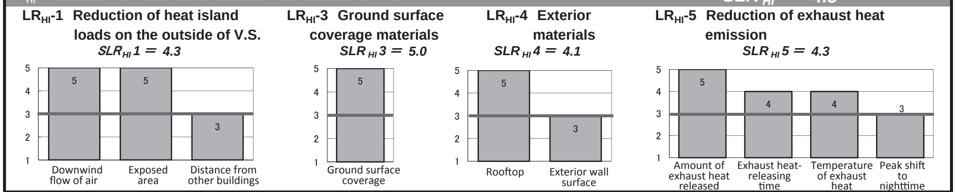
Building Name	XX Building	Site Area	10,000 m^2	
Building Type	Office	Construction Area	2,700 m^2	
Location	Kagoshima city	Building-to-Land Ratio	27.0 %	*Appearance, views, etc.*
Climate Zone	Area Category V	Total Floor Area	2,900 m^2	When you paste a picture,
Area / Zone		Floor Area Ratio	29.0 %	please cancel the Protect Sheet.
Completion	2014/6/1 Scheduled	Number of Floors	2	
Floor Area Ratio lir	200 %	Structure		
Classified Location	[1] urban areas with fewer empty spaces	Average Occupancy	0 persons	
		Annual Occupancy	0 hrs/yr	

(2)-1 Assessment results of Medium-level categories (bar chart)

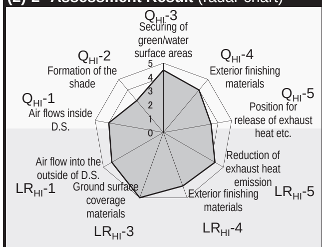
Q_{HI} Mitigating effects on hot environment inside V.S. SQ_{HI} = 3.8



LR_{HI} Reduction of heat island loads on the outside of V.S. SLR_{HI} = 4.5 注1



(2)-2 Assessment Result (radar chart)



(2)-3 Built Environement Efficiency BEE_{HI}

$$BEE_{HI} = \frac{Q_{HI}\text{: Mitigating effect on hot environment inside V.S.}}{L_{HI}\text{: Heat island load on the outside of V.S.}}$$

$$= \frac{25 \times (SQ_{HI} - 1)}{25 \times (5 - SLR_{HI})}$$

$$= \frac{70.7}{11.5} = 6.1$$

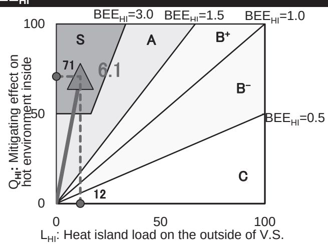


Figure 3.3.9: An example of CASBEE-HI Assessment Result Sheet (excerpt)

3. CASBEE Family of Tools

7) Example of CASBEE-HI evaluation

Assessment Result Rank S (BEE_{HI}: 6.1)

Building outline
Type of building use: Office
Site address: Kagoshima City
Site area; 10,162m2
Total floor area; 2,993m2
Number of floor levels: +2 F
Completion: May 2008
Legal floor area ratio; 200%
Floor area ratio; 29%
Prevailing wind direction; North West
Open space ratio; 73%
Ratio of Ground cover by plats; 39%

Assessment Outline

(1) Surrounding environment and air flow; Situated near the Kotsuki River, the building has placed and shaped to introduce river wind into the site. It uses natural energy as natural air flow comes into the entrance.
(2) Sun shade; The site has relatively small shaded space as it gacilitates a large meeting space for events. However many tall trees are planted surrounding the site to provide shadings.
(3) Green cover; open spaces are almost covered by plants except car passage.
(4) Exterior materials ; it creates “green earth” by covering almost all roof top by plants for public use.

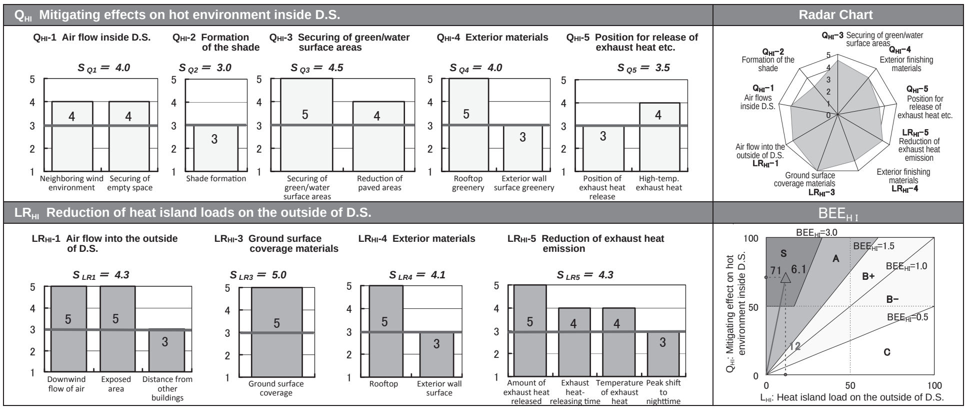


Figure 3.3.10: An example of CASBEE-HI evaluation

3.4 CASBEE for Market Promotion (CASBEE-MP)

3.4.1. CASBEE for Market Promotion assessment tool

3.4.1.1. Creation of a good circle in the real estate market for popularization of green buildings

A vicious circle of blame games among stakeholders has been pointed out as one of the biggest drawbacks to popularizing green buildings. In order to convert such a "vicious" circle into a "good" one, it is essential to conduct appropriate assessment regarding the environmental performance of buildings, "visualize" the added property value and the mechanism of such value improvement brought by a Design for Environment (DfE), and have a shared understanding of the value among the parties involved.

CASBEE-MP was thus developed as a tool to establish a shared information system in the real estate market.

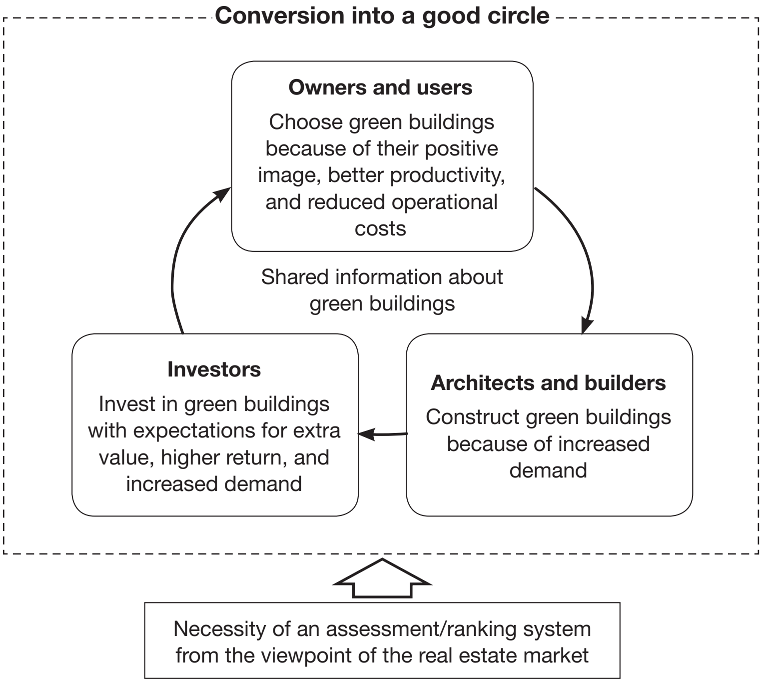


Figure 3.4.1: Creation of a good circle

3.4.1.2. Position of CASBEE-MP in the CASBEE family

In the CASBEE family, various tools are available for many building types and purposes. CASBEE-MP is classified as CASBEE for Buildings and is a very brief version of existing building assessments for the property market.

3.4.1.3. Background

1) Background of CASBEE-MP development

(1) The CASBEE family had been especially made as a DfE (Design for Environment) com-

munication tool, and was not widely used for the promotion of green properties in the property market.

(2) We sometimes received inquiries about the evaluation compatibility between CASBEE and other tools such as LEED, when overseas investors and foreign tenants examined Japanese properties. It was desirable to make CASBEE evaluation compatible with other tools such as LEED and BREEAM based on common assessment items.

(3) UNEP SBCI or the United Nations Environment Program – Sustainable Buildings and Climate Initiative proposed global common metrics such as energy use, GHG emissions, water use, recycled waste, indoor environment, biodiversity and economics.

(4) In UNEP FI PWG (United Nations Environment Programme – Finance Initiative Property Working Group), there is a movement to request every party making building environmental assessment tools develop a rating tool that is simple and compatible but not expensive.

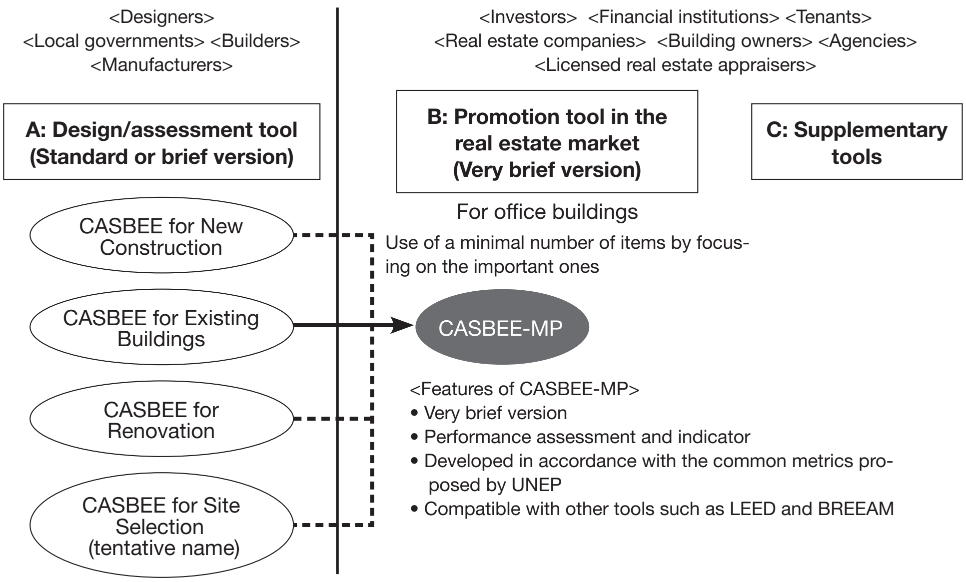


Figure 3.4.2: Background of CASBEE-MP development

2) Features of CASBEE-MP

On the basis of the above, CASBEE-MP is characterized by:

a. The coverage of the common metrics proposed by UNEP SBCI
b. The compatibility of assessment items between CASBEE and other rating systems such as LEED
c. The minimized number of assessment items
d. The established linkage to property appraisal
e. The effective utilization of frameworks of the existing laws and standards (e.g., building health standards, housing performance indication systems and recycling laws)
f. The mechanism that can be widely used by property market players
g. Not necessarily requiring a full version of the CASBEE assessment

h. The primary target being existing office buildings (It is expected to later also include retailers and other building types for assessment)

3.4.1.4. Conceptual image of CASBEE-MP

The conceptual image of CASBEE-MP is as follows:
- The common metrics proposed by UNEP SBCI being covered;
- The assessment items important for property appraisal being selected from approximately 110 items of the current CASBEE family; and
- The super simplified tool that can be used in the property market.

Also, the other rating systems in the world (e.g., BREEAM, LEED, and Green Star) should also cover the common metrics.

Ideally, all the rating systems should share the common metrics in the future as illustrated in the figure below and also include the assessment items that are particular to each country, such as earthquake resistance in Japan. Every system can be connected with property appraisal. Furthermore, the rating systems for DfE and for investors can coexist, as planners and contractors need elaborate systems while investors need simpler systems.

- Creating simple, comparable, compatible system
- Covering common metrics
- Connecting to property appraisal

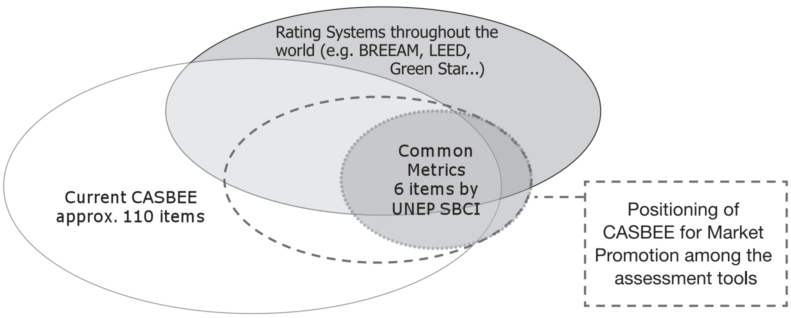


Figure 3.4.3: Image of CASBEE for Market Promotion

3.4.1.5. Outline of sustainable building index (UNEP SBCI)

In 2009, the Common Carbon Metric (CCM) was launched at COP15, because, without a global consensus, confusion brought about in the market and the efforts to fully implement sustainable building practices were undermined. The UNEP Sustainable Building Index provides a globally consistent framework to understand, measure, report, and verify the actual building performance regarding core sustainability issues. The Index is not intended to be a rating system, but rather intended to steer building industry stakeholders towards focusing on the primary issues that have been agreed upon by the leaders and decision-makers of this sector.

The Index shall focus on measurable, reportable and verifiable indicators, be applicable to existing residential and non-residential buildings and facilitate both top-down and bottom-up aggregation of the performance of building stock. The Index shall include the aspects of buildings' impact and benefits with regard to:

- Energy/Greenhouse Gas Emissions
- Water
- Materials
- Social Issues (Indoor environment quality)
- Biodiversity and Land Use
- Economics

3.4.1.6. Assessment items of CASBEE-MP

This CASBEE-MP tool has two aspects: 1) the evaluation of environmental performance and 2) the disclosure of environmental performance value (Index).

Clear indication of environmental performance value is required in the property market and it is important to disseminate such ideas. The tool partially refers to the CASBEE criteria, and furthermore aims to refer to the global common standard or index that will be commonly used by many building environment assessment tools.

Table 3.4.1 shows the assessment items of CASBEE-MP.
The five items (namely Energy/GHG, Water, Materials/Safety, Biodiversity/Site, and Indoor Environment) compose the main assessment categories of the tool, thus including the five components of the Sustainable Building Index. Each of the five categories contains a prerequisite item. “Soil Environmental Quality/Regeneration of Brown Fields,” “Public Transportation Access,” and “Measures regarding Natural Disasters” contribute to Biodiversity/Site, as these assessment items are related to the site quality.

3.4.1.7. Case study

With regard to approximately 30 office buildings assessed by CASBEE tools over the past few years, the correlation between the CASBEE-MP assessment points and the comprehensive environment efficiency (i.e., BEE value) obtained by the current edition of CASBEE-NC or -EB is shown in Figure 3.4.4. As the BEE values given by the CASBEE tools increase, the points by CASBEE-MP also increase, thus indicating there is a correlation between these two variables. The CASBEE-MP assessment points of 60, 66 and 78 correspond to the BEE value-based ranks of B+, A and S, respectively.

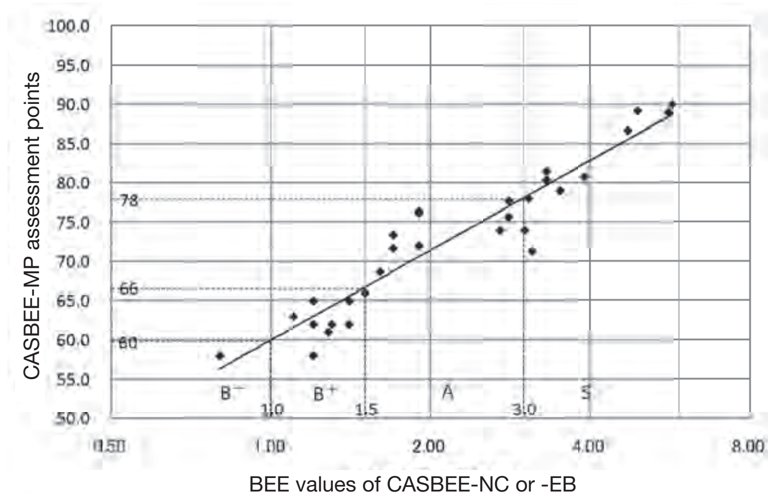


Figure 3.4.4: Relationship between the CASBEE-MP assessment points and the BEE values of CASBEE-NC or -EB

Table 3.4.1: Items of CASBEE for Market Promotion (Office version)

Group	Items		Unit of Measurement	Method of Measuring and Assessment	points
Energy consumption/ GHG emissions	Prereq	Target setting and Monitoring		meets the requirements of Energy conservation Law Standard of present CASBEE	prereq
	1	Energy Intensity/Carbon Intensity (calculated)	MJ/m^2/year kWh/m^2/year $kg\text{-}CO_2/m^2$/ year	New item (evaluated by new simulation tool, BEST(*1) et al.)	15 - 25
	2	Energy Intensity/Carbon Intensity (measured)	MJ/m^2/year kWh/m^2/year $kg\text{-}CO_2/m^2$/year	New item (total energy consumption data evaluated by positioning on DECC(*2) data et al.)	1 - 5
	3	Renewable energy	%	New item	1 - 5
Water	Prereq	Target setting and Monitoring		New item	prereq
	1	Water Intensity (calculated)	m^3/m^2/year	New item	1 - 5
	2	Water Intensity (measured)	m^3/m^2/year	New item	1 - 5
Material/ Safety	Prereq	Earthquake-resistance		Standard for earthquake resistant after 1981 or Seisimic Index of Structure (Is) >0.6 or other Index	prereq
	1	Exceeds of earthquake-resistance Seismic Isolation & Vibration Damping Systems		Standard of present CASBEE	1 - 5
	2	Recycled Materials Use (number of items of structural and non-structural recycled materials use for the present)		Standard of present CASBEE	1 - 5
	3	Service Life of Structure material	year	Standard of present CASBEE	1 - 5
	4	Ease of MEP Renewal/ Increace Self-sufficiency Rate of Power		Standard of present CASBEE New item	1 - 5
Biodiversity /Site	Prereq	Avoiding from immigrant Fauna & Flora (specified, not specified, careful)		New item	prereq
	1	Preservation & Creation of Biodiversity (Conservation, restoration, management of Ecological Resources, Quantity & Quality of Greening for the present)	%	Standard of present CASBEE	1 - 5
	2	Soil Environmental Quality/ Regeneration of Brown Field	Y/N	New item (Standard draft of CASBEE for Sustainable Site)	1 - 5
	3	Public transportation access		New item (Standard draft of CASBEE for Sustainable Site)	1 - 5
	4	Measures to Risk of Natural Disaster		New item (Standard draft of CASBEE for Sustainable Site: flood, subsidence, tsunami, landslide et. Al)	1 - 5
Indoor Environment	Prereq	Indoor Environment Standard of buildings, offices, and Division of smoking and nosmoking areas		Confirmation of measurement document is available	prereq
	1	Daylighting		Standard of present CASBEE	1 - 5
	2	Natural Ventilation Performance		Standard of present CASBEE	1 - 5
	3	Perceived Spaciousness & Access to View		Standard of present CASBEE	1 - 5
				maximum	100 points

(shaded) Items of Sustainable Building Index proposed by UNEP-SBCI (draft)

*1 BEST: Building Energy Simulation Tool

*2 DECC: Detabase for Eenergy Consumption of Commercial buildings

References

Japan Sustainable Building Consortium: CASBEE for New Construction (2010 Edition)

Japan Sustainable Building Consortium: CASBEE for Existing Buildings (2010 Edition)

Japan Sustainable Building Consortium: CASBEE Property Appraisal Manual (2009 Edition)

UNEP SBCI: Sustainable Buildings & Climate Initiative, Draft Briefing on the Sustainable Building Index, May 2010

UNEP FI PWG: Responsible Property Investing: Metrics for Performance Measurement, Second in a Series of Toolkits on Responsible Property Investing

UNEP FI PWG: An Investors' Perspective on Environmental Metrics for Property, May 2011

3.4.2. Basic concept for property appraisal and CASBEE assessment

3.4.2.1. Reasons why the economic effects of green buildings were not analyzed in Japan

Unlike the building certification by LEED in the U.S. and Green Star, the economic effects of green buildings and the effects of additional value have rarely been analyzed despite the increasing popularity of CASBEE tools, including those designed for use by local governments. The possible reasons for this are as follows:

In 2001 when the R&D project for CASBEE tools started, the first property investment company or Japanese Real Estate Investment Trust (J-REIT) was listed on the stock market in Japan. Following the listing, property securitization-related transactions became active in the property market until around 2007 in the "fund boom." Properties for investment traded in the market were subjected to due diligence to check overt risks for investors such as legality, structural safety, and environmental risks (asbestos, PCB, etc.) of buildings as well as risks such as soil contamination and earthquakes. Any insufficiencies in averting overt risks were deemed as "devaluing factors."

Meanwhile, environmental load factors such as CO_2 emissions and waste generated during construction, operation and demolition of buildings, and loss of biodiversity as a result of development were not considered as the above-mentioned "overt risks." Property investment companies and private investors settled their accounts every six months or shorter, and placed the emphasis on the improvement of short-term performance and considered that environmental load risks, against which there were no statutory regulations, were only potential factors with low priority.

3.4.2.2. Beginning of consideration of environmental added value and the theory behind it

Against the above-mentioned backdrop, the special collection of academic reports in commemoration of the 10th anniversary of the Tokyo Association of Real Estate Appraisers, released in October 2005, carried an article titled "A note on environmental value added for real estate" (Masato Ito) (Reference). The article attempted to theoretically explain how extra value could be added by reducing "environmental risks," improving the image of assets, and improving cash flow through energy conservation, etc., none of which were considered important for property investment in those days. The article can be summarized as follows:

The value of a property, like other assets, is determined by three factors: "Expense characteristics" (how much cost is claimed for it), "Marketability" (how it is priced in the market) and "Profitability" (how much profit is expected from it).

With regard to the "Expense characteristics," sellers have a solid reason for considering this factor. If they have paid reasonable additional cost for properties with high environmental performance, they naturally want to add the cost to the sales prices. However, in the market, these properties cannot necessarily be traded at prices with such an additional factor in mind. Concerning the "Profitability," properties may be accepted by a reasonable market as long as they can generate profits in terms of investment. For this reason, the "Profitability" is important for green properties.

The property value that reflects the "Profitability" or the "value indicated by the income approach" can be calculated by dividing the "net income produced by the property" (deducting costs such as maintenance, taxes and insurance from the total revenues produced by the property including the rent) by the "capitalization rate of the property" (a percentage of the net income to the amount of investment in the property). Formula-1 defines the value indicated by the income approach (in the case of the direct capitalization method).

$$\text{Value indicated by the income approach} = \frac{\text{Net income produced by the property}}{\text{Capitalization rate of the property}} \quad \text{<Formula-1>}$$

According to the above formula, if a property can produce a higher net income, the value of the property becomes higher. It also suggests that the more stable the net income is (i.e. the risk of change in the net income being low) the lower the capitalization rate becomes for the property investment, leading to higher property value.

Thus, an increased "net income" can lead to an increased property value. The reduction in the "capitalization rate" in the denominator can also lead to an increase in the property value. The more stable the net income is, the lower the capitalization rate can become for investors.

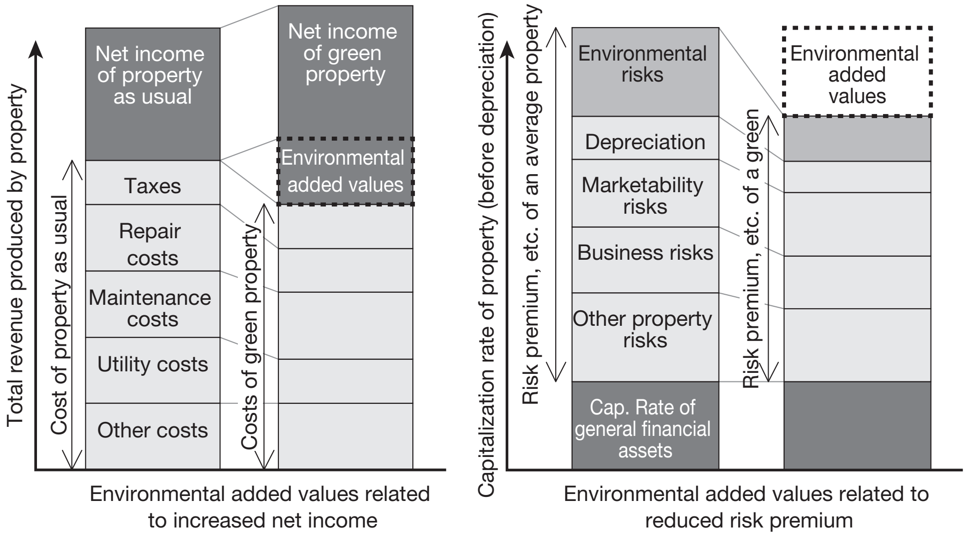


Figure 3.4.5: Illustration of added values represented by net income and capitalization rate (partial revision of reference 3)

As shown in the left-hand graph of Figure 3.4.5, reduction in utilities and repair costs as a result of improved energy savings and durability can lead to increased net income, and increased income as a result of improved productivity can also lead to increased net income.

For the capitalization rate, as shown in the right-hand graph of Figure 3.4.5, risk premiums peculiar to the property and depreciation rate are added to the capitalization rate of general financial assets (long-term government bonds, etc.). For green properties, future environment-related taxes and reduction in the risks related to environmental regulations as well as reduction in the depreciation rate as a result of improved service life can lead to reduction in the capitalization rate (the rate before depreciation). Furthermore, green properties may also produce the effect of improved image and reduce their marketability risks.

3.4.2.3. Expansion of environmental added value theory

The above-mentioned environmental added value theory was later discussed by the Survey and Research Committee of the Japanese Association of Real Estate Appraisal and, in fiscal 2007, the committee launched the “Working Group on Environmental Added Value (chaired by Masato Ito).” The activities of the group include research on the model cases of environmental added values realized in Japan, and review of environmental regulation risks and environmental performance assessment systems associated with CASBEE tools. The group also performs, on a trial basis, environmental added value assessment based on the model cases. The results of these activities are reported in the “Value of Property with Consideration for the Environment Is Sure to Increase – Theory and Implementation of ‘Environmental Added Value’ of Property” (June 2009) (Reference 2).

To associate CASBEE tools with real estate appraisal, CASBEE (PA) WG was launched in June 2008 and initiated joint discussions with the Japanese Association of Real Estate Appraisal. The studies conducted by the group were taken over by the Working Group for CASBEE and Property Appraisal, which developed the manual.

3.4.2.4. Similarities between CASBEE and property appraisal

This section describes the property pricing theory based on which CASBEE can be used for property appraisal and also addresses the related concepts.

As shown in Figure 3.4.6, the value that reflects the “profitability” of a property, or to put it differently, the “value indicated by the income approach,” can be calculated by dividing the “net income produced by the property (the income after deducting the costs such as maintenance, taxes and insurance from the total income produced by the property including the rent)” by the “capitalization rate of the property (a percentage of the net income to the amount invested in the property).” Formula 2 shows the calculation formula of the value indicated by the income approach (for the direct capitalization method).

$$\text{Value indicated by the income approach} = \frac{\text{Net income produced by the property}}{\text{Capitalization Rate}} \qquad \text{<Formula-2>}$$

The above formula and the “built environment efficiency (BEE)” formula used in CASBEE tools are very similar (Figure 3.4.6).

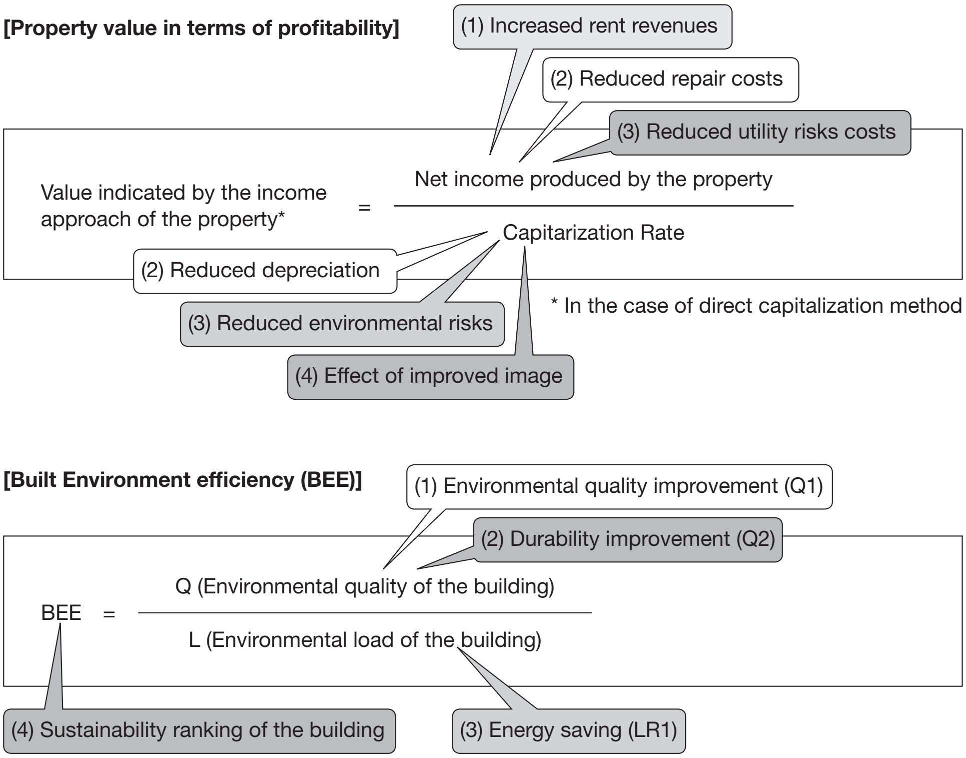


Figure 3.4.6: Conceptual images of value indicated by the income approach formula (for direct capitalization method) and CASBEE environment efficiency formula (Revision of Reference 3)

For example, improved environmental quality can lead to increased rent ((1) in the above figure) while improved durability can lead to reduced repair costs and reduced depreciation ((2) in the above figure) and energy savings can lead to reduced utility costs and reduced environmental risks ((3) in the above figure). In addition, the sustainability ranking of the building can eventually be reflected in the effect of the improved image ((4) in the above figure).

The CASBEE formula does not represent the monetary value itself, but it represents the similarity of the value indicated by the income approach formula in which the property value increases as the cash flow amount increases or risk premiums decrease.

Table 3.4.2 shows the relevance between CASBEE assessment items and property appraisal items. Indoor environment items are mainly related to the increase in the total revenues while Q2 “Quality of Service” items are mainly related to the reduction in costs and the future reduction in environmental risks. Energy items that currently attract the most attention are related to the reduction in costs and the future reduction in environmental risks. Outdoor Environment on Site items and CASBEE ranking (BEE) contribute to the improved image. It cannot be reflected in the present pricing but has potential for future pricing.

Table 3.4.2: Relevance between CASBEE assessment items and property appraisal items

CASBEE assessment items	Property appraisal items			
	Increased total revenue	Reduced costs	Reduced risks	Improved image
Q1-1 Noise & Acoustics	○			
Q1-2 Thermal Comfort	○	○		
Q1-3 Lighting & Illumination	○			
Q1-4 Air Quality	○			
Q2-1 Service Ability		○	○	
Q2-2 Durability &Reliability		○	○	
Q2-3 Flexibility & Adaptability		○	○	
Q3 Outdoor Environment on Site				○
L1 Energy		○	○	
L2 Resource & Material			○	
L3 Off-site Environment			○	
CASBEE Ranking				○

3.4.2.5. How to determine pricing factors from CASBEE assessment items

Table 3.4.3 summarizes the contents of Table 3.4.2 from the property appraisal point of view. Figure 3.4.7 shows how detailed items for CASBEE assessment can be translated into pricing factors and how they can be reflected in the property value from the property appraisal perspective. The latest results of such ongoing analysis are given below.

Table 3.4.3: Viewpoint of CASBEE assessment items and property appraisal items

CASBEE assessment items	Viewpoint of property appraisal
Q1	Many of the items could lead to increased total revenue
Q2	Many of the items could lead to both reduced costs and reduced risks
L	The items are mainly related to reduced risks
L1	The items could lead to reduced cost
Q3 BEE Ranking	The items could produce the effect of improved image as a result of increased market recognition and could contribute to reduced property investment risks

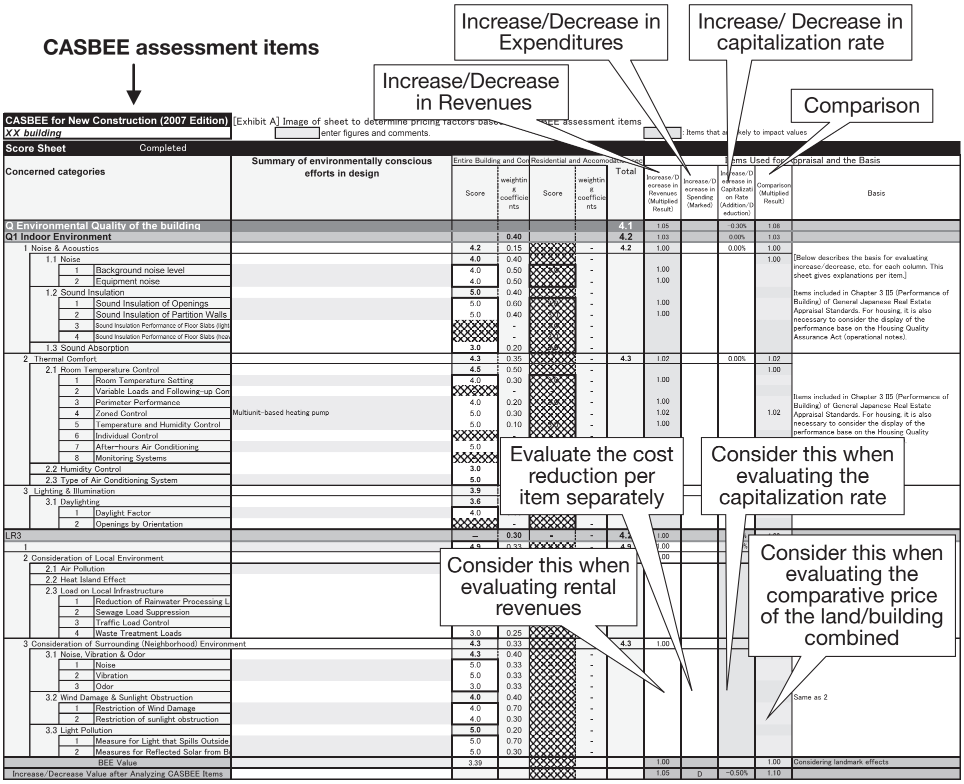


Figure 3.4.7: Image sheet to determine pricing factors based on CASBEE assessment items

References

[1] "A note on environmental value added for real estate" (Masato Ito), Thesis report commemorating the 10th anniversary of the Tokyo Association of Real Estate Appraisers
http: //www.tokyo-kanteishi.or.jp/sonota/rep10th.html

[2] "Value of property with consideration for environment is sure to increase – theory and implementation of 'environmental added value' of property" (Survey and Research Committee of Japanese Association of Real Estate Appraisal), Jutaku-shimpo-sha

[3] "Supplementary documents for the 8th CASBEE Open Seminar" by Ito and others, July 24th, 2008, IBEC

<Column-4>

Sustainable assessment as a tool for translating sustainability features into value

Frank HOVORKA,
Head of sustainable real estate policy, Caisse des Dépôts
Co-chair, UNEP FI Property Working Group, France

Introduction

Different studies have highlighted the costs and benefits of sustainable buildings compared to conventional properties[1]. These studies have focused on the financial aspects of sustainable buildings as a whole. In addition, a recent but expanding academic research area investigates the premium reflected in the market prices and rents of certified buildings[2]. While providing a good business case for sustainable real estate as a whole, it is still unclear how each sustainability feature may impact value.

Translation

Energy, health and environment performance is not the simple result of the intrinsic quality of the building. The creation of green value depends on:

the performance of buildings (the responsibility of which lies with the owner, investor or developer);

the quality of operation (which largely depends on the facility manager);

the conditions of use (which depend on tenants).

The Built Environment Efficiency was a very important step for a comprehensive use of sustainable indicators. That was brought by Masato Ito to the Property Working Group of the UNEP-FI initiative. This helps to connect the sustainable assessment (as CASBEE) to the decision makers following the diagram right:

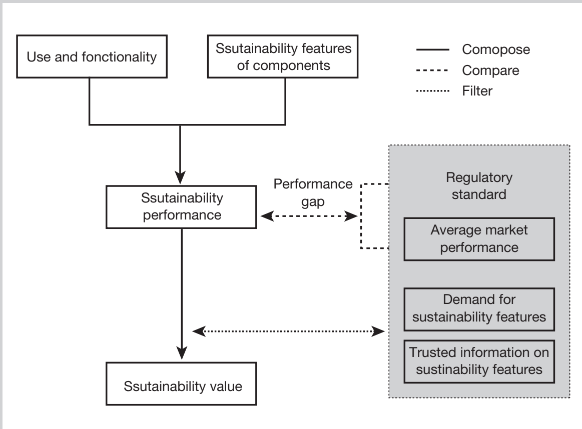


Figure C4.1: Sustainability performance and value

Labels can translate the complexity of physical indicators. As such, they could have a multiplier effect on the perceived value. To play such a role, labels should reflect effective performance for specified use conditions.

These impacts (or benefits) may thus be translated into worth and value for the investors. Four main situations may be distinguished:

1 Langdon (2003), Kats (2005), WGBC (2013)
2 Kok, McAllister, ….

- the impacts result in direct monetary gains for the building owner, or for the tenants who may thus accept to pay higher rents.
- the impacts also result in intangible gains for the building owner, such as reputation gains
- the impacts result in a reduction of the financial risks (higher exit yield link to lower obsolescence, for example) and a higher resiliency to shifts in the regulatory context (see UK transaction constraints on the buildings with poor EPCs)
- the impacts result in a worth creation in the long term, such as the indirect positive spinoffs on the neighborhood which could, over time, be translated into higher property prices in the neighborhood.

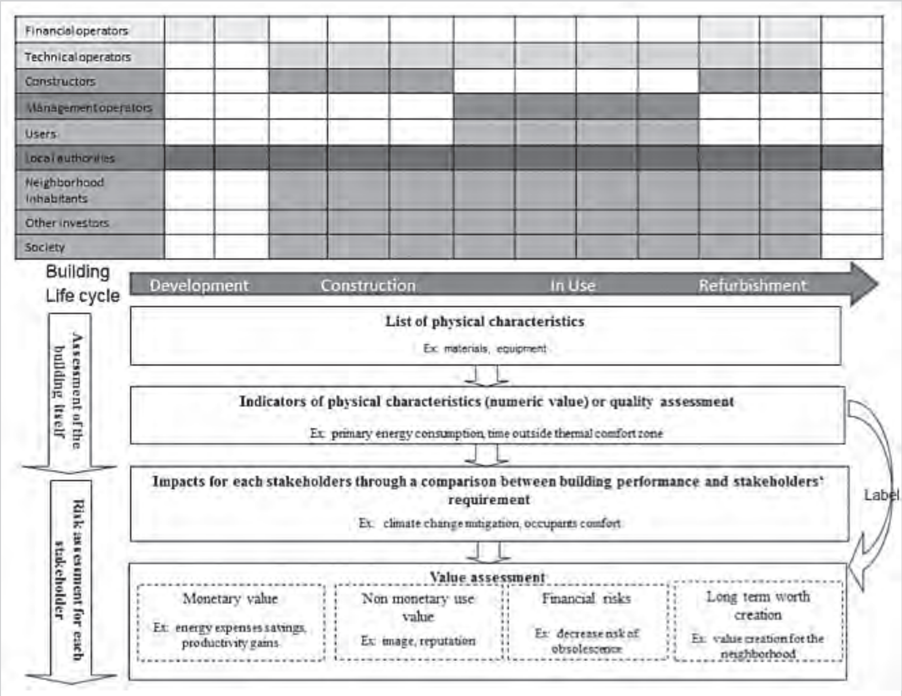


Figure C4.2: Translating sustainability features into value

Following that path, a sustainable assessment, such as CASBEE, can move from an image improvement and a benchmarking tool to a useful and valuable information process for investors, insurers, bankers, asset managers and valuers in order to integrate sustainable criteria into the daily work of each stakeholders. ■

<Column-5>

Linkage between environmental performance assessment and property appraisal

Thomas LÜTZKENDORF,
Professor, Karlsruhe Institute of Technology, Germany

David LORENZ,
Professor, Karlsruhe Institute of Technology, Germany

Increasing the demand and competitive position of sustainable buildings (i.e. buildings which are energy and resource efficient, health-friendly, comfortable, and which combine high technical and functional quality with an appealing architecture and urban design quality) requires, at least, the following: on the ohne hand, investors and other market participants need to realize and accept their responsibility towards society and the environment. In order to do this, market participants need to be vested/equipped with information and assessment results which highlight and evidence, amongst other issues, buildings' environmental quality and performance.

On the ohter hand, however, a true shift in market participants' behaviour and decision making processes requires the ability to translate buildings' environmental performance into economic advantages. In this context, property valuation plays a crucial role. See the following Figure C5.1:

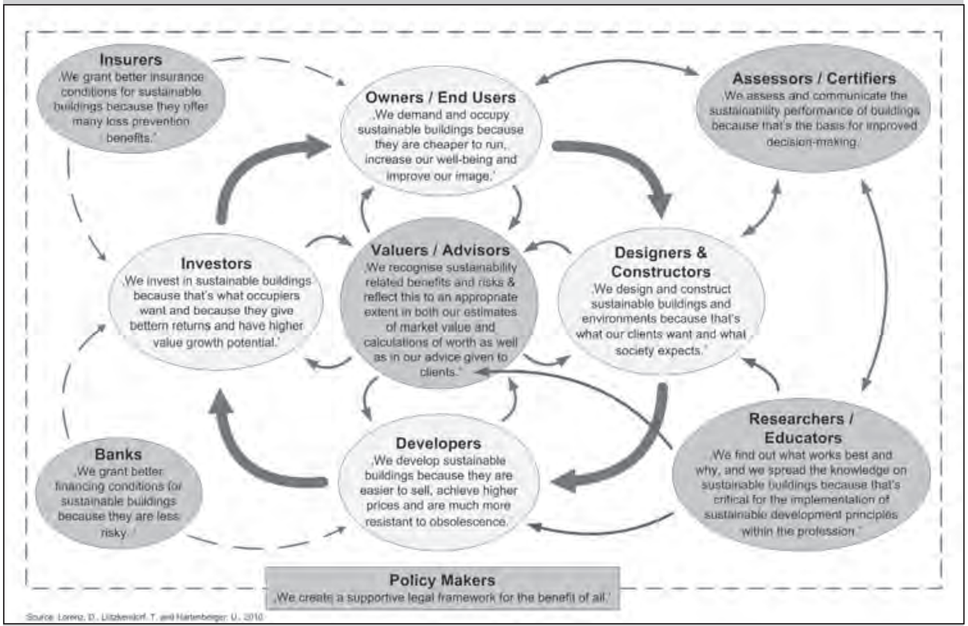


Figure C5.1: Towards sustainable property markets – loops of feedback and adaptation

Already at an early stage, the developers of CASBEE have realised, taken up and implemented such considerations as they have always proposed a close linkage between environmental performance assessment and property valuation/appraisal. As such, they supported and further advanced a worldwide trend which has, in the meantime, led to advances in valuation theory and practice.

Within the past years, real estate professionals have realized that property pricing is increasingly distinguishing between buildings that exhibit different sustainability-related building features and associated physical or operational performance. There is recognition that buildings that are not resource efficient, low carbon in terms of operation and location and are not equipped to be flexible to changing occupier needs will not be future-proofed in market value terms. And this, in return impacts on value stability and likely value development of all properties in the marketplace.

The valuation/appraisal profession has responded to this: for a considerable period of time, the profession has been undertaking efforts to better integrate sustainability considerations into the valuation/appraisal process. A notable example of this trend is the publication of *Valuation Information Paper 13, Sustainability and commercial property valuation* by the world's largest organization for property professionals, the Royal Institution of Chartered Surveyors (RICS).

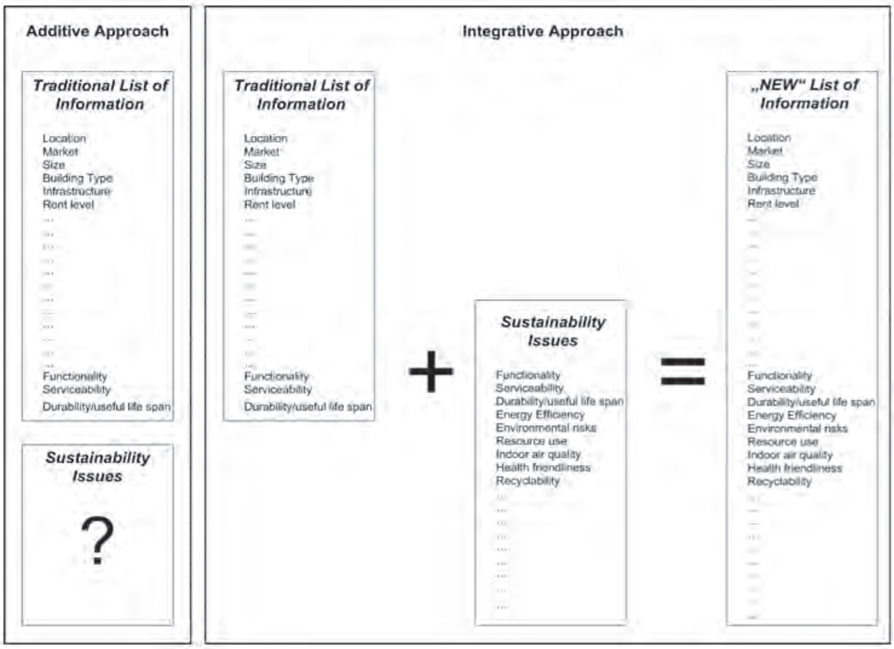


Figure C5.2: Towards an integrated structure of information for describing buildings for valuation purposes (Lützkendorf and Lorenz, 2011)

While basic valuation/appraisal methods remain unchanged, sustainability issues are increasingly embedded into the traditional "canon" of value-relevant factors (see Figure C5.2). For example, together with colleagues from Switzerland, Austria and Germany the authors have developed a guideline (in German only) on how to integrate sustainability issues into valuation practice (see: www.nuwel.ch). The guideline proposes and recommends the application of a "long-list" of information and data that integrates “traditional” and sustainability-related factors that impact on the economic value of buildings. The guideline is already being recommended for application by Swiss valuation organizations.

As a consequence, valuation/appraisal professionals have a constantly increasing demand for reliable information on the environmental quality of buildings. Possible sources for such information are the results of environmental performance/ sustainability assessment systems. Therefore, such systems can become an information source for third parties, particularly for valuation/appraisal professionals. However, new requirements emerge from this for the developers of assessment and certification systems because valuation/appraisal professionals are usually not (or not only) interested in the highly aggregated overall assessment result. This is because from a valuation perspective, actual performance and key building attributes/ characteristics matter. Consequently, the usability of sustainability assessment results as an information source for valuation/appraisal professionals depends upon the disaggregation of the assessment results including the provision of the basic information/data inputs. Developers of environmental performance/sustainability assessment systems may wish to react accordingly.

From the authors’ point of view, the aforementioned issue represents an excellent opportunity for increasing the collaboration between two formerly distinct disciplines (i.e., sustainability assessment of buildings and property valuation/ appraisal). It appears that these disciplines rely heavily on each other.■

Source:

Lützkendorf, T. and Lorenz, D. (2011), Capturing sustainability-related information for property valuation, Building Research & Information, Vol. 39, No. 3, pp. 256–273

3.5 CASBEE for Urban Development (CASBEE-UD)

3.5.1. CASBEE for Urban Development (CASBEE-UD)

3.5.1.1. What Is CASBEE-UD?

CASBEE-UD can be used to evaluate urban development projects on the ground where there are several architectural constructions and other areas for various purposes such as roads, public squares and green spaces. In CASBEE-UD, the environmental performance of such constructions and areas is examined collectively.

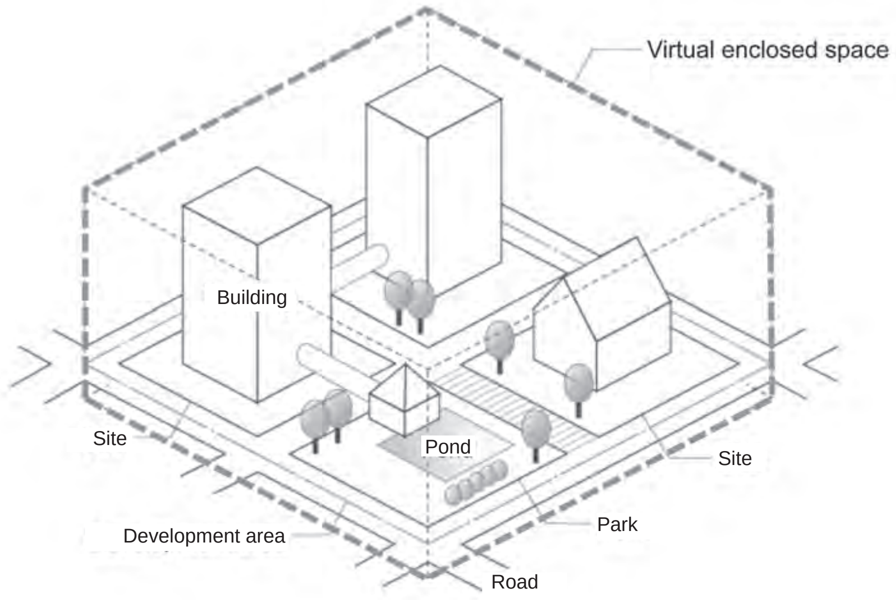


Figure 3.5.1: Assessment subjects for CASBEE for Urban Development

3.5.1.2. Circumstances behind the development of the tool and its revision

The Japanese Act on Special Measures Concerning Urban Renaissance came into effect in 2002, because of which a large-scale and high-density development project in metropolitan areas can be allowed if the reasoning is sound enough to justify the project (e.g., sufficient contribution towards society can be made or appropriate environmental measures have been taken). Accordingly, the need for usable assessment/rating methods regarding the environmental performance of urban development projects has emerged. In addition, in 2005, the Kyoto Protocol came into effect and new measures for a lower carbon society were expected to be initiated. Under such circumstances, the first version of CASBEE-UD was released in 2006, and the following year, the current version of CASBEE-UD, which can be used more widely and easily than the first version, was made available to the public. CASBEE-UD has thus served as a useful tool to developers and city/district planners.

Later, in 2011, the Great East Japan Earthquake struck our nation and since then the necessity for more advanced local safety performance and improved stability in the energy-related environment has been higher than ever. In 2012, the “Low Carbon City Promotion Act (Eco-City Act)” was established, resulting in an increased demand for assessment tools that can organically fit and work together with the Act. In response to such a trend, drastic revision of the CASBEE-UD tool is currently underway in cooperation with the Housing and City Bureaus of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT). The outline of the drastic revision plan is given below.

3.5.1.3. Assessment method

As in the case of many other CASBEE family tools, the assessment of CASBEE-UD is conducted from two perspectives: Q_{UD} (environmental quality inside the virtual enclosed space boundary) and L_{UD} (environmental load on the outside of the boundary). The comprehensive assessment result is expressed as the built environment efficiency of an urban area of interest (BEE_{UD}), which is obtained by Q_{UD}/L_{UD}. The subscript UD of Q_{UD}, L_{UD} and BEE_{UD} indicates that these are the results of CASBEE-UD assessment.

What to assess is described in detail in the later sections, and the key concept here is that the assessment of Q_{UD} is based on the triple-bottom-line approach and L_{UD} is evaluated according to how effectively low-carbon initiatives are carried out. The scoring criteria have been established in such a way that better results are assigned to the projects planned in accordance with the compact design of an urban structure, because it will be increasingly important to efficiently utilize the land and social capital in our country, which is now facing the situation of fewer children, an aging society and depopulation.

In the assessment, the boundary of an area concerned, which functions as the virtual enclosed space boundary, is determined based on the regulations and systems of relevant laws on construction and urban development (for example, regarding urban redevelopment projects, specific blocks and district planning) to which a project of interest is subject. As a natural consequence, any project for assessment is assumed to be executed under a certain defined policy for development. One or more districts can be addressed by the project. The scale of areas to be assessed conforms to that of the “urban development project for integrated city functions” provided in the Eco-City Act (Figure 3.5.2).

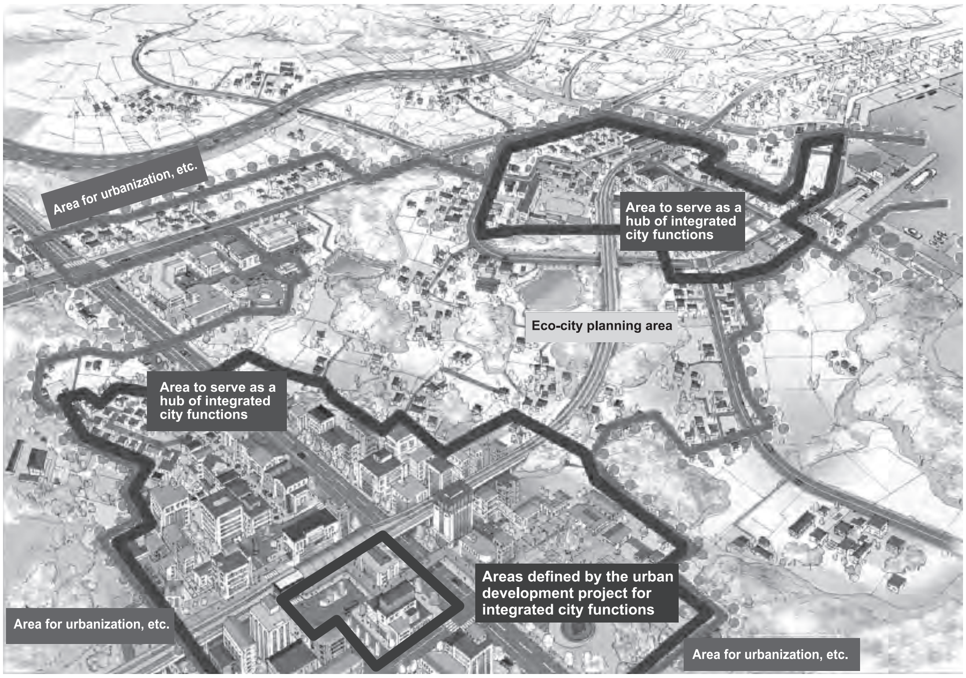


Figure 3.5.2: Illustration of the concept of areas defined by the Eco-City Act
(Source: "Example of areas defined by the urban development project for integrated city functions," available on the website of the Ministry of Land, Infrastructure, Transport and Tourism-modified by the author)

3.5.1.4. Assessment of Q_{UD} (Environmental Quality of an urban area of interest)

The environment, society and the economy, all of which are together defined as the triple bottom line, are designated as three Major Items in the assessment of Q_{UD} and each assessment item is assigned to one of these three groups. Each "Major Item" consists of several Middle Items, each of which consists of Minor Items. Table 3.5.1 gives the details of the assessment items. Regarding scoring, in accordance with the common method among the CASBEE family tools, each Minor Item is marked in a range of five levels and their scores are added up to calculate the total assessment results of Middle Items, Major Items, and Q_{UD}, respectively. Because the triple-bottom-line approach has become a norm when sustainability is discussed, it is used as the base for the Q_{UD} assessment. However, it should be remembered that "realization of a lower carbon footprint," which is a crucial issue in the field of the global environment, is addressed in the assessment of L_{UD}.

Table 3.5.1: Assessment items included in "Q_{UD}: Environmental quality and performance in urban development"

Major Item	Middle Item	Minor Item	Key assessment points, assessment method, etc.
1 Environment	1.1 Resources	1.1.1 Water resources	Use of rain water, introduced level for a gray water system, sewage treatment level, permeation of rain water through the ground, etc.
		1.1.2 Resource efficiency	Initiatives for re-use/utilization of waste, and use of locally-produced materials or recycling products
	1.2 Nature (greenery/biodiversity)	1.2.1 Greenery	Greenery on the ground, rooftop and wall surfaces
		1.2.2 Biodiversity	Initiatives for creation of patches and corridors, etc.,and conservation of natural resources, consideration of geographical characteristics
	1.3 Man-made objects (constructions, etc.)	1.3.1 Buildings designed for environment	Frequency of conduct of CASBEE assessment on building
2 Society	2.1 Fairness and legality	2.1.1 Legal obligations (compliance)	Compliance of the relevant laws on development, and the level of initiatives taken for voluntary conduct of prediction and monitoring
		2.1.2 Area management	Establishment of a management group by parties involved, and the validity of foundation for its sustainable operation such as finance
	2.2 Safety and security	2.2.1 Desaster prevention	Understanding of disaster hazard maps and precautions against them, and establishment of BCP or LCP on the area
		2.2.2 Traffic safety	Measures taken for road safety such as secured sidewalks
		2.2.3 Security	Measure taken for security of the area
	2.3 Amenities	2.3.1 Convenience/ Welfare	Distance from retailers, medical facilities, etc.
		2.3.2 Culture	Initiatives for creation of new cultural movement and preservation of historical/cultural heritage, creation of townscape or view, and harmony with the surrounding views
3 Economy	3.1 Transportation and urban structure	3.1.1 Transportation (flow of people and goods/products)	Maintenance condition of transportation facilities, rationalization of physical distribution logistics, joint deliveries, etc.
		3.1.2 Urban structure	Consistency with schemes such as master plans for urban development, handling of brownfield sites, etc.

Major Item	Middle Item	Minor Item	Key assessment points, assessment method, etc.
	3.2 Potential for growth	3.2.1 Population	Estimated increase/decrease in population compared with the previous level
		3.2.2 Economic growth	Level of initiatives taken for creating an active local economy
	3.3 Efficiency and rationality	3.3.1 Information system	Flexibility of district information environment, usability, etc.
		3.3.2 Energy system	Expandability and flexibility of the system as a whole, etc.

Below is the supplementary explanation of the three Major Items, whereby the perspective and principles of the evaluation of assessment items are given.

1) Environment

The three Middle Items (i.e., Resources, Nature, and Man-made Objects) form the base of the assessment of the environmental quality entailed by an urban development project. In the first item, “Resources,” the key points for assessment may be considered to be associated with the measures for reduction of environmental load (L) rather than the quality of environment (Q), despite which these are included in the assessment of Q. This is because the emphasis is placed on an aspect of the “improvement of environmental quality” such as conservation of water resources and creation of a society opting for recycling, which can be achieved by each measure. In the second item, “Nature,” the substantiality of natural environment/space in an urban area of interest is evaluated in terms of greenery and biodiversity. Lastly, with regard to “Man-made Objects,” the environmental performance of architectural constructions in an urban area of interest is used as a representative indicator. Specifically, the assessment is based on the frequency of use of CASBEE tools for architectural/real estate market purposes and the results of such CASBEE assessments.

2) Society

The assessment is conducted in terms of social performance that can be achieved through a project of interest in itself as well as how much the project or its execution can contribute to better social quality in the neighborhood of a local area designated by the project. The base of the assessment is also formed by three Middle Items. In the first item, “Fairness and Legality,” the appropriateness according to the relevant laws on urban development and the practicality of management systems (especially, to be in harmony with the local community) are evaluated. The next item, “Safety and Security,” addresses the anti-disaster or anti-crime performance of an urban area concerned, which has a direct connection with the sense of security of residents and visitors, and the strength or robustness that supports the sustainability of local communities. The last item, “Amenities,” is assessed not only from the viewpoint of accessibility to various service facilities for convenience of everyday life, but also from the viewpoint of improvement of local value such as utilization or creation of historical/cultural assets and contribution toward a better townscape.

3) Economy

The assessment is conducted in terms of economic potential which a project of interest has in itself as well as the possible economic contribution of the project towards the value and functionality of a local area designated by the project and the whole city in which the area is located. As in the case of the previous Major Items of "Environment" and "Society," three Middle Items are used for assessment of "Economy." In the first item, "Transportation and Urban Structure," the effectiveness of transporting systems that underlie economic activities and the utilization of location/site potential from the perspective of urban development are evaluated. Regarding the next item, "Potential for Growth," the key points to be assessed include the population (living population and visiting population including employees) as a fundamental indicator of economic potential of the project and the practicality of schemes to activate economic activities. Lastly, "Efficiency and Rationality" deals with information and energy systems in terms of effective management and services for users in an urban area of interest.

3.5.1.5. Assessment of L_{UD} (Environmental Load of an urban area of interest)

In CASBEE-UD, CO_2 emissions induced by a project of interest (on a scale of a district or local area) are calculated and converted into an L_{UD} score through a series of procedures to obtain a standardized indicator. The outline of the procedures is given below.

i. Calculate the annual CO_2 emissions induced by the execution/operation of a project of interest based on two scenarios: the case of business as usual (BAU) with no low-carbon initiatives being taken and the non-BAU case in which the initiatives are in effect.

ii. Estimate the population after the project comes into effect, using the common equation that has been defined in advance. Divide either of the above-obtained results by the estimated population to calculate annual CO_2 emissions per person (i.e., L_{BAU} and $L_{non\text{-}BAU}$). → The difference between these two ($\Delta L = L_{non\text{-}BAU} - L_{BAU}$) is considered as the CO_2 reduction attempted by the project.

iii. Express the obtained $L_{non\text{-}BAU}$ as a score ranging from 0 to 100 points. The $L_{non\text{-}BAU}$ score should be determined according to the position of $L_{non\text{-}BAU}$ falling on a logistic curve that is drawn on the assumption that 75 points in the score correspond with the obtained L_{BAU} and 25 correspond with the 20% reduced value of the obtained L_{BAU} (i.e., $0.8 \times L_{BAU}$).

In the assessment of $L_{non\text{-}BAU}$, the "Manual on Low-Carbon District Planning," which was released in accordance with the enforcement of the Eco-City Act, is used as a reference to consider effective low-carbon initiatives. That is, of the initiative examples provided in the manual (see below), those regarded as being especially effective in a project of interest are selected for calculation.

[1] Improvement of an area to serve as a hub of integrated urban functions and appropriate locations of other urban functions
[2] Encouragement of use of public transportation systems
[3] Rationalization of freight transportation
[4] Preservation of green spaces and promotion of greenery
[5] Utilization of public facilities to install systems for the effective use of fossil fuels and the adoption of non-fossil energy use

[6] Promotion of lower-carbon buildings
[7] Facilitation of reduced CO_2 levels emitted through use of cars

3.5.1.6. Examples of the assessment trials

The framework of the tool is being polished up while it has been used on trial for several projects. The example given below is a trial case regarding the assessment of an area designated for a public welfare facility at the East-Exit North District of Tamachi Station in Minato Ward, Tokyo (hereafter referred to as the “T Project”).

The T Project can be summarized as the designated area of 4.6 ha (of which 1.2 ha is the green space), an aggregate of four buildings containing the cultural hall/theater, sports center, medical clinics, nursery school, etc., and the total floor space of approximately 57,000 m^2.

With regard to the Q_{UD} assessment, the score attained in “Environment” was 3.4 because of reasons such as appropriate consideration for biodiversity and a high greenery ratio achieved by securing a large green space in spite of the facility being located downtown. In “Society,” the facility itself serves as the disaster prevention base equipped with various service functions, which was highly rated in terms of safety/security and amenities to produce a score of 3.8. When it came to “Economy,” potential for growth remained average despite the effect of the introduced district heating/cooling system, resulting in a score of 3.5. Thus, the obtained final score of Q_{UD} was 3.5.

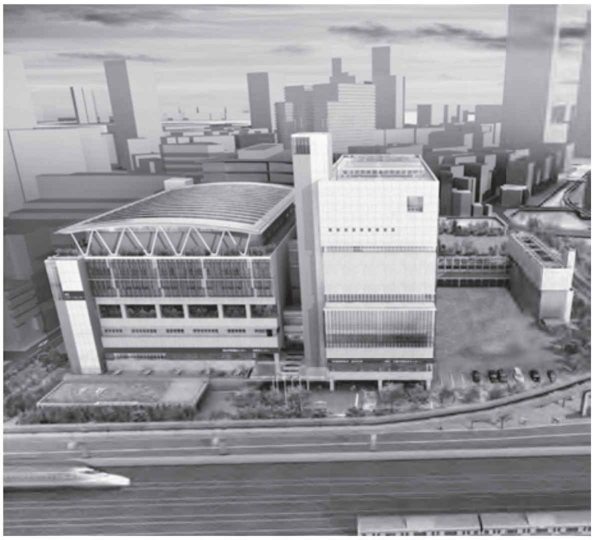


Figure 3.5.3: Image of the exterior view of the facility in the “T Project”

Figure 3.5.4 shows the whole process of calculation in the assessment of L_{UD}. Regarding all the buildings designed by the project, CO_2 emissions in the case of BAU were estimated based on factors such as the floor area by building type and carbon intensity, to produce the results of 4,920 t-CO_2/year in the transportation sector and 5,310 t-CO_2/year in the household sector. On the other hand, the downward arrows in the figure represent the reduced amounts of CO_2. Using the initiatives listed above ([1] to [7]), these reductions can be classified as follows:

Initiatives [1] and [2]: Reducing effect on the volume of car traffic owing to the location adjacent to a railway station – Transportation sector (1,026 t-CO_2/year)

Initiatives [5] and [6]: Improvement of the building exterior performance and the district heating/cooling system – Household sector (1,433 t-CO_2/year)

Initiative [4]: CO_2 absorbing effect of the green space in A – (23 t-CO_2/year)

Therefore, the annual CO_2 emissions in A are 10,243 (t-CO_2/year) as BAU; the total reduced amounts are 2,446 (t-CO_2/year); and the total CO_2 emissions when the initiatives are in effect are 7,797 (t-CO_2/year) as non-BAU. Either value of BAU and non-BAU is divided by the estimated population of 2,482, thus producing the results of L_{BAU} being 4.1, $L_{non\text{-}BAU}$ being 3.1 and ΔL being -1.0.

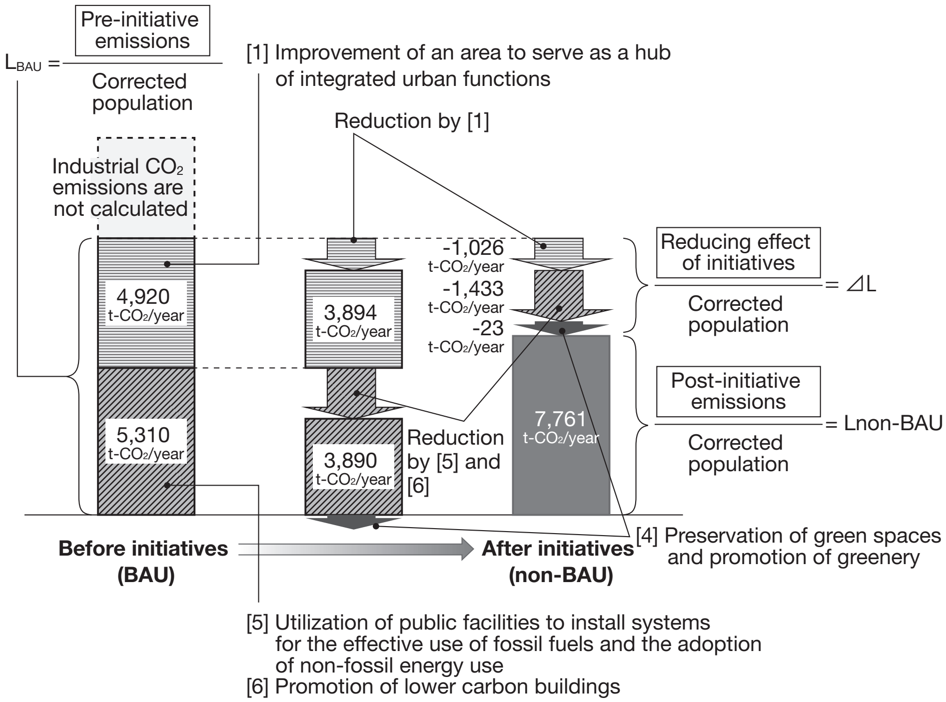


Figure 3.5.4: Example of calculation process for the estimation of L_{UD}-reducing effect of initiatives

Although the accurate estimation obtained through drawing a logistic curve is in progress, the L_{UD} score in this case is expected to be around 20. Therefore, dividing the Q_{UD} score by the L_{UD} score (i.e., [25 x (3.5 – 1)]/20), the built environment efficiency of the urban area designated by the project (i.e., the BEE_{UD} score) will be 3.0, which is a value estimated with use of some provisional conditions.

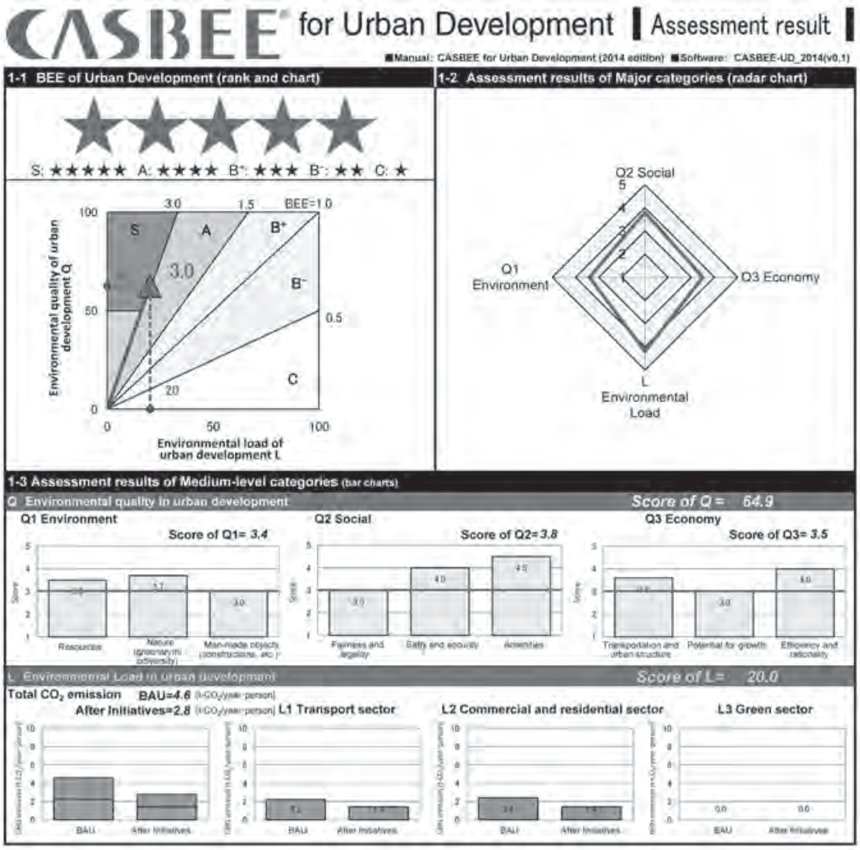


Figure 3.5.5: An example of CASBEE-UD evaluation (image)

References

1) Subcommittee on City and Local Environmental Assessment of the Architectural Institute of Japan: City and Local Environmental Assessment.

2) Ministry of Land, Infrastructure, Transport and Tourism: Pamphlet on the Low Carbon City Promotion Act (2012).

3) Ministry of Land, Infrastructure, Transport and Tourism: Manual on Low-Carbon City Planning (2012).

4) Minato Ward Office: The Outline of the Public Welfare Facility at the East-Exit North District of Tamachi Station (2011).

3.5.2. CASBEE Community Health Checklist

3.5.2.1. Community environment and health

Although a “healthy lifestyle” has been considered most important to maintain and improve health, there is a certain limit to such improvement that can be achieved by individual efforts. Because of this, the living environment, which is the foundation of our life, is receiving much attention.

In recent years, it has become more evident that a “residence,” whether it is good or bad, can considerably affect the health of the people living in it. On the other hand, their lifestyle also depends greatly on the environment of the local “communities.”

For example, the outside air is polluted, or too many steps make walking troublesome, or there is often a near miss with a car because of narrow sidewalks, or no usable facilities are available for local activities, or there is no convenient public transportation system. In a community with such problems, it is necessary to improve the surrounding environment to the maximum by means of “removal of safety/security compromise factors” and “provision of usable facilities and better services” and create a comfortable, safe and secure neighborhood, which simultaneously can help people to maintain and facilitate good health.

3.5.2.2. Outline of CASBEE Community Health Checklist

1) Objectives

CASBEE Community Health Checklist is a simple diagnostic tool used for residents to become aware of the health-related issues in their neighborhood in advance. It was developed as a community version of “CASBEE Health Checklist,” which is a tool intended for residences (see Section 3.2.3.).

2) Assessment system

The checklist conforms to the assessment system based on the International Classification of Functioning, Disability and Health (ICF) of the World Health Organization (WHO). Communities are evaluated from two perspectives: (1) “removal of function-disabling factors” and (2) “sufficiency of encouraging factors for activities and participation.”

3) Assessment items

The checklist comprises 36 assessment items (Table 3.5.2). These items have been determined in a way that can handle/evaluate any community despite its location, whether it is downtown or in the countryside. The function-disabling factors are examined in terms of [1] Natural environment, [2] Safety and sanitation environment and [3] Traffic and transportation, while the encouraging factors for activities and participation are considered from the viewpoints of [4] Local activities, [5] and [6] Facilities and services, [7] Health check-up facilities and [8] Social capital. With regard to assessment items classified as any of [1] to [3], questions are given to ask how frequently the assessor feels there is a danger or concern about issues concerned. In [4] and [5], the frequency of participation or usage is asked. The items of [6] and [7] assess the condition of a community environment from a specific perspective. In scoring, the adopted method of simple addition makes the full score 115 points.

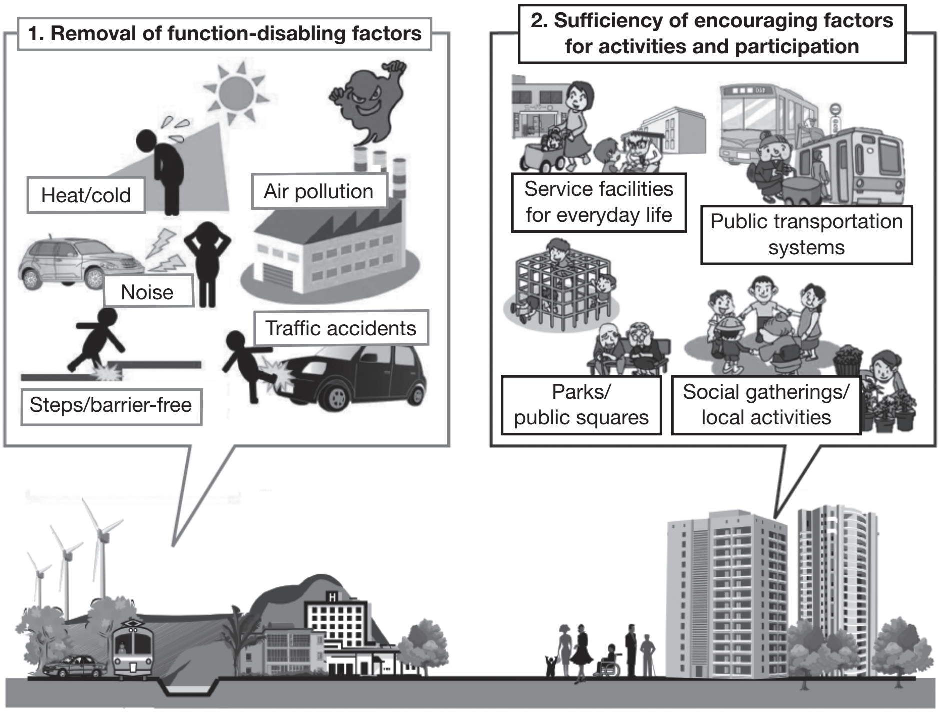


Figure 3.5.6: Elements in a community to be assessed

Table 3.5.2: Assessment items of CASBEE Community Health Checklist

I. Removal of function-disabling factors	
Middle Item	Minor Item
[1] Natural environment <Q Format: A>	1. Outdoor thermal environment (summer)
	2. Outdoor thermal environment (winter)
	3. Outdoor odor
	4. Outdoor sound and vibration environment
	5. Environmental radiation
	6. Aquatic environment
	7. Green space environment
[2] Safety and sanitation environment <Q Format: A>	8. Waterworks
	9. Garbage dump
	10. Smoking/non-smoking partition
	11. Crowdedness or population density
	12. Local safety (recognition of danger)
	13. Precautions against disasters
[3] Traffic and transportation <Q Format: A>	14. Precautions against falling
	15. Traffic control
	16. Accessibility to neighboring areas

II. Sufficiency of encouraging factors for activities and participation	
Middle Item	Minor Item
[4] Participation in local activities <Q Format: B>	19. Participation in community or neighborhood activities
	20. Walking and sports
	21. Cultural or lifetime activities
[5] Use of facilities and services <Q Format: B>	22. Use of public transportation systems
	23. Use of exercise facilities
	24. Use of meeting facilities and libraries
	25. Use of parks, public squares and promenades
[6] Practicality of facilities and services <Q Format: C>	26. Usability of public transportation systems
	27. Usability of exercise facilities
	28. Usability of meeting facilities and libraries
	29. Availability of parks, public squares and promenades
	30. Accessibility to financial institutions
	31. Aesthetic aspect of townscape and view
[7] Health check-up facilities <Q Format: C>	32. Accessibility and availability of medical clinics
	33. Accessibility and availability of dental clinics
[8] Social capital	34. Communication and interaction with neighbors
	35. Acquaitance with neighbors
	36. Confidence in neighbors

4) Checklist (online assessment through the website)

Each assessment item gives a question that is easy to understand and according to the given format of the question, the answer applicable to the assessor is selected by ticking before the obtained scores are added up.

The checklist is available at the relevant website and the assessment can be conducted online.

<Q Format: A> Asking about the frequency of occasions when a feeling of danger or concern occurs

Ex: Outdoor air environment: Are there occasions when you feel the air outside is bad?

Bad	☐ Frequently	☐ Sometimes	☐ Rarely	☐ Not at all	Good
	⬇	⬇	⬇	⬇	
	0 point	1 point	2 points	3 points	

<Q Format: B> Asking about the frequency of participation or usage

Ex: Use of exercise facilities: Are there occasions when you use exercise facilities such as a gymnasium, sports gym or athletic field?

Good	☐ Every day, or no less than a few times a week	☐ Once a week, or no less than a few times in a months	☐ Once a month, or no less than a few times in a year	☐ Once a year or so	☐ Not at all	Bad
	⬇	⬇	⬇	⬇	⬇	
	4 points	3 points	2 points	1 point	0 points	

<Q Format: C> Asking about the condition of a community environment from a specific perspective

Ex: Usability of exercise facilities: Are there exercise facilities that are easily available and usable (such as a gymnasium, sports gym and athletic filed)?

Good	☐ Very much the case	☐ Agreeable to some extent	☐ Hardly think so	☐ Not at all	Bad
	⬇	⬇	⬇	⬇	
	3 points	2 points	1 point	0 point	

Figure 3.5.7: Examples of checklist answers and scores

3.5.2.3. How to present the assessment results

The aspects of a community, which may affect the health of the assessor, can be identified by answering the questions regarding the "obstacles and worries in the living/community environment" and "your everyday activities."

1) Total scores

Based on the results of the questionnaire survey participated in by 10,000 people nationwide, the assessor can obtain the ranking of his/her community healthiness.

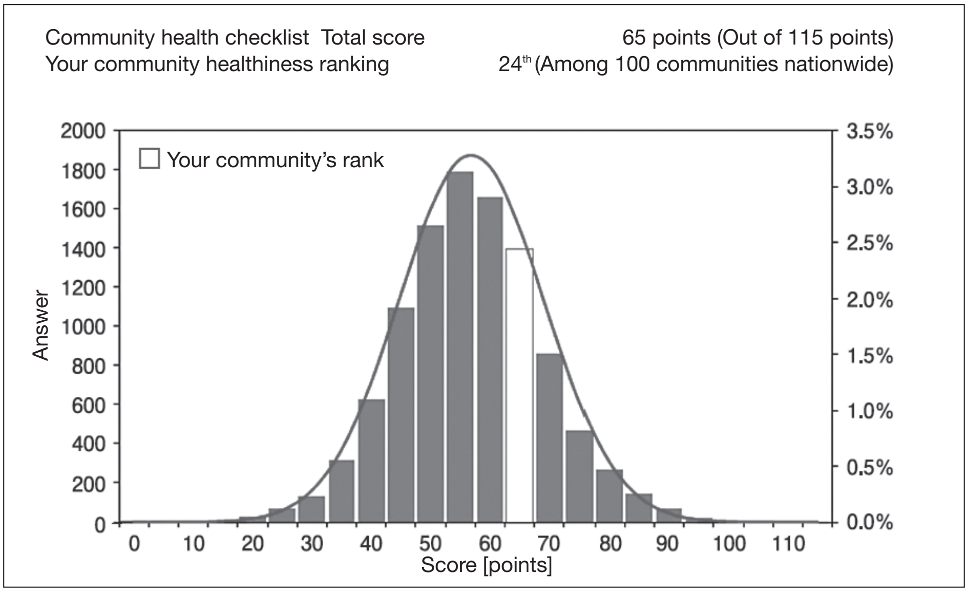


Figure 3.5.8: Example of the ranking results

2) Scores presented according to the assessed aspects of a community

In addition to the total scores, the scores of each aspect of a community can be compared with the national average scores, enabling the identification of which aspect of the community is fulfilling or requires more attention.

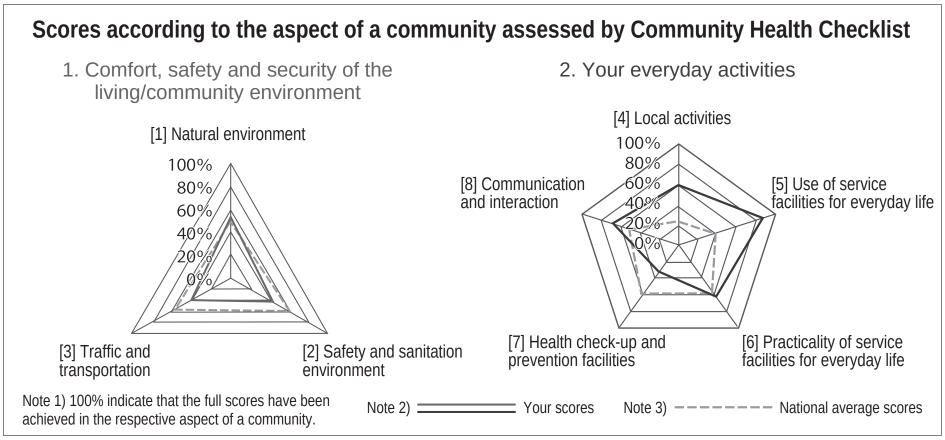


Figure 3.5.9: Example of scores presented according to the aspect of a community

3.6 CASBEE for Cities (CASBEE-City)

3.6.1. Assessment of stocks and flows

Generally speaking, city development entails a long time span. Social capital and various types of infrastructure, which form the foundation of our everyday life, cannot be established overnight. This aspect of a city as a stock variable should be taken into consideration when cities are evaluated. On the other hand, although various measures are put into effect in a city, many of them are planned on a yearly basis. Therefore, when it comes to the assessment of these measures, the aspect of a city as a flow variable should also be considered. It always needs to be remembered that the current condition of a city (i.e., stock) is realized as an accumulated result of various measures (i.e., flows) in the past.

Figure 3.6.1 shows the similarity between the urban/city environment assessment and the corporate financial assessment from the flow-stock relationship perspective. It is noteworthy that, from the time scale concerned, the assessments of stocks and flows focus on entirely different aspects of the activities taking place in a city. CASBEE-City is a tool developed to assess the current condition of the whole area of a local government as a stock.

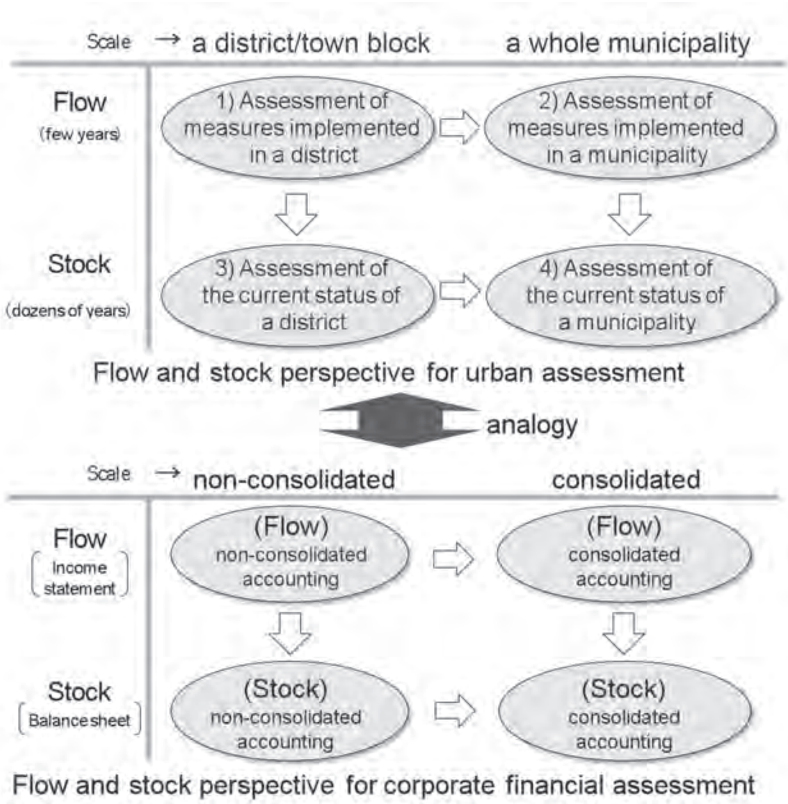


Figure 3.6.1: Flow and stock perspective for urban assessment and for corporate financial assessment

3.6.2. Overview of CASBEE-City tool

It is extremely important to assess the environmental performance of cities and widely release the results to the public in terms of disclosing the hidden issues and facilitating the understanding of the current situation of cities. Just like we humans have regular medical checkups to make sure there is nothing wrong with our body, cities also need regular examinations to see if there are any problems. CASBEE-City was developed in order to support the sustainable development of cities and is, so to speak, a health check-up tool for local governments (Murakami, *et al.* 2011). An overview of CASBEE-City, which was domestically developed in 2011, is given below.

The CASBEE-City tool was developed to comprehensively evaluate the environmental performance of local governments (on a scale of city, ward, town or village). In 2008, the Committee for the Development of Environmental Performance Assessment Tools for Cities was launched and discussions from various angles took place before the first edition of CASBEE-City was released in 2011. The tool is characterized by an extensive and comprehensive assessment of the current condition of cities, which is conducted from the viewpoint of the environment, society and economy (i.e., a triple-bottom line approach). After the release of the first edition in 2011, opinions from those such as local government officials and experts were gathered to improve the tool, and in 2013, the tool was upgraded in cooperation with the Office for Promotion of Regional Revitalization, Cabinet Secretariat of Japan. As is also described later, it has been decided that CASBEE-City will be used as a follow-up tool for city environments in a national project of the “Future City” Initiative.

The framework of the CASBEE-City assessment is shown in Figure 3.6.2. As in the case of other CASBEE tools, the concept of built environment efficiency (BEE) has been introduced to CASBEE-City.

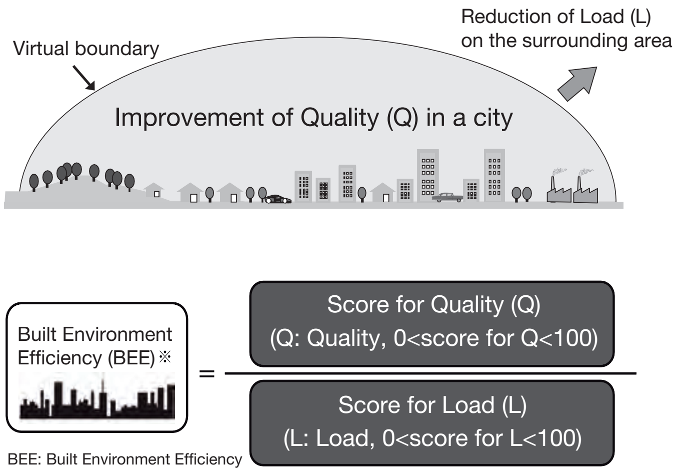


Figure 3.6.2: Assessment structure of CASBEE-City tool

In CASBEE-City, a virtual enclosed space boundary, which surrounds the entire local government concerned, is defined as shown in Figure 3.6.2. The boundary is determined at the discretion of local governments. It is relatively easy to collect the data on a city, ward, town or village boundary and therefore these boundaries are used in CASBEE-City. As in the case of other CASBEE tools, CASBEE-City clearly distinguishes the inside from the outside of the virtual enclosed space boundary and comprehensively evaluates a local government area of interest from two different perspectives: L (environmental load on the outside of the boundary) and Q (environmental quality and societal activity inside the boundary).

The CASBEE-City assessment items are outlined in Figure 3.6.3 and detailed information is listed in Table 3.6.1.

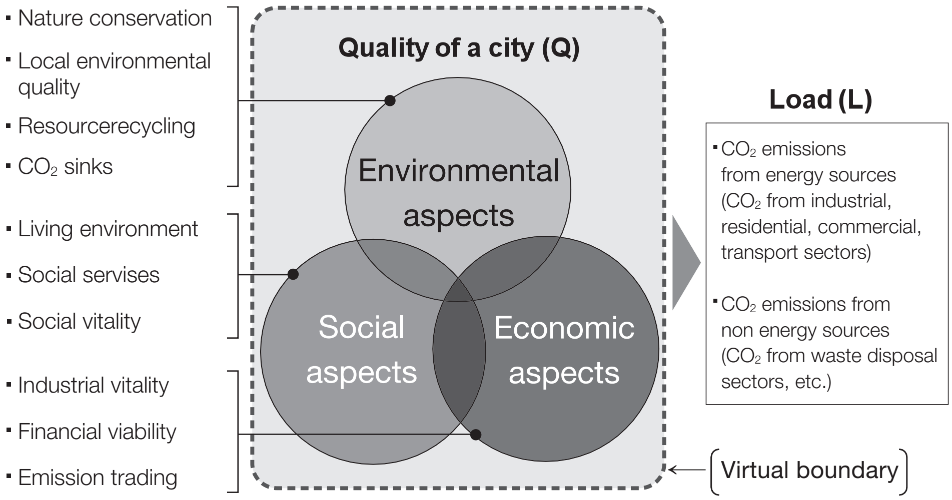


Figure 3.6.3: Assessment items of CASBEE-City tool

Table 3.6.1: Assessment items of CASBEE-City (in detail)

Category	Major Item	Middle Item	Minor Item
Q: Environmental quality and societal activity	Q1 Environment	Q1.1 Nature conservation	Q1.1.1 Ratio of natural land
		Q1.2 Environmental quality	Q1.2.1 Atmosphere quality
			Q1.2.2 Water quality
		Q1.3 Resource efficiency	Q1.3.1 Recycling ratio of general waste
		Q1.4 Measures for CO_2-absorbing sources	Q1.4.1 Measures concerning carbon sink by forests
	Q2. Society	Q2.1 Living/city environment	Q2.1.1 Residence standard level
			Q2.1.2 Traffic safety
			Q2.1.3 Crime prevention
			Q2.1.4 Disaster preparedness
		Q2.2 Social services	Q2.2.1 Educational service level
			Q2.2.2 Cultural service level
			Q2.2.3 Medical service level
			Q2.2.4 Childcare service level
			Q2.2.5 Elderly care service level
		Q2.3 Societal vitality	Q2.3.1 Population increase/ decrease rate
			Q2.3.2 Healthy life expectancy
	Q3 Economy	Q3.1 Industrial competence	Q3.1.1 Equivalent of GRP per capita
			Q3.1.2 Workforce
		Q3.2 Financial foundation	Q3.2.1 Local tax revenue
			Q3.2.2 Outstanding local government bond debt
		Q3.3 Carbon offsetting	Q3.3.1 Support for limited CO_2 emissions in other areas
L: Environmental load	L1 Energy-induced CO_2 emissions	Industry, household, business, transport	
	L2 CO_2 emitted from other sources	Waste, etc.	

* The above-listed assessment items are based on CASBEE-City (Standard version) released in 2012.
* CASBEE-City (Professional version) contains more assessment items.

The environmental quality and societal activity of local governments (Q) are assessed from the triple-bottom line perspective, i.e., the environment, society and economy (these are defined as three Major Items) and each assessment item is assigned to one of these three categories. With regard to the environmental load (L), the levels of CO_2 emitted through societal activities in a local government area are evaluated. Therefore, a local government that depends on heavy industry naturally yields large amounts of environmental load, if estimated CO_2 emissions are directly used as the CO_2 emissions of the local government without correction. It should not be dismissed that these industrial cities are struggling with external diseconomies of large CO_2 emissions, whereas other local governments are enjoying the benefits of products supplied by the former without emitting CO_2. It is reasonable for these local governments benefiting from such situation to be responsible for their share of external diseconomies. CASBEE-City, therefore, has also adopted the assessment framework in which CO_2 emissions involving industrial activities are shared by both places of production and consumption. When the place of production takes all the responsibility for industrial CO_2 emissions, it is called the "Emitter-Pays Principle." On the other hand, in the "Beneficiary-Pays Principle," the places of consumption also accept their share of industrial CO_2 emissions. In CASBEE-City, these two methods for the assessment of L are available. The comparative advantages between these two principles (the former focusing on the aspect of production with the latter emphasizing the aspect of demand) are considered to vary according to the purpose of use. If either principle should be selected, the beneficiary-pays principle is considered appropriate.

In CASBEE-City, two tools (i.e., standard and professional versions) are available. In the standard version, based on public statistical information, local governments across the country can be assessed using uniform criteria and their environmental performance can be obtained by a relatively simple procedure. The professional version employs more assessment items than the standard version and was developed for use, for example, when related officials and specialists make a plan for the future of respective local governments.

3.6.3. CASBEE-City (Standard version)

The measurement of environmental performance of local governments necessitates the collection of various data in the respective fields. However, such demanding hurdles including data gathering have been an obstacle to the conduct of local government environment assessment. CASBEE-City (standard version) was developed in order to reduce the workload of tool users and facilitate urban assessment.

No matter how ideologically superior the assessment item is, it is impossible to conduct urban assessment with no relevant quantitative data available. In the standard version, therefore, the statistical data, which are widely released to the public, can be used to calculate the scores of assessment items. In other words, if no public statistical information can be found within a range of publicly accessible data, these items are strictly excluded.

The effectiveness and validity of the standard version CASBEE-City are being examined by a nationwide questionnaire survey. As indicated in Figure 3.6.4, there is a high correlation between the objective assessment results of local governments, which are obtained by the standard version, and the subjective assessment results of local governments, which are produced by citizens across the country (Kawakubo, *et al.* 2013).

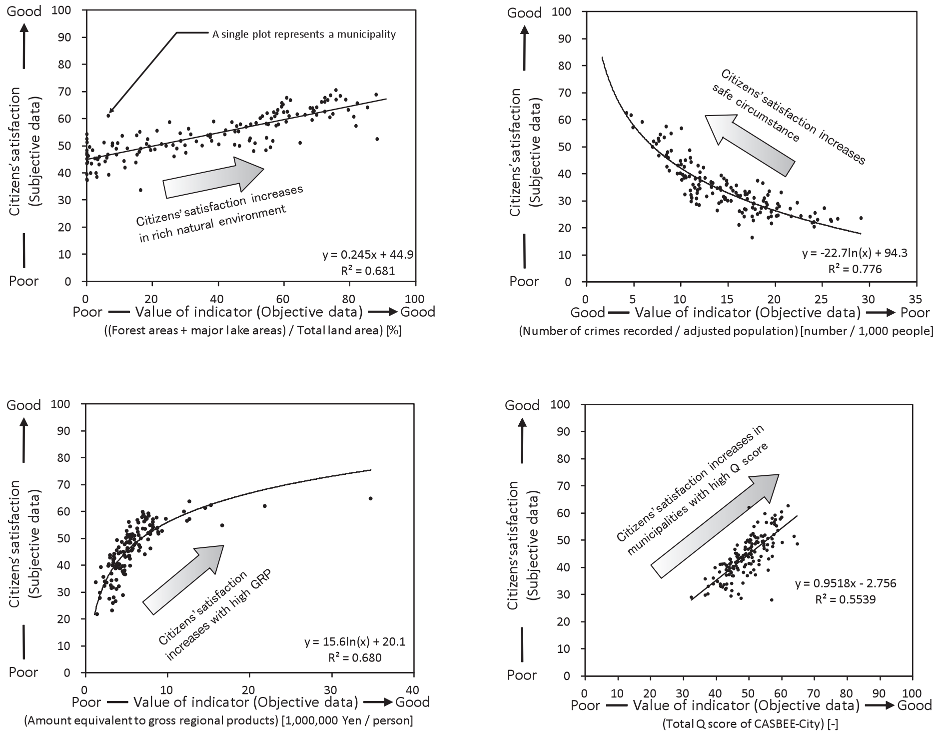


Figure 3.6.4: Relationship between CASBEE assessment result and citizens' satisfaction

As of 2010, there are 1,750 basic municipalities (cities, wards, towns and villages) in total in Japan, each of which has its own autonomous body. Below are the results of assessment on the environmental performance of all these local government areas using the standard version of CASBEE-City (Kawakubo, *et al.* 2011 and 2012). In conducting the assessment, the required publicly available statistical data were first collected from appropriate sources such as the database of the Statistics Bureau of the Ministry of Internal Affairs and Communications, White Papers of each Ministry, and study results released by national research centers, etc. Based on this vast amount of data, the environmental performance of each local government was evaluated. The assessment results were output on a two-dimensional map with use of a geographical information system (GIS). Figure 3.6.5 shows the assessment results of Q1 (Environment), Q2 (Society) and Q3 (Economy), while figure 3.6.6 gives the results of Q (i.e., Q1 + Q2 + Q3), L and BEE.

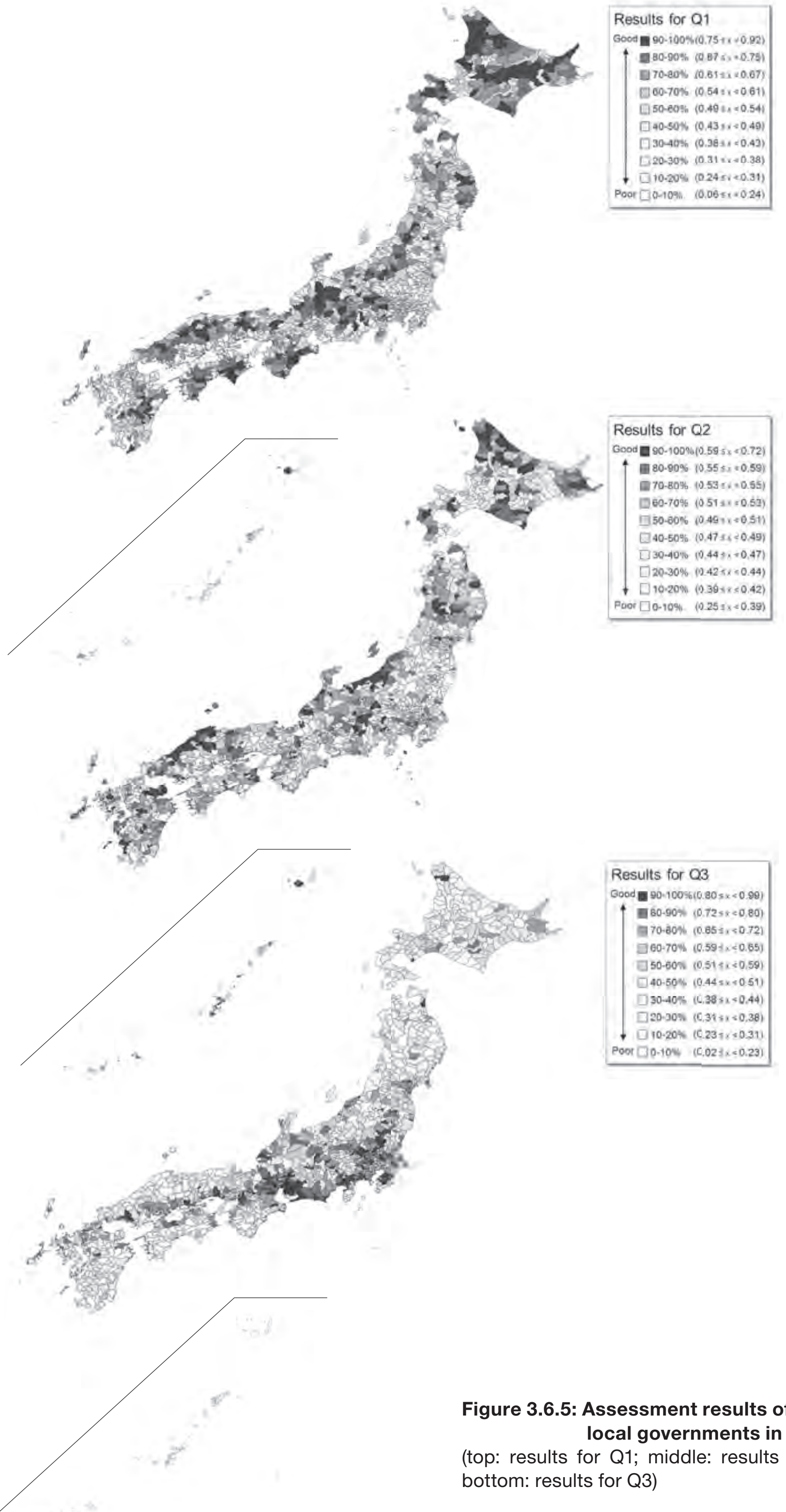


Figure 3.6.5: Assessment results of all local governments in Japan
(top: results for Q1; middle: results for Q2; bottom: results for Q3)

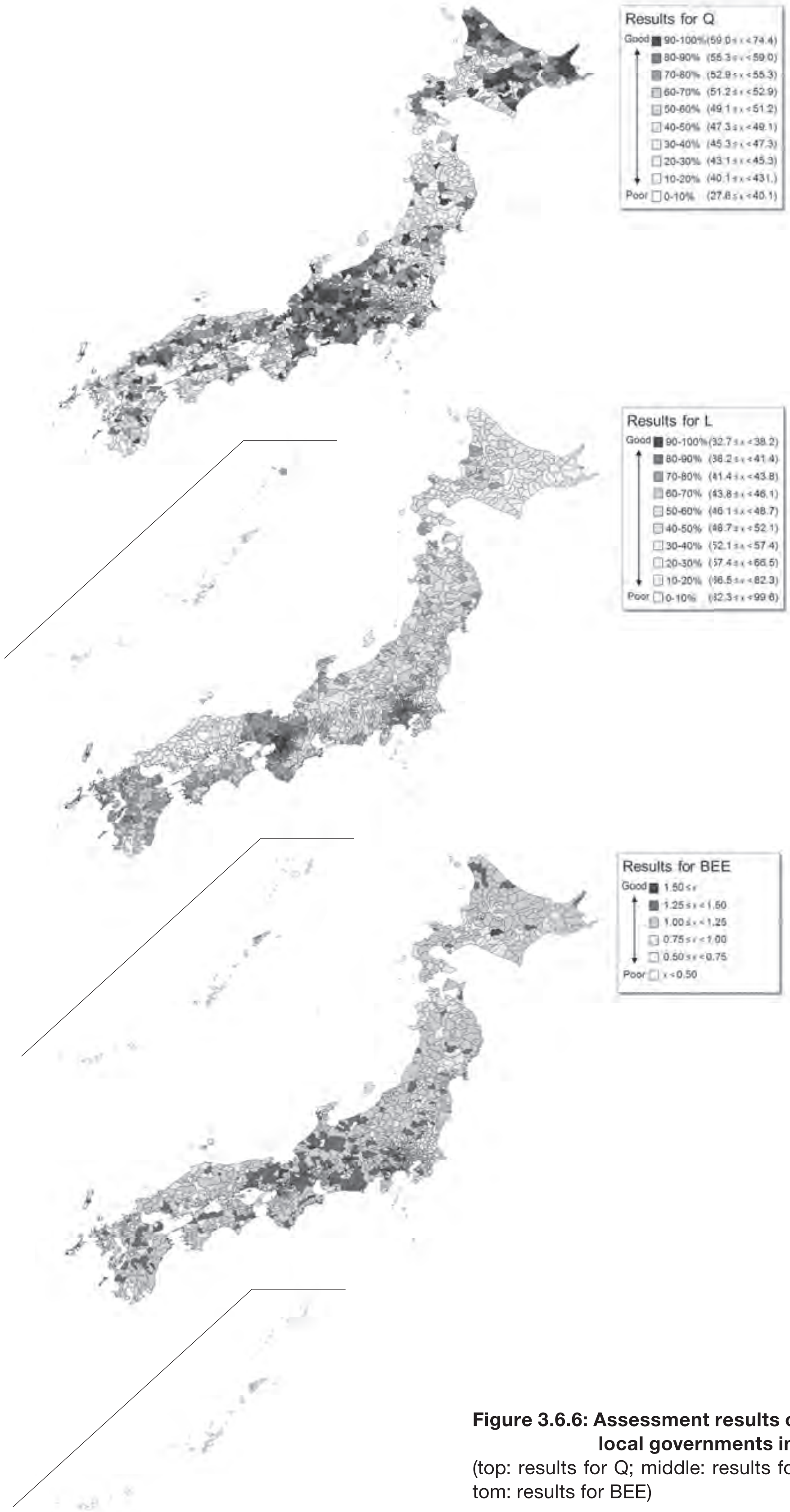


Figure 3.6.6: Assessment results of all local governments in Japan
(top: results for Q; middle: results for L; bottom: results for BEE)

As a rule, in the assessments of Q1 and Q2, local governments with a lower population density produced better results. On the other hand, the results of Q3 exhibit the completely opposite tendency and local governments with a higher population density were rated higher. When it comes to the comprehensive result of Q1, Q2 and Q3 (i.e., Q or environmental quality and societal activity), local governments with a lower population density tend to gain better results. In the assessment of L, higher results were produced by major urban areas where the population density is high, because of advanced transportation systems with less energy intensity and a higher ratio of people living in apartments that are more energy conservative than detached houses. Lastly, the BEE results indicate that the local governments located in the central regions of Japan earned well-balanced scores for both Q and L and were highly evaluated for these better assessment results.

3.6.4. CASBEE-City (Professional version)

The objectives of CASBEE-City development include helping to understand the current condition of local government environments. Through provision of assessment results to understand the current condition of local governments and the consequent disclosure of hidden issues, CASBEE-City also functions as a supporting tool for the discussion of possible measures to be taken for a better future, which is a key aspect of CASBEE-City. The local government trends can be roughly estimated by the aforementioned standard version. However, when specific measures are discussed at the advanced level, more detailed data on a local government of interest are needed. The professional version, which is introduced in this section, is useful to obtain such detailed data.

The professional version of CASBEE-City was developed with the expectation of use mainly by experienced individuals such as related officials and experts in the field of city planning and covers a more extensive range of assessment items than the standard version. The data collection for the assessment is somewhat more difficult than the standard version, but it will be rewarded by the advantageous features realized by its framework for more detailed assessment.

CASBEE-City allows not only the assessment of the current condition but also future predictions. By inputting the data such as local government target scores for the coming years, the tool can visualize future development compared with the present situation. The results are plotted on a two-dimensional BEE chart, which is also useful when examining which measure is most effective. Both standard and professional versions of CASBEE-City can perform such assessment of chronological change. However, the results of the professional version can provide more detailed and useful information. Contribution towards the sustainable development of local governments is considered to be made by sharing the assessment results among all the stakeholders including experts and citizens.

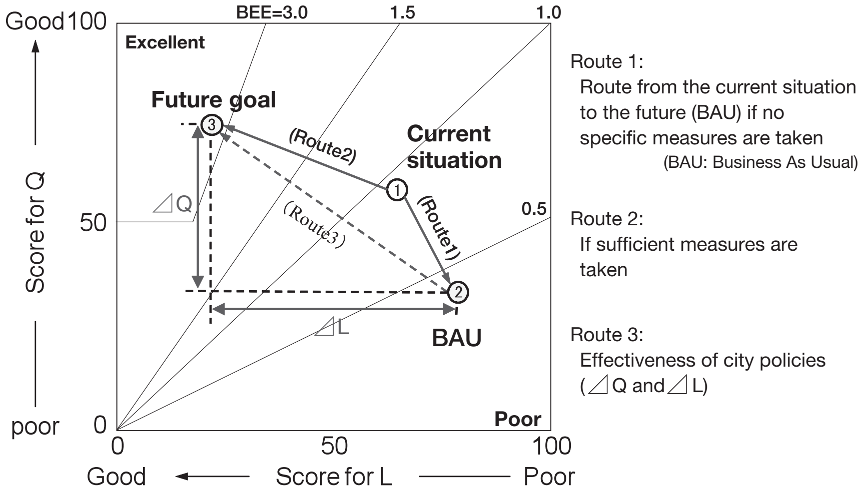


Figure 3.6.7: Utilization image of CASBEE-City for considering future action plans

Acknowledgements

The research results reported in this section were obtained in cooperation with members/officials of the Committee for the Development of Environmental Performance Assessment Tools for Cities, the Office for Promotion of Regional Revitalization of the Cabinet Secretariat of Japan, the Ministry of Land, Infrastructure, Transport and Tourism, and local governments across the country, as well as many other people involved in the project. The author would like to express his deepest gratitude to them.

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<Column-6>

Towards green cities

Serge SALAT,
President,
Urban Morphology and Complex Systems Institute, France

While governments and municipalities are committing themselves to fostering urban sustainability, they need tools to measure the current performance of their cities, to find the levers to better them, and to assess the efficiency of the actions engaged. The challenge that has been successfully addressed by CASBEE is to address the key issues of urban sustainability while taking into account the complexity of the numerous interactions occurring on the city scale.

Urban morphology provides a robust framework to encompass the complexity of interactions happening on the city scale. Urban form strategies that foster sustainability are to be based on the following triptych:

- Environment: Cities that are at the same time more compact and with a finer grain succeed in reducing transportation and operational building energy, and reduce their environmental load.

- Economics: Fine grain, which is a characteristic of Japanese cities, maximizes connections, interactions and inclusiveness, and as a result amplifies the economic benefits of agglomeration economies and supports economic growth

- Social: High accessibility to a various range of urban amenities such as healthcare, childcare, education or green spaces ensures the proximity to daily services for all the people and improves livability. This high accessibility is made possible through optimal distributions with a long tail of small scale amenities

Robust methodologies and tools have been developed in the recent years to address the complexity of urban sustainability. They have been fed by complex systems' theory and build on spatial distributions, scale hierarchies and graph analysis to help optimizing urban spatial planning. Analyses of distribution and of scale hierarchy explain for instance how proximity to essential urban amenities is ensured on the city scale. The following figure shows that the distribution of parks in Paris follows a Pareto distribution, with a long tail of very small parks that ensures that 80% of Parisians reside less than 5 minutes' walk from a park.

Figure C7.1: 80% of Parisians reside less in Paris than 5 minutes' walk from a park.

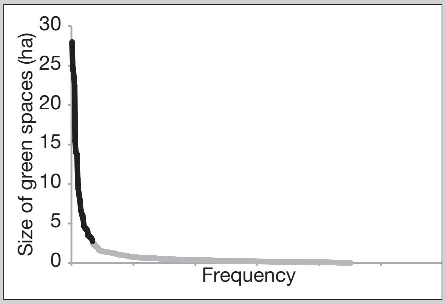

Figure C7.2: Long tail distribution of parks

(Source: Urban Morphology and Complex Systems Institute)

Methods and tools exist to measure in minute detail parameters influencing urban sustainability. However, because of their level of detail, they are not appropriate for a nation-wide implementation. The great success achieved by CASBEE-City is to strike a smart and finely tuned balance between science and policy. On the one hand, it has been thought as a general assessment system of urban sustainability which is an operational and pragmatic tool for mayors, developers and all urban stakeholders eager to move toward greener cities. But on the other hand, the necessary simplified assessment framework encompasses the complexity or urban issues, providing an accurate reflection of what detailed analysis methods would conclude.

CASBEE succeeds in taking a step back from the complexity of urban issues on the city scale by selecting key indicators providing an accurate estimation of urban performance; even if what is measured by these key indicators results from complex upstream mechanisms and interactions. In the case of urban amenities, where detailed analysis would identify the imbalance in the distribution of physicians or childcare facilities in the city, CASBEE-City rests upon an accurate first-order proxy that is the number of physicians or childcare facilities.

CASBEE is at the same time a systemic and strategic approach of urban sustainability. It is systemic as the very core of CASBEE is to assess the city as a system, with an inside and an outside, separated by a well-defined boundary; the system having an intrinsic quality, and applying a load to the outside. Systemic also as the variety of CASBEE tools makes it possible to assess the different scales, from the building up to the city scale. It is strategic as it makes it possible to assess the current situation, set objectives, and supports the implementation of scenarios and trajectories toward greener cities. As a robust method and tool to assess urban sustainability and monitor the change towards more sustainable, inclusive and successful cities, CASBEE is a great achievement that helps cities move in the right direction.■

3.7. CASBEE Connector to BIM

3.7.1. Background

The rapidly spreading use of Building Information Modeling (BIM), which is based on the three-dimensional computer-aided design (3D CAD) system, is considered to be transforming the style of work involved in all the processes of design, construction and operation of buildings. Especially in recent years, the degree of such change is reaching a rapid level.

On the other hand, the development and use of comprehensive assessment tools for the environmental performance of buildings, which can contribute to the establishment of a sustainable society, have already become a worldwide trend. Now each country has gone through all the phases of tool development, the focus is shifting to the establishment of rational and international common criteria among the tools and their operation and the development of a flexible system that can reflect the regional characteristics and individuality of each tool.

Against such a global backdrop, in October 2010, after approximately two years' preparation, Japan Sustainable Building Consortium (JSBC) developed and released the first version of "connector" by which BIM and CASBEE can work hand in hand with each other and some of the CASBEE assessment items can be evaluated semi-automatically. It was the world's first connector product released in the market for the integration of BIM with the Environmental Performance Assessment System of buildings to make its mark domestically as well as overseas. The progress of development had been continually presented on occasions such as panel discussions at the conference of the Architectural Institute of Japan and can be summarized as follows:

"Integration of BIM with CASBEE –1" in 2009

Examining the background information (history and the current status of BIM) in detail, the expected achievements and challenges for the development of connector were discussed from multiple angles to clarify the positioning of the initiation of the research.

"Integration of BIM with CASBEE –2" in 2010

Focusing on the research/development update and progress, each stakeholder (including providers, building design offices, construction companies, and educational architectural institutions) reported the results and issues from their respective points of view. Considering the latest movement inside/outside the country, possibilities regarding the linkage to change in the processes for design, construction and operation and the market reform for popularizing sustainable buildings were discussed.

In accordance with the initial plan, the connector developed has adopted a system in which CASBEE assessment is directly conducted using the BIM tool. However, for a long-term goal, it will be developed to be an independent tool as a "connector" in the original sense.

3.7.2. Situations regarding BIM

BIM simultaneously integrates 3D image processing technology with a series of information on drawings/specifications in the field of architecture, landscape and civil engineering to create a digital database, whereby work-related data such as design, altered design, finalized design, maintenance, and renovation history can continuously be stored, processed and displayed. BIM therefore is an innovative and extremely speedy support system for building design, construction and management, with high efficiency and reproducibility (Figure 3.7.1). It is also considered to be a very effective tool to enable automatic assessment when a wide range of Design for Environment (DfE) systems are examined. BIM has already been introduced in the field of industrial design such as ship-building and automotive industries. However, in the world of building design where every product is individually constructed depending on the regional characteristics, use of BIM was not so common except in a few cases.

However, recent situations such as large-capacity computers, high-speed processing, low prices, and development and availability of sophisticated software programs have totally changed the conventions. BIM has rapidly gained popularity across the world and its range of applications is also expanding, which affects the architectural curricula of educational institutions such as universities. Many recent seminars and workshops for BIM indicate increasing interest from those in the field.

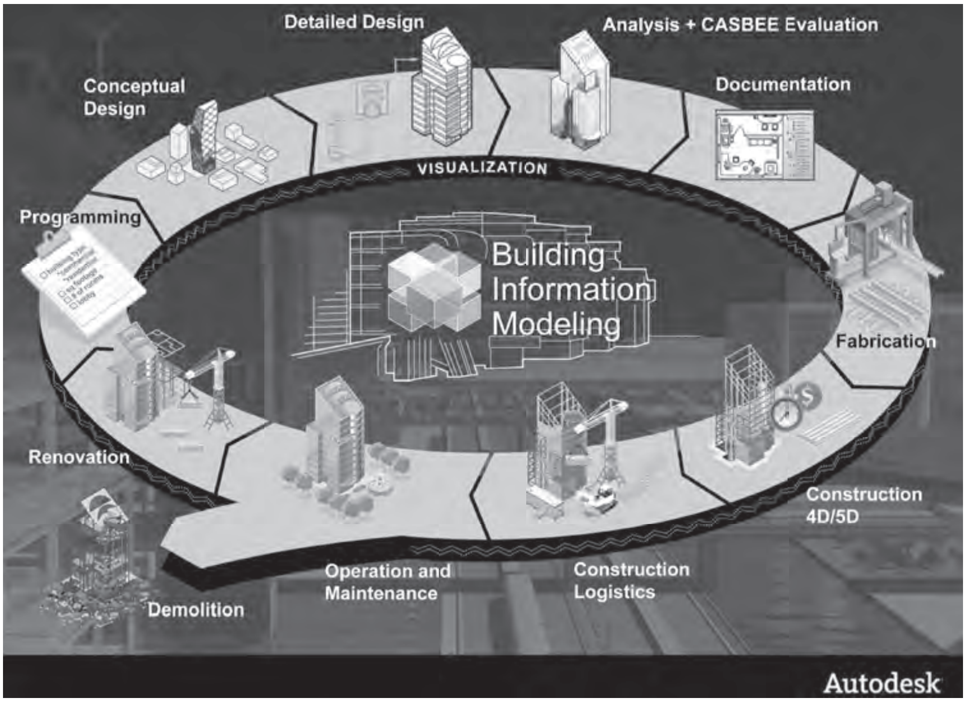

Figure 3.7.1: Conceptual image of how to utilize BIM through the lifecycle of buildings (© Autodesk)

3.7.3. Integration of BIM with CASBEE

As described above, there is high demand for further promoting the use and effective operation of design support tools to improve comprehensive environmental performance. It is therefore inevitable that these two sought-after systems of the times and society be connected to each other and provide a framework to automatically conduct CASBEE assessment and visualize the results by entering the data into design via the BIM tool (see Figure 3.7.2).

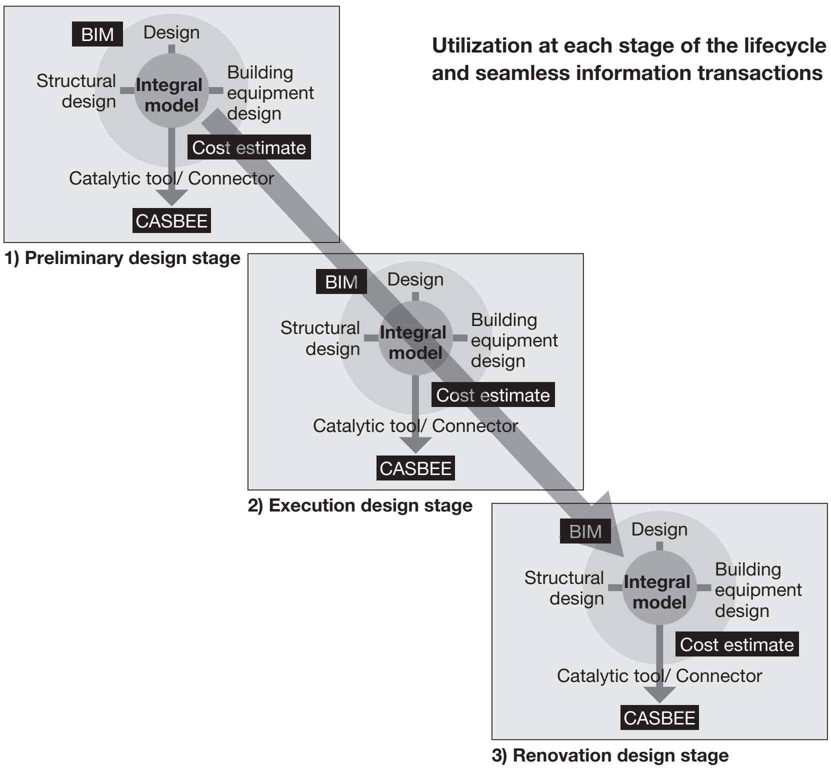

Figure 3.7.2: Conceptual image of how to utilize the CASBEE-BIM connector through the lifecycle of buildings

As a preliminary trial, a U.S. assessment system LEED whose use is rapidly becoming common especially in the Americas demonstrated a future model of the assessment system working together with BIM. The model was developed and released to the public in 2007 as part of "Project Chicago" named by the main developers of the U.S. Green Building Council (USGBC) and Autodesk Inc. It was quite a futuristic and appealing demonstration video.

In response to such a movement, the Committee for CASBEE Research and Development under the umbrella of JSBC, which is the main organization in charge of CASBEE development, initiated the research and development for the establishment of such a system and its commercialization, in cooperation with Autodesk Inc., which is the leading pioneer of BIM and is also a member of JSBC. The Working Group for CASBEE-BIM (CASBEE-BIM WG), which consists of members such as national government officials, academic authorities, experienced individuals, and relevant committee members, was launched and started its activities in September 2008.

3.7.4. Outline of connector development

3.7.4.1. Major effects expected from the development of connector

(1) Time efficiency in CASBEE assessment

- Semi-automatic calculation and summation of environmental indicator levels that are estimated based on architectural drawing data
- Improved accuracy of calculated environmental indicator levels

- Extraction of the relevant drawing data to calculate environmental indicator levels
- Preparation for a set of printed administrative documents for submission to a local government

(2) Contribution towards the construction of green buildings
- Support for the Design for Environment by establishing an interactive connection between drawing data and environmental performance
- Support for the management of environmental performance by enabling environmental indicator levels to be calculated at the planning stage
- Support for the management of a project in which the results of CASBEE assessment are used as management targets

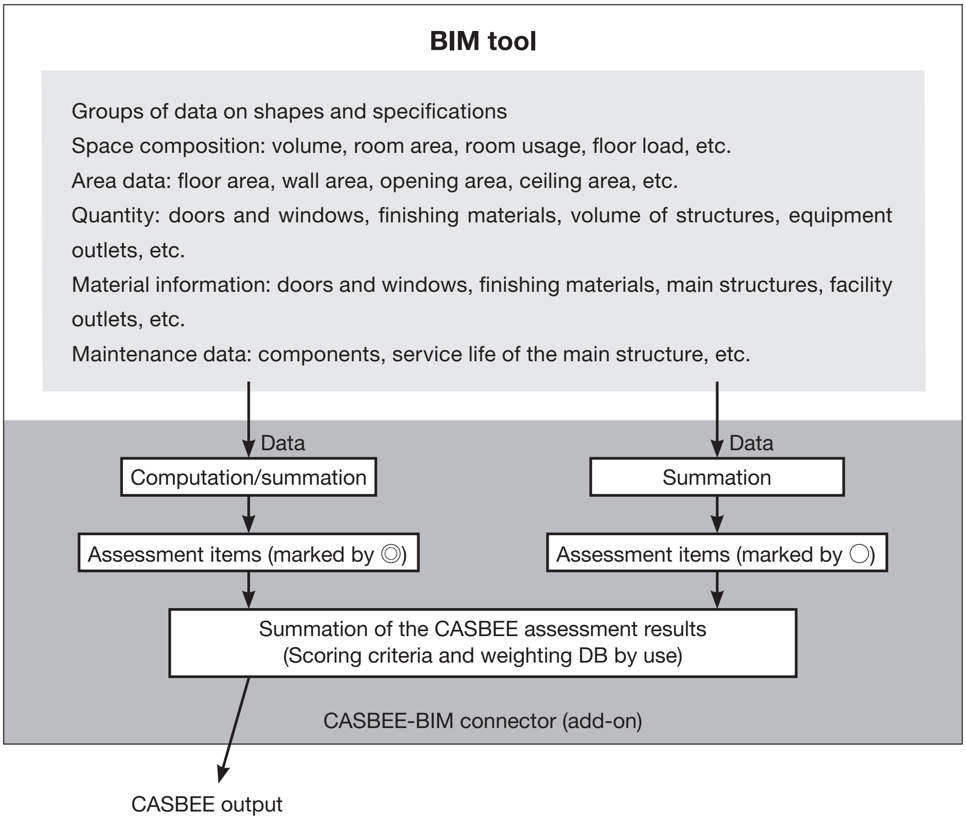

Figure 3.7.3: Conceptual image of how BIM and CASBEE tools are connected to each other

3.7.4.2. Basic concept for determination of which assessment items should be included

Although there are several purposes for the integration of CASBEE with the BIM tool, the most important for the CASBEE developers is the assessment simplification that can lead to more common usage of the tool. In developing the connector, a questionnaire survey on the levels of difficulty in handling the CASBEE assessment items was first conducted among those in the field. Reflecting their opinions and focusing primarily on the simplification of CASBEE assessment, 13 assessment items (as listed in Table 3.7.1) were selected to be included in the assessment by the first version of connector.

Specifically, especially prioritized for inclusion were the assessment items requiring complicated calculations in the environmental engineering field in spite of being categorized in the field of building design (e.g., heat transmission coefficient, sun-shading rate, PAL, daylight factor, or those marked by ◎ in Table 3.7.1). The assessment items that need no complicated calculation but selection and addition of relevant numerical values obtained by BIM were also included (those marked by ○ in Table 3.7.1).

Table 3.7.1: Prioritized items for inclusion in CASBEE assessment

Prioritized items for inclusion in the assessment by the connector (13 items)			
Q1 Indoor environment	2. Thermal environment	2.1.3 Perimeter performance	◎
	3. Lighting & illumination	3.1.1 Daylight factor	◎
		3.1.2 Openings by orientation	○
		3.1.3 Daylight devices	○
	4. Air quality	4.2.2 Natural ventilation performance	○
Q2 Quality of service	1. Service ability	1.1.1 Provision of space & storage	○
		1.2.1 Perceived spaciousness and access to view	○
		1.2.2 Space for refreshment	○
	3. Flexibility & adaptability	3.1.1 Allowance for floor-to-floor height	○
		3.1.2 Adaptability of floor layout	○
		3.3.6 Provision of backup space	○
LR1 Energy	1 Perimeter annual load (PAL) for buildings		◎
LR3 Off-site environment	3. Consideration of surrounding environment	3.2.2 Restriction of daylight obstructions	○

◎: Assessment items to be examined by architects but require calculations in the environmental engineering field
○: Assessment items that demand a lot of time and effort, but can be calculated by selecting and adding up the relevant numerical values

3.7.4.3. Basic concept for defining a spatial area to be evaluated

In CASBEE assessment, the definition of a space to be evaluated varies depending on assessment item and building usage. With regard to methods for spatial averaging and representing, the current manual provides no more than a set of rules because of the policy that emphasis should be placed on the simplicity of assessment. There are no detailed definitions yet.

On the other hand, when the BIM tool is used to perform averaging or representing, strictly defined rules are required. The conceptual system of room classification by the usage, which can be used for the assessment items in Table 3.7.1, was reviewed (applicable only to the whole building or the common areas). The currently used BIM tool has the capability to handle the concept of “rooms” and each room can be named accordingly. However, the BIM tool cannot recognize the difference among rooms from the perspective of their usage. It is therefore impossible to automatically calculate “the average of office rooms.” In the present process of developing/upgrading the connector, whenever assessment is conducted, the assessor has to select rooms to define a spatial area to be evaluated. When considering the application to third-party certification, etc., which necessitates detailed rules as a base for assessment, the "definition of rooms by use" becomes a crucial issue because it takes an impractically long time to assess many rooms and calculate their average. Such a definition is also essential for the process of other applications including thermal load calculation.

3.7.4.4. Flow of the assessment

By enabling CASBEE assessment to be easily conducted using the BIM tool, the results of CASBEE assessment can be roughly obtained when the basic data of a building in a project are determined (i.e., at the initial planning stage). This is useful for managing the environmental performance targets. Figure 3.7.4 is a flow chart of the assessment with use of the connector, which has been discussed by CASBEE-BIM WG.

On the other hand, in the current BIM tool, necessary information and indicators for CASBEE assessment are not prepared as a standard for the objects of construction materials and components. It is also difficult for users to provide detailed data for such information and indicators at the initial stage. However, if such data for such information and indicators are available from the initial stage, the assessment and feedback ([1] and [2] in Figure 3.7.4, respectively) can be performed very smoothly. The establishment of consensus between the client and the assessor is considered to be facilitated from a stage earlier than before. An advantage of BIM utilization is "front-loading." It is therefore essential to ask vendors to make sure that, as a standard, "construction materials" or "spaces" meet the level of the initial values of information or indicators necessary for the assessment.

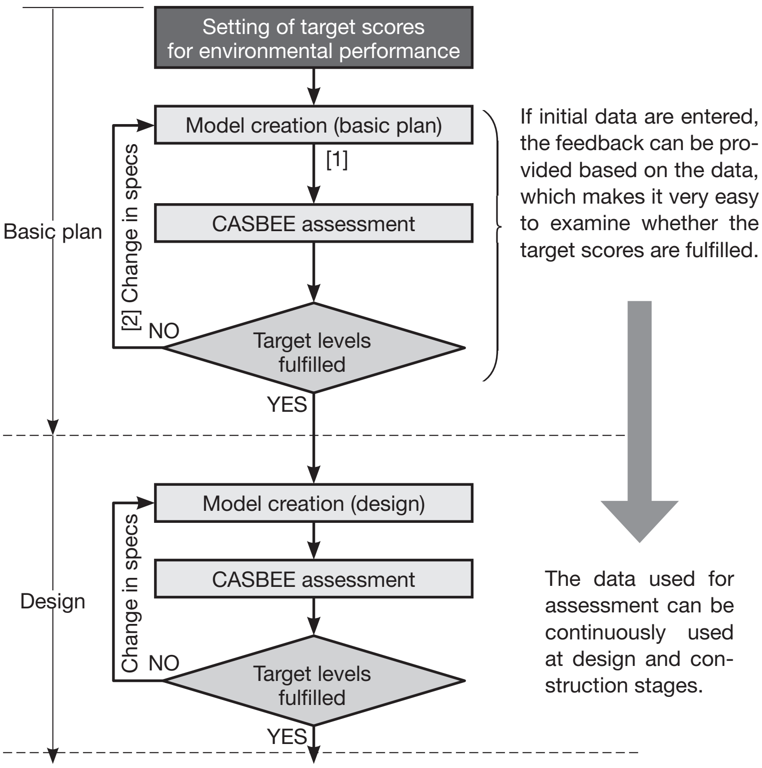

Figure 3.7.4: Flow chart of CASBEE assessment with use of the BIM tool

3.7.5. Future challenges

Besides what has been described so far, the major issues discussed by CASBEE-BIM WG at present are as follows:

a. Securing of the reliability of calculation results obtained by the BIM tool

b. In the process of the above-mentioned calculation, how to display the input items that are at the discretion of individual assessors

c. Automatic preparation of application documents for authorized third-party certificates of CASBEE assessment and application documents necessary for local government application

d. Simplification and rationalization of the CASBEE assessment system itself, to enable automatic assessment by BIM

In the process of developing an add-on CASBEE connector to the BIM tool, the concept of CASBEE assessment in the BIM tool was reviewed and challenges for developing the connector were clarified. Based on CASBEE assessment results to be obtained in further research, discussions will be conducted through case studies. The tool's effectiveness will also be improved by focusing on the two issues presented below.

a. Determine the initial values of data to be entered, which are necessary for CASBEE assessment: with regard to performance levels of walls, materials of openings etc., discuss possible methods, for example, to set the default option as the performance level roughly equivalent to Level 3 in the CASBEE assessment.

b. Improve the reliability by showing the calculation sheet, indicator level calculation or summation process check sheet, etc., in the CASBEE assessment and BIM tool.

Below is a summary of the general rules compiled through a series of work involved in the connector development and expected to be needed for upgrading the connector ("Guidelines on the Introduction of CASBEE Assessment into the BIM Tool").

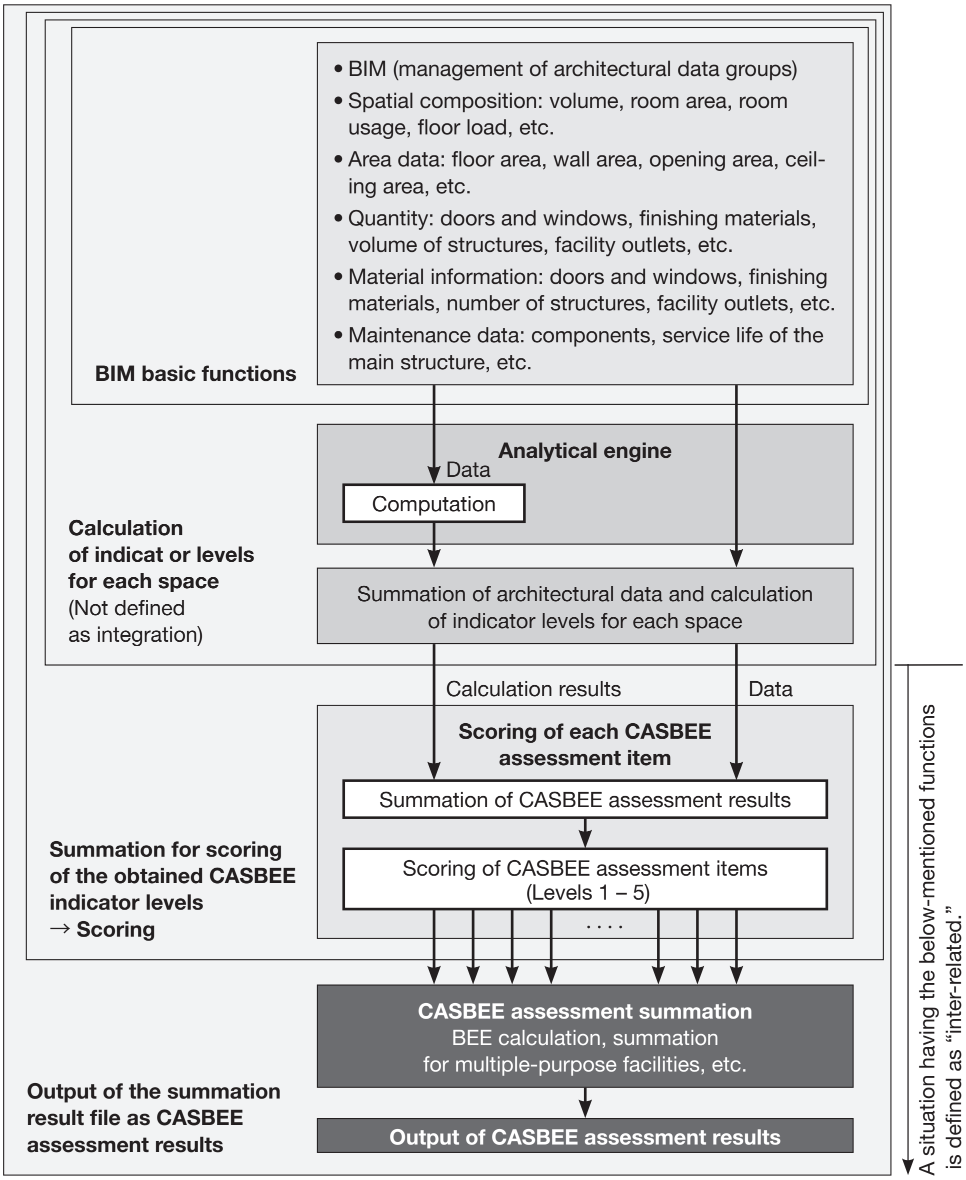

Figure 3.7.5: Definition of the integration between CASBEE and BIM tool

In the gidelines, the "integration" of CASBEE and other tools such as BIM means that the functions described in the lower part of the figure are operable. That is, simple calculation of some of the indicator levels necessary for CASBEE scoring is not sufficient to be regarded as integrated.

References

1) BIM Japan vol.1, X-Knowledge Co., Ltd. publisher, 2008 (in Japanese).

2) Iwamura, K., Development of CASBEE-BIM Connector, IBEC, 182, 10-14, 2011 (in Japanese).

4. CASBEE Promotion and Support Systems

4.1. CASBEE Accredited Professional Registration System

4.2. CASBEE Certification System

4.3. Building Administration systems

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4.1. CASBEE accredited professional registration system

CASBEE is based on making assessment as quantitative as possible, but it includes assessment items that are qualitative in nature. As such, it requires a specialized engineer with expertise and knowledge in the comprehensive environmental performance evaluation of buildings. That is why the CASBEE Accredited Professional Registration System was established. Those aiming to become accredited professionals must attend the training course, pass the examination and complete registration. Currently, the assessor training course and examination are held only in Japan.

The advantages of successful registration as an accredited assessor are as follows:
a. Demonstrating the ability to conduct accurate assessments in accordance with CASBEE
b. When applying for the certification system, assessments conducted by a qualified assessor are required.
c. When being entrusted by a third party to conduct CASBEE assessments as part of subcontracting work, an accredited professional should be involved in the assessments as specified in the assessor system outline.
d. Regarding submitting assessment results to a local government, the trend of mandatory assessments by an accredited professional has been growing (e.g., CASBEE Osaka Mirai).
e. The CASBEE assessment result is being requested in an increasing number of cases at the time of competition proposal and placing an order for design work, which reflects a growing need for accredited professionals.

There are 3 qualifications for a CASBEE Accredited Proffesional depending on the assessment tool the assessor is capable of using. Details of the individual assessor systems are described below.

4.1.1. CASBEE Accredited Professional for housing

CASBEE Accredited Professional for Housing covers CASBEE for New Detached Houses and CASBEE for Existing Detached Houses (for Existing Buildings). The qualification is necessary when evaluating a detached house in accordance with CASBEE. A qualified candidate for the examination should be one of the following: a first-class architect, a second-class architect or a registered architect for wooden buildings.

- Objective: Foster and accredit competent professionals exclusively for CASBEE-Home
- Course and Test: Twice a year, organized by IBEC
- Eligibility: First- and second-class architects, and architects for wooden buildings
- Number of registrants: ca.6,800 (as of December 2013)

4.1.2. CASBEE Accredited Professional for buildings

CASBEE Accredited Professional for Buildings covers tools presented in CASBEE for

New Construction, CASBEE for Existing Buildings and CASBEE for Renovation including their abridged versions. This qualification is required when evaluating buildings other than detached houses in accordance with CASBEE. The qualified candidates for the examination should be first-class architects.

- Objective: Foster and accredit competent professional of CASBEE-NC, EB, and RN
- Course and Test: Twice a year, organized by IBEC
- Eligibility: First-class architects
- Number of registrants: ca.7,100 (as of December 2013)

4.1.3. CASBEE Accredited Professional for market promotion

The CASBEE Accredited Professional for Market Promotion is a qualification required when conducting assessments in accordance with CASBEE for Market Promotion. People who are involved in management/operation or appraisal of real estate are supposed to use CASBEE for Market Promotion. Therefore, unlike assessors for housing and buildings, CASBEE for Market Promotion has no eligibility requirements for the examination.

Process for successful registration:
Pass the examination after completing the CASBEE Accredited Professional for Market Promotion course, and apply for registration. (Those who have already been registered as CASBEE Accredited Professionals for Buildings are exempt from the examination as an exception.)

- Eligibility: N/A (Candidates must be mainly specialized in the real estate industry including research, evaluation, effective utilization, management and operation.)
- Number of registrants: 370 (as of December 2013)

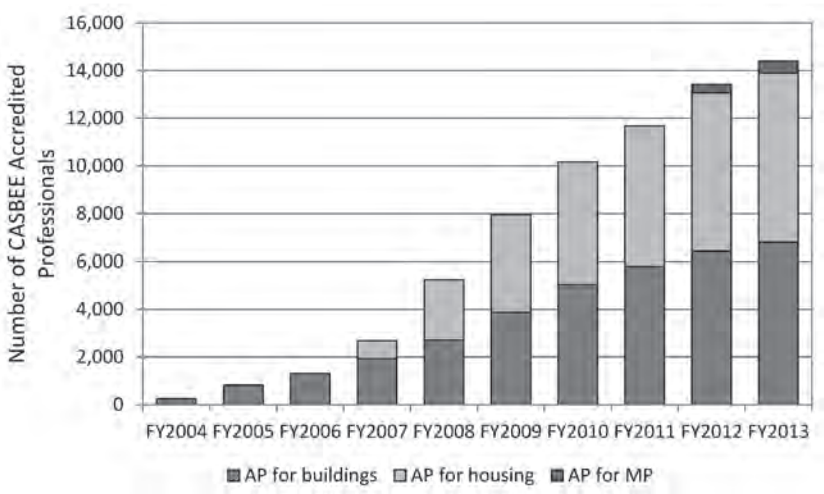


Figure 4.1.1: Cumulative numbers of CASBEE Accredited professionals (as of December 2013)

4.2. CASBEE certification system

4.2.1 Reporting system by local governments

Currently, 24 local governments in Japan employ the “Sastainable Building Reporting System (SBRS). ” In the system, all of the CASBEE-assessed buildings reported to the local governments’ assessment results (ranking) are available on the Internet. As of March 2013, the number of reported buildings exceeds 11,000 (see Section 4.3.2 & 6.2.3). CASBEE is an assessment system applied to a great number of private buildings (other than detached houses), which makes CASBEE very special and unique and which is one of its main features.

4.2.2. Certification for buildings

CASBEE Certification for Buildings is a system in which a third party examines and certifies assessment results provided by CASBEE for New Construction, Existing Buildings, Renovation and their brief versions. An application for certification must be accompanied by assessment results provided by a CASBEE Accredited Professional for Buildings described above. Since the system started in 2004, over 230 buildings throughout Japan have so far been certified. A certificate and the emblem shown below are issued to certified buildings.

- Target: CASBEE for New Construction, Existing Buildings, Renovation and their abridged versions
- Certification body: Institute for Building Environment and Energy Conservation (IBEC) and 14 private institutions approved by IBEC
- Number of certified buildings: 232 (as of December 2013)

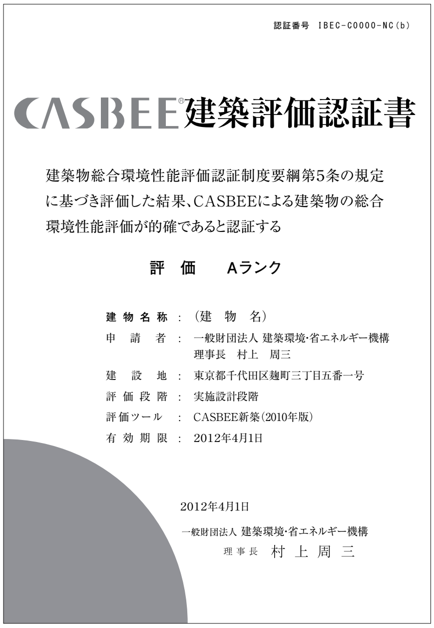
4.2.3. Certification for housing

CASBEE Certification for Housing is a system in which a third party examines and certifies assessment results prepared in accordance with CASBEE for New Detached Houses. An application for certification must be accompanied by assessment results provided by a CASBEE Accredited Assessor for Housing described above.

- Target: CASBEE for New Detached Houses
- Certification body: Institute for Building Environment and Energy Conservation (IBEC) and 5 private institutions approved by IBEC
- Number of certified houses: 104 (as of December 2013)

4.2.4. Certification for CASBEE for market promotion

Certification for CASBEE for Market Promotion is a system in which a third party examines and certifies assessment results prepared in accordance with CASBEE for Market Promotion. An application for certification must be accompanied by assessment results provided by a CASBEE Accredited Professional for Market Promotion described above. Since the first certification of this system in December 2013, 38 certificates have been issued. The certificate is expected to be used when buying and selling real estate in the future as evidence that clearly demonstrates the building’s environmental performance.



認証番号　IBEC-C0000-NC(b)

CASBEE®建築評価認証書

建築物総合環境性能評価認証制度要綱第5条の規定に基づき評価した結果、CASBEEによる建築物の総合環境性能評価が的確であると認証する

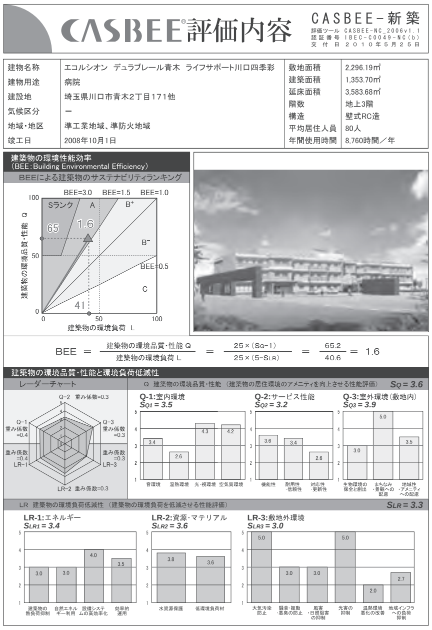
評　価　　Aランク

建物名称	：	（建　物　名）
申請者	：	一般財団法人 建築環境・省エネルギー機構 理事長　村上　周三
建設地	：	東京都千代田区麹町三丁目五番一号
評価段階	：	実施設計段階
評価ツール	：	CASBEE新築(2010年版)
有効期限	：	2012年4月1日

2012年4月1日

一般財団法人 建築環境・省エネルギー機構
理事長　村上周三

Certificate



Assessment Result

Figure 4.2.1: CASBEE-NC Certificate

Figure 4.2.2: CASBEE Certificate Emblem

4.3. Building administration systems

4.3.1. CASBEE as a policy instrument at national government level

Since the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) stipulated its environmental action plan in 2004, when the importance, visibility and expression of assessments of environmental performance of buildings were increasing, CASBEE has been clearly positioned as a promotional tool for such governmental policies.

The importance of the popularization of CASBEE has been demonstrated in efforts for improving environmental performance of governmental facilities such as the MLIT Government Buildings Green Program and policies for nationwide measures to combat climate change including the Evaluation and Review of the Kyoto Protocol Target Achievement Plan and the Innovation Plan for Environmental Energy Technology. CASBEE is also actually adopted as an indicator tool for determining the level of environmental performance in the Leading Project for Promoting CO_2 Reduction in Housing and Buildings and the Certification of Low-Carbon Buildings in which the government provides subsidies to eco-friendly buildings.

The Certification of Low-Carbon Buildings is a system based on the Eco-City Act that allows certified buildings to receive tax benefits or easing of requirements in the floor area ratio. The determination based on comprehensive assessments of environmental performance varies depending on individual local governments. However, currently, 8 local governments have adopted CASBEE for conducting certification.

Environmental Action Plan of MLIT, enacted in June 2004

MLIT Government Buildings Green Program
(MLIT Government Buildings Department, August 2006)

Fully adopting CASBEE as Standards for Planning Green Government Buildings
Fully adopting CASBEE as Standards for Green Assessment and Renovation Plan

Evaluation and Review of the Kyoto Protocol Target Achievement Plan
(Global Warming Prevention Headquarters, September 2007)

Noting the importance of widening the range of buildings covered by CASBEE tools
and promoting their use

Leading Project for Promoting CO_2 Reduction in Housing and Buildings
(MLIT, since April 2008)

Fully adopting CASBEE as an assessment index for selecting businesses in the subsidy system

Innovation Plan for Environmental Energy Technology
(Council for Science and Technology Policy, Cabinet Office, May 2008)

Presenting CASBEE as a social system technology, the development of which is to be promoted

Low Carbon City Promotion Act (Abbreviation: Eco-City Act) (2012)

Local governments adopt CASBEE as standards for low-carbon building certification.

Figure 4.3.1: Governmental policies using CASBEE as an instrument

4.3.2. CASBEE as policy instrument at local government level

4.3.2.1. Sustainable building reporting system

CO_2 emissions from the private sector (commercial and households sectors) continue to grow in Japan. Especially after the ratification of the Kyoto Protocol, governments are being pressured to take immediate action to reduce CO_2 emissions and enhanced regulations in the abovementioned sectors. Now, 24 local governments employ the “Sustainable Building Reporting System (SBRS)” regulation targeting the commercial sector and housing sectors. For buildings, planning is important as they exist for a very long time once built. The system incorporates environmental performance assessment for buildings before construction. Through the system, a number of buildings are assessed for environmental performance; therefore, the system is expected to drive the market toward further sustainability.

The system requires large building owners to submit a building environmental plan and the government to publish said plan on the website. The purpose of the system is to encourage building owners to carry out voluntary efforts to reduce environmental load and create a market that will highly value environmentally sound and high-quality buildings and structures. The outline of SBRS is as follows:

Building owners themselves evaluate buildings in terms of measures they have carried out to consider the environment in accordance with the guidelines provided by the government.

The government publishes the environment-conscious measures to be taken by building owners and their evaluation on its website.

The government may provide some incentives to help building owners carry out voluntary measures.

Table 4.3.1 shows local authorities that have introduced SBRS. Under the required ordinances and guidelines, building owners are asked to carry out a comprehensive assessment of their buildings’ environmental performance when a building above a certain size is newly constructed. Most local governments, except the Tokyo Metropolitan Government and Chiyoda Ward, have adopted CASBEE for their SBRS.

4.3.2.2 Built environment performance indication system

Although results of the self-evaluation of built environment performance are published on the website, it is not easy for many people to actually find out this information for home purchases. The Built Environment Performance Indication System is a program in which environmental performance must be displayed in advertising medium, such as flyers, websites, pamphlets and magazines. The objectives of the system are:

(1) To provide potential buyers with a choice in relation to environmental performance according to the self-evaluation through SBRS as common ground.

(2) To build a mechanism by which market players appreciate and fairly value the buildings with excellent environmental performance in the market.

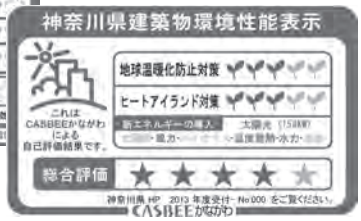
(3) To encourage housing suppliers and developers to make voluntary efforts and cooperate in disseminating environmental protection measures.

Table 4.3.1 Municipalities having adopted CASBEE in their policies

Municipals	Started	Subject Building	Indication program
Nagoya City	2004.04	New construction or extension having over 2,000 m^2 total floor area	
Osaka city	2004.10	New construction or extension having more than 2,000 m^2 total floor area New construction applied for extra maximum floor-area ratio more than 1,000 m^2 site area	☑
Yokohama city	2005.07	New construction or extension having more than 2,000 m^2 total floor area	☑
Kyoto city	2005.10	New construction or extension having more than 2,000 m^2 total floor area	
Kyoto prefecture	2006.04	New construction or extension having more than 2,000 m^2 total floor area	
Osaka prefecture	2006.04	New construction or extension having more than 2,000 m^2 total floor area	☑
Kobe city	2006.08	New construction or extension having more than 2,000 m^2 total floor area	☑
Kawasaki city	2006.10	New construction or extension having more than 2,000 m^2 total floor area	☑
Hyogo prefecture	2006.10	New construction or extension having more than 2,000 m2 total floor area	
Shizuoka prefecture	2007.07	New construction or extension having more than 2,000 m2 total floor area	
Fukuoka city	2007.10	New construction or extension having over 5,000 m2 total floor area	☑
Sapporo city	2007.11	New construction or extension having more than 2,000 m^2 total floor area	
Kitakyushu city	2007.11	New construction or extension having more than 2,000 m^2 total floor area	☑
Saitama city	2009.04	New construction or extension having more than 2,000 m^2 total floor area	
Saitama prefecture	2009.10	New construction or extension having more than 2,000 m^2 total floor area	☑
Aichi prefecture	2009.10	New construction or extension having over 2,000 m^2 total floor area	
Kanagawa prefecture	2010.04	New construction or extension having more than 2,000 m^2 total floor area	☑
Chiba city	2010.04	New construction or extension having more than 2,000 m^2 total floor area	
Tottori prefecture	2010.04	New construction or extension having more than 2,000 m^2 total floor area	
Niigata city	2010.04	New construction or extension having more than 2,000 m^2 total floor area	
Hiroshima city	2010.04	New construction or extension having more than 2,000 m^2 total floor area	☑
Kumamoto prefecture	2010.10	New construction or extension having more than 2,000 m^2 total floor area	☑
Kashiwa city	2011.01	New construction or extension having more than 2,000 m^2 total floor area	☑
Sakai city	2011.08	New construction or extension having more than 2,000 m^2 total floor area	☑

Kawasaki City

Osaka City



Kanagawa Prefecture

Yokohama City

Figure 4.3.2: Municipal indication systems of the built environment performance

4. CASBEE Promotion and Support Systems

5. Benefits through CASBEE usage

5.1. Relationship between BEE Index, Energy/CO_2e Conservation and Cost

5.2. Incentives Provided by Local Governments

5.3. Health promotion in housing and community

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5.1. Relationship between BEE Index, Energy / CO_2e conservation and cost

5.1.1 Green government buildings and CASBEE

In order to reduce environmental impact due to the development of public facilities by the government, the Standards for and Commentaries on Green Government Buildings, edited by the Government Buildings Department, the Secretariat of the Minister of Land, Infrastructure, Transport and Tourism, were published in 2006. (For details, please refer to "6.2.2. Examples of Utilization by the Government, <Case-1> Governmental Buildings")

Regarding public facilities, environmental performance assessments during the planning stage have been requested. In addition to assessments on $LCCO_2$ (CO_2 emissions), LCR (resource consumption), LCW (wastes) and LCC (costs), tools from CASBEE for New Construction (brief version) are included. Figure 5.1.1 shows a BEE (Built Environment Efficiency) chart on which the relationships between CASBEE, $\Delta LCCO_2$ (life-cycle reduction rate of CO_2 emission) and ΔIC (increase rate of initial construction costs) are plotted in terms of various design specifications for a model government building having a total floor area of 3,000 m^2, presented in the Standards for and Commentaries on Green Government Buildings. The BEE value for a model government building having the standard design specifications in 1990 was 0.9 (Rank B-), which is almost the same level as the average office buildings nowadays. If the model government building is designed using the current standard specifications, the BEE value will increase to 1.4 (Rank B+); in addition, $\Delta LCCO_2$ will be reduced by 5% compared to the one using the standard design specifications in 1990. On the other hand, ΔIC needs to increase by 1% as a budget for environmental measures. Further, regarding the current green government building sample having versatile environmental technologies, the BEE value will increase to 2.1 (Rank A); in addition, $\Delta LCCO_2$ will be reduced by 15%. However, a 3% increase in ΔIC will be necessary in order to secure a budget for the environmental measures. In this manner, we are now able to study the relationships between CASBEE, the reduction rate of $LCCO_2$ and a budget for environmental measures, which have never been very clear until now.

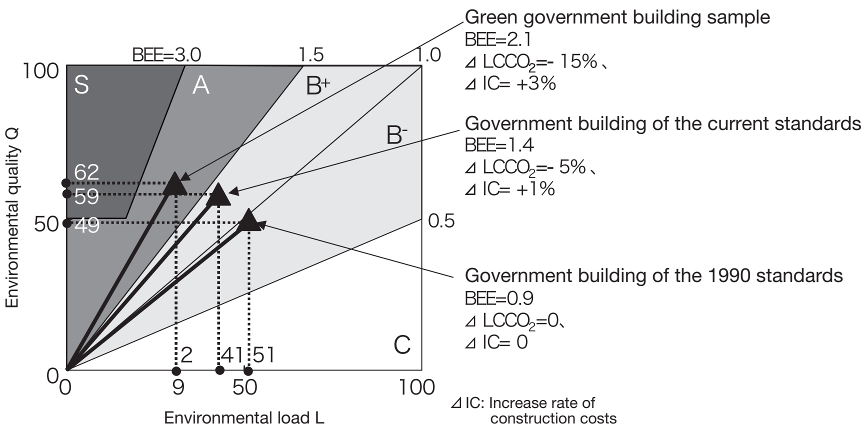

Figure 5.1.1: Sample study of the relationship between CASBEE, reduction rate of $LCCO_2$ and increase rate of construction costs in model government buildings

5.1.2: Performance improvement effects of CASBEE in government buildings, hospitals and schools

Figure 5.1.2 shows a chart in which the relationships between the BEE value of CASBEE and the reduction rate of $LCCO_2$ are plotted in terms of various design specifications for model facilities representing buildings of the central government and the Tokyo Metropolitan Government, hospitals and high schools.

Symbol ○ represents the study results for government buildings. According to the regression line, using the BEE value around zero (between Rank B- and B+) as a benchmark, we can see the relationship between the BEE value and the reduction rate of $LCCO_2$ that indicates when the BEE value is around 1.5 (between Rank B+ and A), the reduction rate of $LCCO_2$ is 10%. Similarly, when the former is around 3 (top of Rank A), the latter is about 30%. Hospitals and high schools are slightly different due to their specific purposes of use and the difference in standard design specifications. However, we can see from the chart that the larger the BEE value is (the higher the CASBEE rank is), the more the reduction rate of $LCCO_2$ is expected.

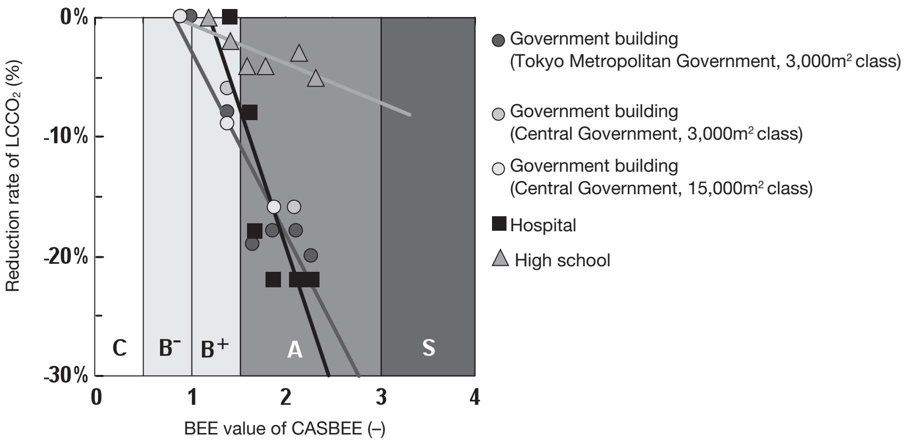

Figure 5.1.2: Relationship between the BEE value and the reduction rate of $LCCO_2$ in government buildings, hospitals and high schools

Figure 5.1.3 uses the same case study described above and shows the increase rate of initial construction costs due to the implementation of environmental measures, including energy-saving, longer service life and the adoption of eco-materials, on the vertical axis. For example, take the government building represented by ○, using the BEE value around zero (between Rank B- and B+) as a benchmark, we can see the relationship between the BEE value and the increase rate of initial construction costs due to the implementation of environmental measures that indicates when the former is around 1.5 (between Rank B+ and A), the latter is about 3%. Similarly, when the former is around 3 (top of Rank A), the latter is about 15%. Hospitals and high schools are slightly different due to their specific purposes of use and the difference in standard design specifications. However, we can see from the chart that it is necessary to secure a sufficient budget for implementing environmental measures in order to achieve a high BEE value (to advance in the CASBEE rank).

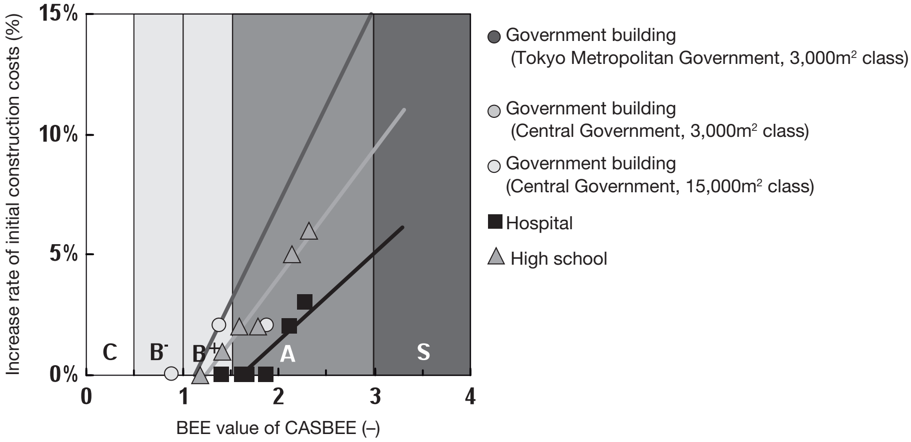

Figure 5.1.3: Relationship between the BEE value and the increase rate of construction costs in government buildings, hospitals and high schools

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[1] Standards for Green Government Buildings and Commentaries, edited by the Government Buildings Department, the Secretariat of the Minister of Land, Infrastructure, Transport and Tourism, Public Buildings Association, January 2006

[2] Hayashi T., Fujiwara T., Ibe G., Tokita S., Ikaga T. and Endo J.: Development of LCA tool to evaluate the effect of environmental techniques for Tokyo Metropolitan Government facilities, AIJ J. Technol. Des. No. 23, (2006), pp. 253-258 [in Japanese]

5.2. Incentives provided by local governments

Many Japanese local governments have introduced various types of incentives for encouraging building owners to build high ranked CASBEE buildings.

In the city of Osaka, the rating should at least reach the B+ rank, the third of CASBEE's five grades, if the approval for increased maximum floor area ratio is given to the building being assessed. Many local governments have urban development schemes in which developers can obtain extra floor area ratio, and some utilize the Sustainable Building Reporting System (SBRS) as a condition for approval. In Nagoya, a 250% maximum floor-space ratio will be given if the buildings are S-ranked by CASBEE, whereas 200% will be given to the A-ranked buildings. Financial support can be provided for high score buildings based on SBRS. Tottori Prefecture uses SBRS to subsidize detached houses that are A-ranked by CASBEE for housing. The city of Kitakyushu also subsidizes residential buildings selected that at least reach the B+ rank.

Some of the major incentives provided by local governments are described below.

5.2.1. Subsidies, an increase in the floor area ratio, etc.

Nagoya City:

Upon applying the Comprehensive Design System, a further increase in the floor area ratio is allowed depending on the assessment based on CASBEE Nagoya. (The maximum allowable ratio is usually 200%. However, for buildings rated as Rank S, the relaxing of the ratio is extended up to 250%.)

Kitakyushu City:

- Utilizing as requirements for adoption in the Project for Apartment Buildings Supply in Major Urban Areas (Rank B+ and over)
- Offering subsidies to households moving in from outside the city for buying and building a house as part of the project for supporting and encouraging long-term residency in Kitakyushu City (up to 1 million yen)
- Utilizing as requirements for adoption in the subsidy system for mortgage interest rates (Rank B+ and over)

Fukuoka City:

- Utilizing rankings of CASBEE Fukuoka as one of the requirements for an increased floor area ratio in the measures concerning the promotion of renewal of inner-city functions in Fukuoka City

Tottori Prefecture:

- Buildings rated as Rank A or over in CASBEE Tottori (Detached Houses) are entitled to an extra 70,000 yen on top of the subsidy. (The subsidy program for eco-friendly wooden housing)

Kumamoto Prefecture:

- Utilizing as requirements for adoption in global warming countermeasures for small and medium enterprises

Saitama Prefecture:
- Upon applying the Comprehensive Design System, a further increase in the floor area ratio is allowed up to 20% depending on the score given to major items of CASBEE Saitama.

Kashiwa City:
- Upon applying the Comprehensive Design System, a further increase in the floor area ratio is allowed for buildings rated as Rank S in CASBEE Kashiwa.

5.2.2. Implementation of award systems utilizing CASBEE

Osaka City:
- CASBEE Osaka Mirai of the Year

Osaka Prefecture:
- Osaka Sustainable Building Award

Saitama Prefecture:
- Environmental Architecture Housing Award (General architecture section)

Kanagawa Prefecture:
- Kanagawa Global Warming Countermeasures Award

Shizuoka Prefecture:
- Eco-friendly Architecture Award of the Community and Envi-ronmental Affairs Department, Shizuoka Prefecture

Kashiwa City:
- Kashiwa City Eco-friendly Architecture Award

5.2.3. Implementation of certification and financial systems in individual municipalities

Yokohama City:
- Applying Yokohama City's unique certification system to applicants from owners of newly built buildings registered in Yokohama City (8 buildings as of December 2013)

In addition, many local governments implement preferential interest rate systems in collaboration with financial institutions. Depending on the CASBEE score submitted to individual local governments, they provide a preferential interest rate for people with mortgages and low-interest financing for small and medium-sized businesses through financial institutions. Some of the examples are described below.

Nagoya City:
- For people who bought a detached house, depending on the score of CASBEE Aichi (Detached House), a preferential mortgage interest rate is available through a financial institution.

Yokohama City, Kitakyushu City, Aichi Prefecture, Tottori Prefecture and Kashiwa City:
- Depending on the CASBEE score, a preferential mortgage interest rate is available for people who bought a detached house or a condominium.

Kawasaki City, Sapporo City, Saitama Prefecture, Saitama City and Niigata City:
- Depending on the CASBEE score, a preferential mortgage interest rate is available for people who bought a condominium.

Hiroshima City:
- Depending on the CASBEE score, a preferential interest rate is available for people who bought a condominium.
- Providing a low-interest financing system financed by the Environmental Conservation Fund (a special loan) for small and medium-sized businesses

5.2.4. Collaborative incentive with finantial sector

The financial sector, such as banks, may utilize such information to offer better interest rates to consumers who purchase houses. In most cities that introduce SBRS and the Building Environmental Performance Indication System, there are several banks offering better interest rates for home-purchase loans according to environmental performance based on the published building environmental plan or the displayed building environmental performance indication of their house. For instance, up to a 1.5% reduction in the interest rate is available for consumers who bought units assessed as S-ranked by CASBEE-Kawasaki.

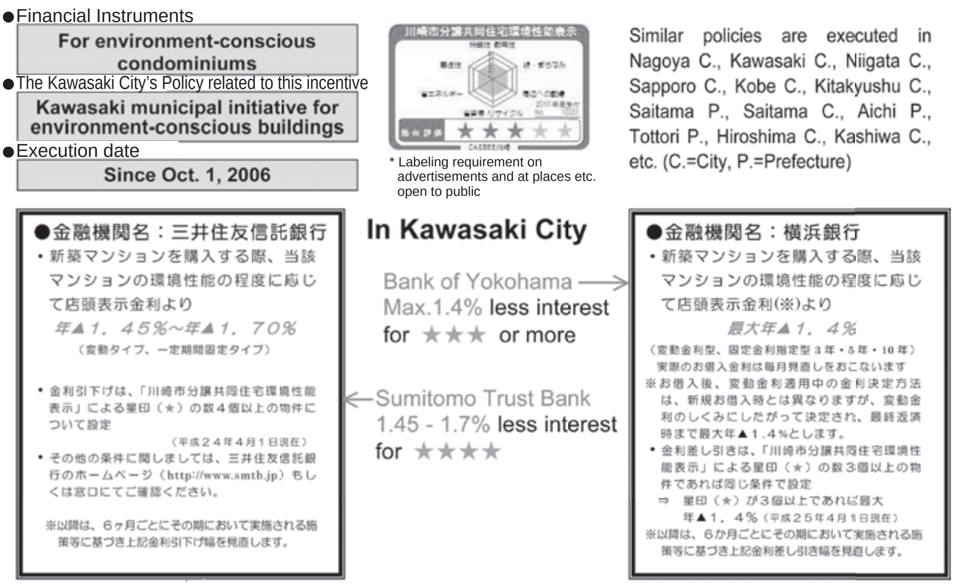

Figure 5.2.1: Collaborative incentive with a bank in Kawasaki City

5.3. Health promotion in housing and community

5.3.1. Health promotion in housing

5.3.1.1. Introduction

Housing serves as an important basis for human life, and the establishment of a living environment that promotes the health of residents is a pressing issue. In this social context, numerous studies and research were conducted in the past, from which we gained extensive knowledge about the relationship between the living environment and the health condition of the residents. (Ando, et.al. 2011, 2012) (Ikaga, et.al. 2011) (Takayanagi, et.al. 2011) (Hayama, et.al. 2011)

This chapter utilizes the checklist of CASBEE for Detached Houses described in Chapter 3.2 and introduces results of a survey on the relationship between the actual living environment across the country and the health condition of residents. (Kawakubo, et.al. 2012)

5.3.1.2. Questionnaire overview

A large-scale questionnaire was conducted directed at residents of detached houses across the country, from which we could understand the level of housing environmental performance and the health condition of residents. In order to understand the housing environmental performance, we utilized “CASBEE for Detached Houses Health Checklist,” which enables a comprehensive assessment of housing health. The checklist consists of a total of 44 check items. Each item is given 0 to 3 points depending on the answer and the maximum score is 132 points, from which we can evaluate the housing health of our own home. Using this checklist, we conducted a survey on the actual environmental performance of more than 5,000 households throughout the country at the end of 2010. An additional survey was also conducted at the beginning of 2011 to understand the health condition of residents of respective houses. The overview of the 2 questionnaires is shown in Table 5.3.1. Health problems addressed in the additional survey are shown in Table 5.3.2.

Table 5.3.1: Questionnaire overview

Target	Residents of detached houses across the country
Method	Online questionnaire
Term	First survey Nov. 26, 2010-Nov. 29, 2010 Second survey Feb. 17, 2011-Feb. 21, 2011
Collection rate	First survey 97.0% Second survey 93.5%
Quantity of final valid responses	5,497 households (23,677 people including live-in family members)
Positioning of first survey and questions	Purpose: Assessment on the housing environment of detached houses across the country using CASBEE for Detached Houses Health Checklist 1. Questions concerning attributes of respondents and their family members 2. Questions concerning housing environment (Health Checklist)

Target	Residents of detached houses across the country
Positioning of second survey and questions	Purpose: Understanding of lifestyles of detached house residents and their health conditions 1. Questions concerning attributes of respondents and their family members 2. Questions concerning lifestyles 3. Questions concerning health conditions of respondents and their family members

Table 5.3.2: Health problems addressed in questionnaire

Disorder of endocrine system	Diabetes mellitus E10–E14
Ophthalmopathy	Disorders of conjunctiva H10–H13
Circulatory condition	Hypertensive diseases I10–I15Heart diseases I20–I52Cerebrovascular diseases I60–I69
Lung disease	Other diseases of upper respiratory tract J30-J39Chronic lower respiratory diseases J40-J44:Asthma J45
Skin disease	Dermatitis and eczema L20–L30
Musculoskeletal disorder	Inflammatory polyarthropathies M05–M14

Table 5.3.3: Overview of questionnaire items (First survey)

Health Checklist			
①Living room (7 questions)	②Bedroom (7 questions)	③Kitchen (5 questions)	④Bathroom/Washroom (7 questions)
⑤ Toilet (3 questions)	⑥Hallway (3 questions)	⑦Corridor/Stairs/ Storage (7 questions)	⑧House surroundings (5 questions)
⑨Nursing care service (6 questions) ※	Maximum score: 132 points (Depending on the answer, each question receives 0 to 3 points. The score consists of points gained from items ① to ⑧, 44 questions in total. 6 questions of ⑨ are excluded from the score count for the time being.		
Attributes and health conditions of respondents			
Sex	Age	Number of family members living together	Number of family members aged 6 or younger
Number of family members aged 65 or older	Number of family members having poor health	Average number of hours at home on weekdays	Floor number
Housing structure	Materials for window sash in the bedroom	Number of windowpanes in the bedroom	Postal code
Annual income of the head of household	Final academic qualification of the head of household	Efforts to stay healthy	Interest in the relationship between housing and health
Current health condition	Concerns about health	Rooms in which heating is on in the winter and the frequency of use	Health condition in winter
Rooms in which air-conditioning is on in summer and the frequency of use	Health condition in summer	Overall health condition of family members living together	Enthusiasm for improving housing environment

Table 5.3.4: List of questionnaire items (Second survey)

Respondent/Basic housing information			
Sex	1) Male 2) Female	Age	1) 30s 2) 40s 3) 50s 4) 60s
Living expense (Utilities)	1) Less than 50,000 yen 2) 50,000 yen and over to less than 100,000 yen 3) 100,000 yen and over to less than 150,000 yen 4) 150,000 yen and over to less than 200,000 yen 5) 200,000 yen and over to less than 250,000 yen 6) 250,000 yen and over to less than 300,000 yen 7) 300,000 yen and over 8) Don't know	Living expense (Medical care)	1) Less than 50,000 yen 2) 50,000 yen and over to less than 100,000 yen 3) 100,000 yen and over to less than 150,000 yen 4) 150,000 yen and over to less than 200,000 yen 5) 200,000 yen and over to less than 250,000 yen 6) 250,000 yen and over to less than 300,000 yen 7) 300,000 yen and over 8) Don't know
Residential floor area	1) Less than $90m^2$ 2) $90m^2$ and over to less than $110m^2$ 3) $110m^2$ and over to less than $130m^2$ 4) $130m^2$ and over to less than $150m^2$ 5) $150m^2$ and over to less than $170m^2$ 6) $170m^2$ and over to less than $190m^2$ 7) $190m^2$ and over 8) Don't know	Age of building	1) Less than 5 years 2) 5 years and over to less than 11 years 3) 11 years and over to less than 19 years 4) 19 years and over 5) Less than 31 years 6) 31 years and over 7) Don't know
Lifestyle /How to spend summer and winter			
Daytime sunlight ① Living room	② Bedroom 1) Large 2) Small 3) None	Preparation for summer heat	①Sunblind ②Ventilation through open windows ③Wearing summer clothes ④Water ingestion ⑤Using an electric fan ⑥Using air-conditioning during the day ⑦ Using air-conditioning during all the sleeping hours ⑧ Using air-conditioning for the first few hours while sleeping 1) Always 2) Sometimes 3) Never
Bathing method	①Number of times taking a bath in a week ②Number of times taking a shower in a week 1) 0 2) 1 3) 2 4) 3 5) 4 6) 5 7) 6 8) 7 and over		
Bath temperature	①Tepid (below 40°C) ②Average (approx. 41°C to 42°C) ③Hot (above 43°C) 1) 0 min. (not getting into a bath) 2) 1~5 min. 3) 6~10 min. 4) 11~15 min. 5) 16~20 min. 6) 21~30 min. 7) 31 min. and more	Ventilation while bathing	1) No ventilation 2) An electric fan only 3) An open window only 4) An electric fan and an open window
Health conditions of family members			
Chronic disease condition	①Respondent ②Spouse ③First child ④Second child ⑤Third child ⑥Father of respondent ⑦Mother of respondent ⑧Father of spouse ⑨Mother of spouse ⑩Others 1) Hypertensive diseases 2) Heart diseases 3) Cerebrovascular diseases 4) Diabetes mellitus 5) Asthma 6) Atopic dermatitis 7) Pneumonia 8) Inflammatory polyarthropathies 9) Allergic rhinitis 10) Disorders of conjunctiva 11) No chronic diseases 12) Don't know 13) Don't like to answer 14) No applicable family members	Symptoms experienced	①Respondent ②Spouse ③First child ④Second child ⑤Third child ⑥Father of respondent ⑦Mother of respondent ⑧Father of spouse ⑨Mother of spouse ⑩Others 1) Sick feeling while bathing in winter (December to February) 2) Heat stroke at home in summer (June to August) 3) None 4) Don't know

5.3.1.3 Relationship between the living environment and health conditions of the residents

Based on data obtained through questionnaires, we conducted a cross tabulation of the environmental performance of detached houses using the points scored in the CASBEE for Detached Houses Checklist and health conditions of the residents. The results of the cross tabulation are shown in Figure 5.3.1. According to the scores of the Checklist, the respondents are classified into 4 groups. By calculating the percentage of people with ill health in each group, we noticed that the group with the highest score has a low percentage of ill health in terms of respective health problems. At the same time, the percentage of healthy people having no chronic diseases is also high in the group with a high score.

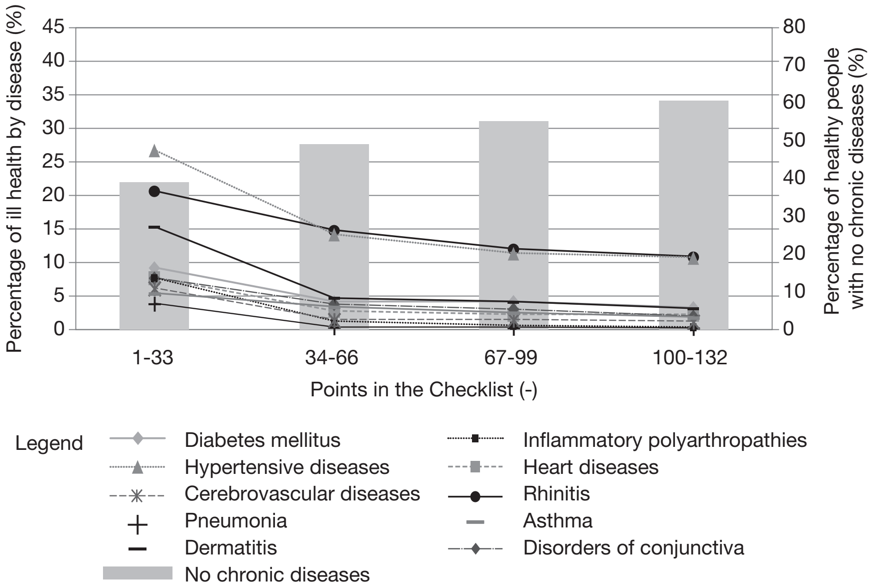

Figure 5.3.1: Relationship between scores and the percentage of ill health (All samples)

The results above indicate there is the possibility to improve the health conditions of residents by creating a suitable living environment. However, there may be some cases in which elderly people whose health conditions are likely to deteriorate compared to young people just happened to live in an old house in a bad living environment. Similarly, we also cannot deny the possibility that people on a high income who are careful about their health happened to live in a house in a favorable living environment. Accordingly, in order to clarify the relationship between the living environment and health conditions of the residents, we also ran another cross tabulation by age and income group. The age groups are classified as follows: (1) Below 30 years old, (2) 30 years old and above to below 60 years old, and (3) 60 years old and above. The income groups are classified into 3 groups as follows depending on the amount of equivalent income: (1) Less than 2 million yen, (2) 2 million yen and more to less than 4 million yen, and (3) 4 million yen and more. Figures 5.3.2 to 5.3.4 show the results by age group, whereas Figures 5.3.5 to 5.3.7 show those by income group. We can see from any of the results in Figures 5.3.2 to 5.3.7 that, as with the results from the first cross tabulation, groups with a high score in the Checklist have a low percentage of ill health in terms of respective health problems. This indicates that a good living environment serves as a basis for the good health of residents.

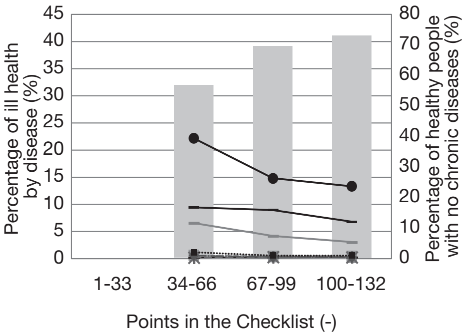

Figure 5.3.2: Relationship between scores and the percentage of ill health (Age group 1)

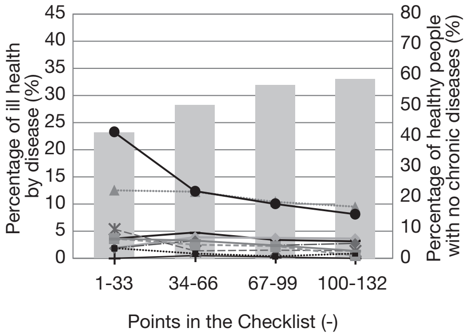

Figure 5.3.5: Relationship between scores and the percentage of ill health (Income group 1)

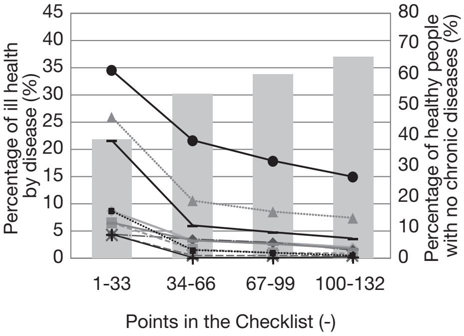

Figure 5.3.3: Relationship between scores and the percentage of ill health (Age group 2)

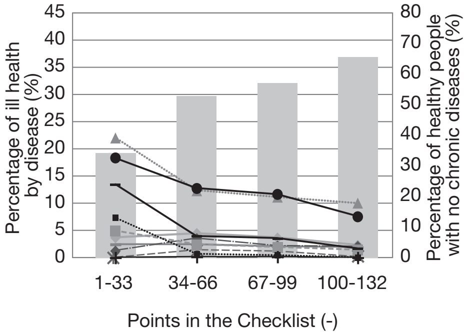

Figure 5.3.6: Relationship between scores and the percentage of ill health (Income group 2)

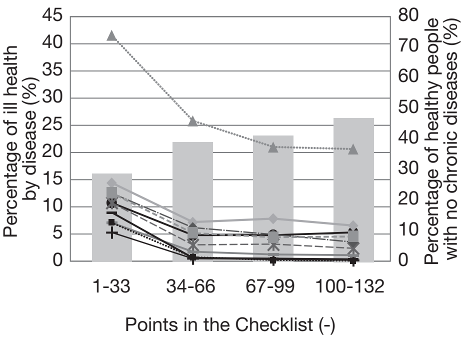

Figure 5.3.4: Relationship between scores and the percentage of ill health (Age group 3)

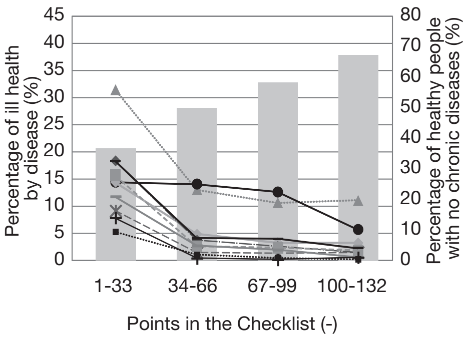

Figure 5.3.7: Relationship between scores and the percentage of ill health (Income group 3)

5.3.1.4 Conclusion

This survey indicated the possibility that improvements in the living environment would prevent respective health problems. The first step for health promotion was to enable residents to check their living environment by utilizing the CASBEE for Detached Houses Health Checklist in order to make them aware of their existing issues. There is no doubt that the housing industry has a large role in the establishment of a dynamic society through public health promotion.

Acknowledgement

This research was conducted as part of joint activities of the Health Maintenance and Housing Improvement Research Committee (chaired by Shuzo Murakami), the Health Maintenance and Housing Improvement Research Consortium (chaired by Shuzo Murakami) consisting of private enterprises and other organizations, and the Working Group for Economic Evaluation of the Health Maintenance and Housing Improvement Research affiliated with the Committee. We would like to express herewith our sincere gratitude for the cooperation from all persons concerned.

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5.3.2 Health promotion by improving local community environment

5.3.2.1. Introduction

The CASBEE Health Community Checklist is a community health check tool for evaluating the environment of house surroundings. With a combination of this tool and the CASBEE for Detached Houses Health Checklist, a housing health check tool, we will be able to create a healthy comfortable living environment. This chapter will introduce actual surveys conducted utilizing the CASBEE Health Community Checklist.

5.3.2.2 Questionnaire overview

As the first step to clarify the correlation between the community environment and the health condition of the residents, a survey utilizing the CASBEE Health Community Checklist has been promoted. In order to understand the actual situation of community environment, we use the CASBEE Health Community Checklist in which assessments are based on the points scored from 0 to 115 depending on the answers from residents. A separate questionnaire is also conducted to understand the health condition of residents. An analysis of the correlation between these two factors has been carried out. An overview of a nationwide Web-based questionnaire is shown in Table 5.3.5. The number of valid responses is 10,026 as indicated in Table 5.3.6. The numbers of valid responses in respective groups by age and sex are more or less evenly distributed.

Table 5.3.5: Online questionnaire overview

Survey method	Online questionnaire	
Target	Men and women aged 20 and above (Monitors from a Web survey company)	
Target city	148 municipalities including all prefectural capitals, government-ordinance-designated cities, core cities, special cities, future eco cities, and eco-model cities	
Extraction method	Random sampling by group (Age×Sex) in individual cities	
Survey type	First half questionnaire	Second half questionnaire
Survey period	Nov. 20-26, 2012	Dec. 10-12, 2012
Survey items	① Health condition of respondent, ② Lifestyle of respondent, ③ Attributes of respondent	④ Health checklist (Community and housing) ⑤ Level of activity of respondent
Valid response	10,026 (Percentage of valid responses: 69.57%)	

Table 5.3.6: Distribution of valid responses (Numbers in brackets are expressed in percentage)

Age	20-29	30-39	40-49	50-59	60-86	Total
Men	798 (8.0)	1,046 (10.4)	1,122 (11.2)	1,088 (10.9)	1,217 (12.1)	5,271 (52.6)
Women	774 (7.7)	954 (9.5)	998 (9.9)	1,029 (10.3)	1,010 (10.1)	4,755 (47.4)
Total	1,575 (15.7)	2,000 (19.9)	2,110 (21.0)	2,117 (21.2)	2,227 (22.2)	10,026 (100.0)

5.3.2.3. Relationship between community environment and health condition of the residents

A histogram of the Checklist scores is shown in Figure 5.3.8. The median and average values are both approximately 57. The histogram is in the form of a normal distribution having the median value of full points at the top. Excluding 6 cities in which the number of valid responses was less than 20, the calculation of scores in 142 cities indicated that cities such as Tama City, Kobe City and Suita City where large-scale new towns are located ranked high on the list. As shown in Table 5.3.7, the middle items indicate that indexes relating to infrastructures are high in urban areas, whereas provincial cities obtained high scores in terms of other indexes. On the other hand, disaster-affected areas and cities with a high crime rate ranked low on the list.

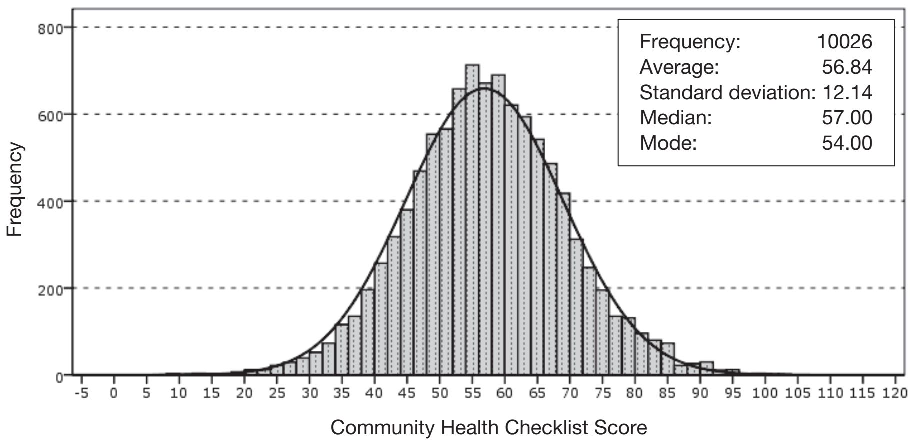

Figure 5.3.8: Histogram of checklist score

Table 5.3.7: Top 10 Scores by city

	Overall score	① Natural environment	① Safe and hygienic environment	③ Transport/ Travel	④ Participation in community activities	⑤ Use of facilities and services	⑥ Maintenance of facilities and services	⑦ Medical checkup facilities	⑧ Social capital
1	Takarazuka	Takayama	Kamaishi	Toyama	Hamamatsu	Chiyoda	Chiyoda	Chiyoda	Takayama
2	Tama	Kushiro	Toyama	Kushiro	Sakata	Shinagawa	Nishinomiya	Nishinomiya	Kamaishi
3	Chiyoda	Fujiyoshida	Tottori	Fukui	Kagoshima	Yokohama	Suita	Shinagawa	Higashi-matsushima
4	Kobe	Kitami	Yamaguchi	Sakata	Takayama	Hachioji	Tama	Suita	Ofunato
5	Suita	Izu	Kumamoto	Minamisoma	Tottori	Ibaragi	Shinagawa	Matsumoto	Iida
6	Otsu	Takarazuka	Iida	Obihiro	Himeji	Shinjuku	Shinjuku	Shinjuku	Hamamatsu
7	Kagoshima	Otsu	Matsue	Tottori	Toyoda	Tama	Kobe	Amagasaki	Suwa
8	Toyama	Yamaguchi	Fujiyoshida	Asahikawa	Mito	Nerima	Hiroshima	Obihiro	Izu
9	Hamamatsu	Miyakojima	Sakata	Iwanuma	Yamaguchi	Toyonaka	Amagasaki	Hamamatsu	Matsue
10	Takayama	Tama	Izu	Izu	Okazaki	Kobe	Kawaguchi	Miyazaki	Toyama

Figure 5.3.9 shows the relationship between the percentage of people with subjective symptoms and the average QOL relating to health by quartile in the Health Checklist score. As the score goes up, we can see the percentage of people having subjective symptoms in terms of all the health problems decreasing and the physical and mental QOLs increasing. The Kruskal-Wallis Test, which demonstrates the one-way analysis of variance, identifies differences between the 4 groups (Significance level: 0.1%).

In addition to the community, the result of analysis in view of the Housing Checklist scores is shown in Figure 5.3.10. The result indicates that the mental summary score of the group having the lowest scores both in housing and community is 44.45, whereas the group having the highest scores in both factors obtained 51.30, which confirms the fact that as the scores of both factors increase, the number of healthy people is likely to increase as well. The same observations are identified in the relationship between subjective symptoms and physical summary scores.

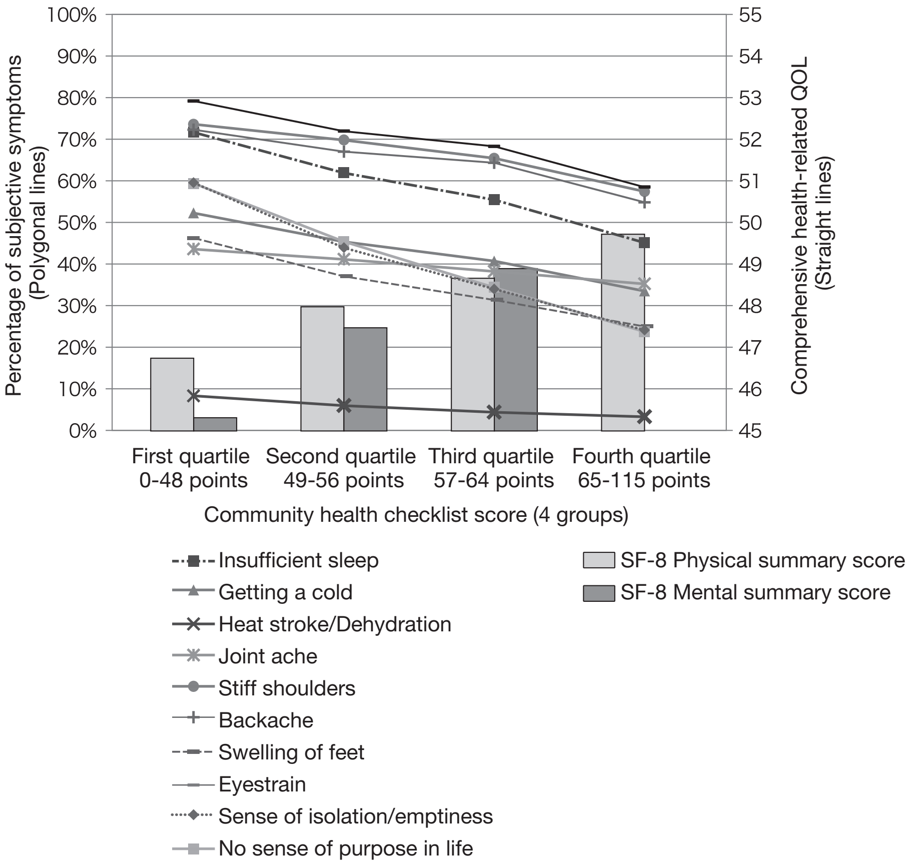

Figure 5.3.9: Correlation between community and subjective symptoms/QOL

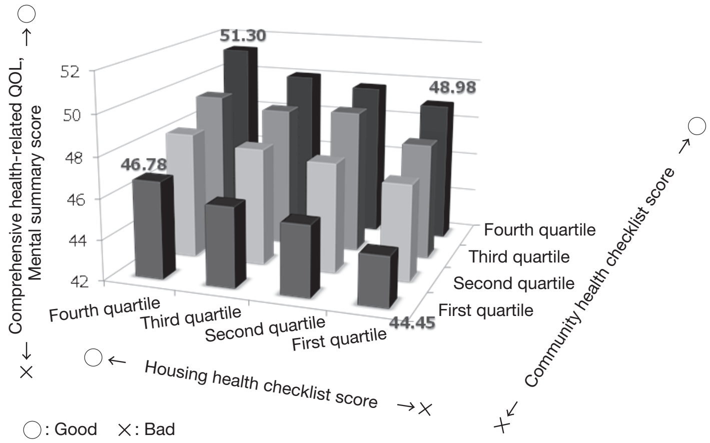

Figure 5.3.10: Correlation between housing/community and mental health

5.3.2.4 Conclusion

The result of large-scale nationwide questionnaires indicates that residents are likely to stay healthy in communities having a favorable environment. The combined use of the CASBEE for Detached Houses Health Checklist and the CASBEE Health Community Checklist enables a comprehensive evaluation of the housing environment, the result of which further indicates a significant correlation with the health condition of the residents. Residents and the government are expected to take a major role in checking the housing environment in order to create a favorable housing and community environment that contributes to the promotion of good health.

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6. Utilization and Dissemination of CASBEE

6.1. Overview

6.2. Utilization in governmental policies

6.3. Practical application

6.4. Utilization in education

6.5. Publicity and academic release

6.6. Overseas collaborations

<Column-7> The Chinese Green Building Labeling Systems and CASBEE
<Column-8> CASBEE-City in Putrajaya, Malaysia

6.7. CASBEE evaluation of vernacular houses

CASBEE®

A decade of Development and Application of an Environmental Assessment System for the Built Environment

6.1 Overview

6.1.1. Efforts made in 3 areas

The CASBEE assessment system was designed to reduce environmental load and to improve quality of life at the same time, the development of which was based on the assumption the system will be widely disseminated both in public and private buildings. Meanwhile, recently, the social demand for improvement in environmental management has been significantly increasing in every phase of a building's lifecycle. The efforts currently seem to be divided into the following two major groups:

(1) Establishment of a market foundation including the development of standards by public administrations, and efforts concerning policies relating to construction and the environment by the central government and local governments such as regulations and guidance

(2) Efforts made by companies and private businesses facing tough choices under market principles

The recent structural reforms promoted in the economy and society have been heading in the direction of deregulation. In the medium and long term, as companies are held socially responsible for their environmental ethics, and the significance of evaluation concerning the comprehensive environmental performance of buildings has been increasing in the market economy, the trend is expected to be based on (1) and to shift its focus on efforts centering on (2). The actual situation seems to shift in the same manner.

In the process of forming such spirit of the times, professional architectural education in universities and the Continuous Professional Development (CPD) for professional practitioners have become increasingly important. The efforts regarding practical use are classified into 3 categories: 1) Policy, 2) Practice, and 3) Education. Some examples and possible applications thereof will be described in the following section.

6.1.2. Political efforts

Various building regulations have recently been established in order to satisfy the needs of the economy and society, including the clarification of building standards and the regularization of performance in the Building Standard Law in response to globalization. Introductions and revisions of policies relating to various laws, standards and guidance for the purpose of enhancement of regulations concerning the building environment have been carried out one after another, examples of which include the Next Generation Energy-Saving Standards (1999), the Construction Material Recycling Law (2002), revisions of the Building Standard Law in response to Sick Building Syndrome (2003), and the Revised Energy-Saving Standards (2012). Especially in terms of the environment, we have clearly come into the era in which tighter regulations are required such as compulsory compliance with the Energy-Saving Standards. So, there seems to be the situation where the related policies are currently being disseminated after the initial stage of establishment and introduction in the midst of boosting social interest in environmental issues. In any case, experts engaged in the construction industry are expected to properly understand the current trend and to make efforts in a proactive manner in order to address the social needs as well as benefits to clients under the competitive situation of the private-sector-led society.

6.1.3. Practical efforts

A wide range of businesses are involved in the construction and operation of a building at every stage of its lifecycle. These businesses are expected in the era of increased global environmental awareness to clarify their efforts concerning environmental issues in society as part of their corporate philosophies or business policies. They should also take action in order to achieve their own objectives and to examine the results thereof.

As typified by the ISO 14001 series (the Environmental Management System), which has become very popular recently in Japan, the environmental management of buildings is also positioned as part of efforts made by private businesses. In order to promote securitization of buildings at home and abroad, implementation of the PFI, which encourages infusion of private-sector funds into public facilities, and the smooth development of the secondhand trading market, it is an urgent task to organize and unify information and history relating to the performance and quality of buildings using IT skills, and to establish a system in which such information may be retrieved whenever necessary. This kind of demand is projected to grow rapidly in the future, when CASBEE is expected to serve as a common scale.

6.1.4. Educational efforts

It is essential to acquire basic concepts and new technologies/programs relating to the planning, construction and operation of eco-friendly buildings in order to firmly establish the efforts described above in society. The essential actions are as follows:

(1) Cultivation of the next generation through education, especially in architectural education at universities

(2) Organizing training courses and other programs based on the CPD for experts engaged in actual practice

Some universities have already introduced the CASBEE assessment in their design education, which is utilized as practical course material in learning the way architecture should be in the global environmental era. (See “6.4. Utilization in education.”)

6.2 Utilization in governmental policies

6.2.1. Practical utilization

There are mainly 2 types of utilization of CASBEE by public administration, which are as follows:

(1) From the viewpoint of promoting the construction and environmental administration: Cases relating to political guidance concerning buildings

(2) From the viewpoint of public administration as a building owner: Cases in which public administration is engaged in placing orders and operation of public works construction

For example, some government-led initiative projects have been implemented such as the Guideline for Green Government Buildings by the Government Buildings Department, the Secretariat of the Minister of Land, Infrastructure, Transport and Tourism (MLIT), and the CO_2 Saving Promotion Initiative Project by the Housing Bureau of the MLIT. In recent years, we have seen a number of projects by local governments in consideration of regional characteristics, based on CASBEE as a common national scale, actual examples of which are provided in the following section.

6.2.1.1. Using Built Environment Efficiency level for general buildings

1) Mandatory requirements for submission and labeling of the comprehensive building environmental performance assessment

The United Kingdom and North America have launched various efforts to encourage the dissemination of buildings focusing on environmental performance by asking for the submission and labeling of the environmental performance assessment result at the designing stage and at the time of final completion as a mandatory requirement for certain buildings. In Japan, initiated by the submission of an environmental consideration plan in Tokyo, many local governments, including Nagoya City, Osaka City and Yokohama City, prepared their CASBEE regional editions reflecting individual regional characteristics. They have also extended their efforts through a mandatory submission of assessment results of buildings with a certain scale specified in ordinances or regulations, a part of which is made available to the public.

2) Preferential treatment for quality buildings having a high level of comprehensive environmental performance

On the other hand, it is possible to encourage dissemination of buildings having a higher level of environmental performance by providing incentives to businesses. (See 5.2. for details.)

6.2.1.2. Order placement and operation of public works construction

1) Examination items of building design competitions and proposals for public buildings

When the public administration selects an architect for a public building, an building design competition or a proposal method is often used. Candidate architects provide individual self-assessment results regarding environmental performance based on standards established by CASBEE in their proposals, which are subject to examination and which will secure a certain level of environmental performance of the building.

2) Utilization in requirements for order placement of public buildings

When the public administration places an order for construction work for a public building, they can ask for a submission of self-assessment results regarding environmental performance in accordance with standards established by CASBEE as a mandatory requirement for order placement in terms of the building's comprehensive environmental performance.

3) Establishment of standards for environmental performance in PFI businesses

In the Private Financial Initiative (PFI) business, providing standards for environmental performance to private investors in terms of a building, which is the target of their investments, serves as their risk management. CASBEE may be used as a measure for determining the level of the target building.

4) Accountability to the public regarding public buildings

As public buildings are constructed by using a considerable amount of taxpayers' money or public funds, it is highly desirable to disclose information about assessment results regarding the environmental performance of the building in order to achieve accountability to the public. CASBEE can also be used as a tool facilitating such information disclosure and the establishment of accountability.

6.2.1.3. Utilization of Assessment Certification System by a third-party body and Accredited Professional Registration System

In all the cases described above, the fairness and reliability of assessment results by CASBEE are extremely important. Though it depends entirely on the discretion of the parties concerned, the effective utilization of the CASBEE Assessment Certification System and the CASBEE Accredited Professional Registration System introduced for ensuring the fairness and reliability is strongly recommended.

6.2.2. Examples of utilization by the government

<Case-1> Governmental buildings

The Government Buildings Department of the Secretariat of the Minister of Land, Infrastructure, Transport and Tourism (MLIT) is a division responsible for the maintenance of government facilities of all the ministries and agencies, having a total site area of 14 million square meters. In March 1998, the department prepared a guideline for the reduction of environmental load in the maintenance of governmental facilities: "Guideline for Development of Environmentally Friendly Government Buildings and Facilities (Green Government Building Development)". For the existing governmental facilities, the "Guideline for Assessment of Environmental Friendliness and Renovation Plan for Governmental Buildings and Facilities (Green Assessment and Renovation Plan)" was introduced in December 2000. Following this, in addition to assessments regarding $LCCO_2$, LCR (resource consumption), LCW (waste) and LCC (costs), new assessment systems incorporating CASBEE, "Green Government Buildings Standards and Commentaries" [1] and "Standards for Green Assessment/Renovation Plan and Commentaries" [2] were released in 2006. The Green Contracts Act was issued in May 2007, and came into force in November of the same year, which made it obligatory to include $LCCO_2$ assessments and CASBEE assessments in design outsourcing contracts in terms of designs for governmental facilities and independent administrative institutions.

Figure 6.2.1: Green Government Buildings Standards and Commentaries

Figure 6.2.2: Standards for Green Assessment/Renovation Plan and Commentaries

As a similar assessment system for public buildings managed by local governments, Tokyo includes in its design outsourcing contracts the utilization of "Environmental and Cost Evaluation System for Tokyo Metropolitan Government-run Facilities" [3] in terms of public buildings run by the local government such as the Tokyo Metropolitan Government Building, high schools and hospitals that utilize $LCCO_2$, LCC and CASBEE in accordance with the guideline for eco-friendly maintenance of Tokyo Metropolitan Government-run facilities prepared to help prevent climate change. Fukushima Prefecture also released the "Guideline for Environmental Coexistence Building Plan and Design in Fukushima" [4] for prefectural government buildings and public schools in November 2006, which indicates that the utilization of CASBEE has gradually become popular at the planning and design stage of public facilities run by local governments. Since the Green Contracts Act (described above), which came into force in November 2007, requires reasonable efforts by local governments, the utilization of LCA in the building sector is expected to increase rapidly in the future in addition to public buildings run by local governments and independent administrative institutions.

The Government Buildings Environmental Report, which has been issued by the Government Buildings Department of the Minister's Secretariat of the MLIT since 2005, provides in the form as shown in Figure 6.2.3 the environmental performance based on CASBEE and the $LCCO_2$ reduction performance in major governmental buildings across the country, the construction of which were ordered by the central government. Figure 6.2.4 shows the relationship between the performance based on CASBEE and the $LCCO_2$ reduction performance for 2 years disclosed in the Environmental Report, plotted on a chart having the BEE value on the horizontal axis and the $LCCO_2$ reduction percentage on the vertical axis. The BEE values for 15 governmental buildings range from 1.2 to 2.1 (Rank B+ to A). The $LCCO_2$ reduction percentages are distributed between 7% and 30%. If we have more data regarding actual government buildings available in the future, the relationship between the BEE value and the $LCCO_2$ reduction percentage is expected to become much clearer.

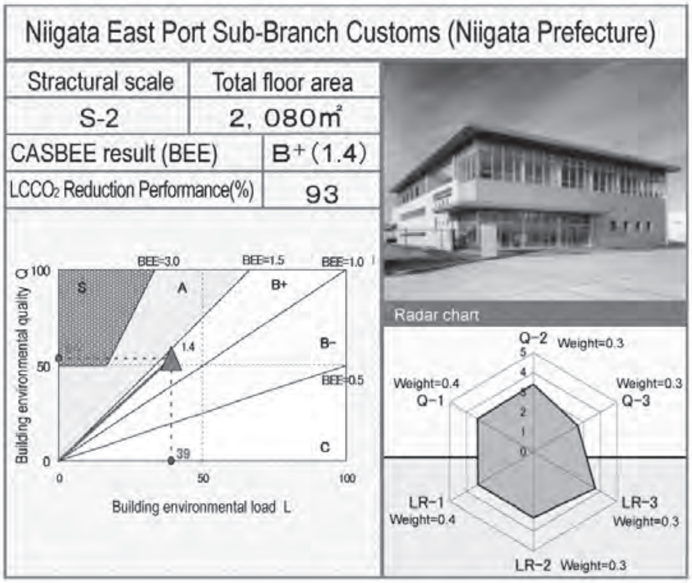

Figure 6.2.3: Disclosure of performance based on CASBEE and $LCCO_2$ reduction percentage in governmental buildings (Source: Government Buildings Environmental Report 2006, Government Buildings Department, MLIT)

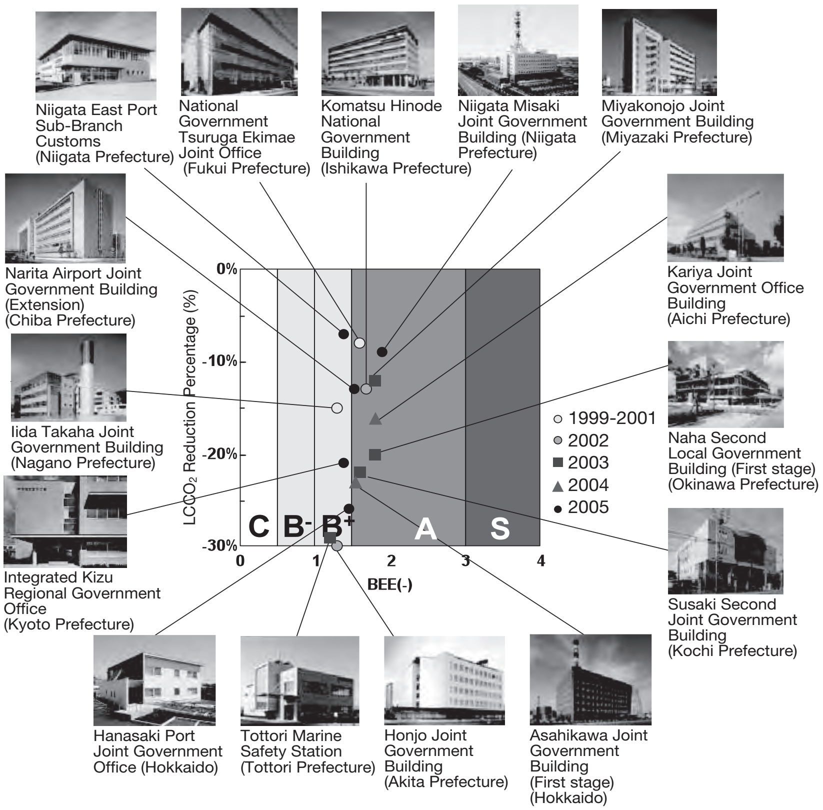

Figure 6.2.4: CASBEE and $LCCO_2$ reduction percentage of government buildings across the country presented in the Government Buildings Environmental Report by the Government Building Department, MLIT (Source: Environmental Report 2005 and 2006, Government Buildings Department, MLIT)

References

[1] "Green Government Buildings Standards and Commentaries 2005 Edition", Public Buildings Association, Tokyo, 2006

[2] "Standards for Green Assessment/Renovation Plan and Commentaries 2005 Edition", Building Maintenance & Management Center, Tokyo, 2006

[3] Hayashi T., Fujiwara T., Ibe G., Tokita S., Ikaga T. and Endo J.: Development of LCA tool to evaluate the effect of environmental techniques for Tokyo Metropolitan Government facilities, AIJ J. Technol. Des. No. 23, (2006), pp. 253-258 [in Japanese]

[4] "Guideline for Environmental Coexistence Building Plan and Design in Fukushima, Commentaries and Assessment Software" (available online), Public Works Department, Fukushima Prefecture, 2006, Source <http://www.pref.fukushima.jp/kenchiku/eizen/top.htm>

<Case-2> School buildings (CASBEE-School)

The Ministry of Education, Culture, Sports, Science and Technology (MEXT) prepared CASBEE-School, an assessment method for the comprehensive environmental performance of school facilities, in order to achieve visualization and an efficient assessment of environmental performance of individual school facilities, which would contribute to the promotion of “Eco-schools” in existing school buildings. The MEXT notified school boards across the country of the launch of CASBEE-School in October 2011. The assessment manual and software are available from the MEXT website.

Figure 6.2.5: CASBEE-School Assessment Manual (Front page)

1) Background

The MEXT published a research study partners conference report “Establishment of Eco-schools” in March 1996. In order to promote eco-schools presented in the report, since 1997, the MEXT has conducted an eco-school pilot model project for public schools in cooperation with relevant ministries and agencies (currently the Ministry of Agriculture, Forestry and Fisheries, the Ministry of Economy, Trade and Industry and the Ministry of the Environment). In September 2004, a basic policy in accordance with the Act on Enhancing Motivation on Environmental Conservation and Promoting of Environmental Education was approved in a Cabinet meeting. The basic policy states that the enhancement of eco-schools development is extremely important.

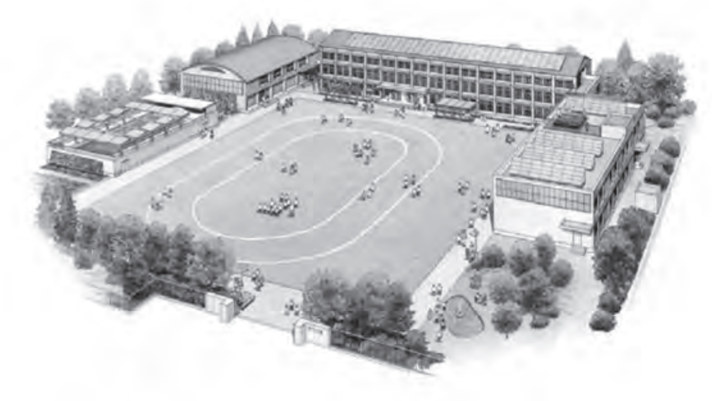

Figure 6.2.6: An Eco-school view

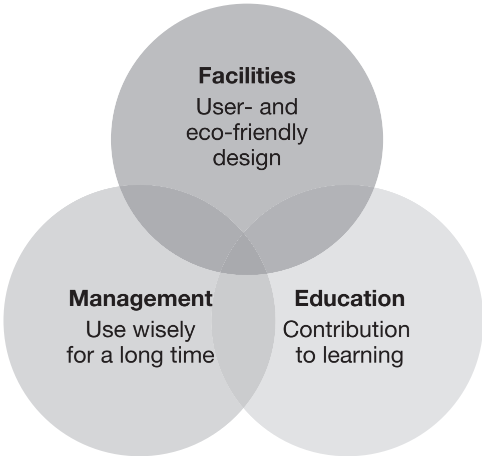

Figure 6.2.7: Basic idea of eco-school

(1) Facilities:
"User- and eco-friendly design" in consideration of users including small children, local communities and the Earth
- A healthy and comfortable space for learning and living
- Harmonized with the surrounding environment
- Design and construction with lower environmental load

(2) Management:
"Use buildings, resources and energy wisely for a long time"
- Considering durability and flexibility
- Making effective use of natural energy
- Using efficiently with zero waste

(3) Education:
Utilizing facilities, principles and systems so they "contribute to learning"
- Utilization for environmental education

In the midst of the increasing awareness of climate change, the MEXT has conducted various research studies by organizing an advisory panel of experts since 2008 in order to develop policies for further promotion of eco-schools. In March 2009, the MEXT finalized a report "Policy for future promotion of eco-schools – New school development for a low-carbon society." The report emphasizes the importance of continuously promoting eco-schools in all school facilities including existing buildings. It also proposes that, as part of practical measures for eco-school promotion, it is necessary to visualize energy-saving effects achieved in school facilities. CASBEE-School was released as the visualization method in September 2010 after being reviewed by a separate advisory panel of experts.

2) What is CASBEE-School?

CASBEE-School is an assessment tool that mainly covers primary schools, junior high schools and high schools, and that enables officers from the school governing institutions such as the school board of education in the local government, who are in charge of school facilities, to understand relatively easily the environmental performance of school facilities including the school building and gymnasium and the entire school premises such as the sports ground and green spaces. The utilization of CASBEE-School allows for the accurate understanding of the current environmental performance of individual school facilities. It also helps predict the situation after the planned eco-renovation, new construction or extensions. We can utilize this tool for the visualization of the effects through improved environmental performance depending on the details of a maintenance project at the planning stage or the environmental measures.

We also expect that students will use the assessment method and its process demonstrated in CASBEE-School as course material in learning the application of the eco-school concept to their own schools.

3) CASBEE-School assessment system

CASBEE-School achieves a comprehensive assessment of the building environmental performance in terms of the quality (Q), including the level of interior comfort in classrooms, and the environmental load (L), including the emission of greenhouse gases. The assessment consists of the rating of 85 items for new construction and 29 items for existing buildings. In CASBEE-School, even if the environmental load is reduced, if the level of comfort in the classroom such as heat and cold is not improved and students have to live with it, the school will not receive a high rating.

The assessment method for CASBEE-School is based on CASBEE for New Construction (Brief edition), adhering fundamentally to the ideas therein. Additionally, CASBEE-School introduces the following ideas in order to achieve simple assessments.

(1) The existing data have been made available including the result of the classroom environmental measurement conducted every year at individual schools in accordance with School Sanitation Standards.
(2) In terms of school buildings and gymnasiums in general designs, the rating is available based on the predetermined assessment value (level), omitting the field investigations and the drawings confirmation process.
(3) The assessment items focus on the characteristics of public schools, including the fact that there are school buildings and gymnasiums on the school premises, each of which requires a different level of environmental performance, and that the introduction rate of fully air-conditioned buildings is quite low.
(4) CASBEE-School is designed to allow people without advanced technical knowledge to conduct assessments by improving commentaries of the assessment manual.

4) How to use CASBEE-School

The assessment sheet for CASBEE-School is provided electronically, consisting of 3 programs such as new construction, renovation and existing buildings. New construction and reconstruction are evaluated by the new construction program. The assessment of existing buildings is based on the existing building program. Though upgrading is evaluated in accordance with the renovation program, similar to CASBEE for Renovation, by combining with an assessment according to the existing building program before upgrading, a comparison between the assessment results before and after upgrading will be available.

5) Actual assessment by CASBEE-School

One actual renovation case is provided below. The school underwent an eco-renovation from 2006 to 2007.

<School outline>

Number of students: Approx. 90
Number of classes: 4
Site area: 38,000 m^2
Building coverage area: 2,800 m^2
Total floor area: 3,600 m^2
Building structure/Number of floors:
(School building) Reinforced concrete construction/2 floors above ground,
(Gymnasium) Steel construction/1 floor above ground
Major upgrading works:
Exterior thermal insulation, structural thermal storage (radiant heating system), natural lighting, ventilation caused by temperature difference, highly efficient lighting equipment

Figure 6.2.8: Renovation to upgrade a corridor into an atrium space in a glass open-ceiling style

This school removed the roof of a corridor and installed an atrium space with a glass open ceiling. This renovation allowed ordinary classrooms to let in light from the north and south. The light environment in the corridor was also improved, providing an open space for communication. It also increased the ventilation performance in summer.

We conducted an assessment regarding this school building before and after the renovation using CASBEE-School. The assessment result of “Facilities utilizing daylight” of “Q1 Indoor environment” has improved from Level 3 to Level 5 due to the introduction of two-sides lighting and high-side lighting after renovation.

Looking at the assessment result in terms of individual categories, the overall rating has improved compared to the rating before renovation, due to the enhancement of heat insulation, creation of barrier-free spaces, interior work plan, installation of a water-saving toilet system and so on. The comprehensive assessment result has improved from BEE=0.7 (★★) before renovation to BEE=1.9 (★★★) after renovation, upgrading from Rank B- to Rank A. Especially, the ratings for “Q3 Outdoor environment” and “LR1 Energy” have substantially improved, as indicated on a well-balanced radar chart.

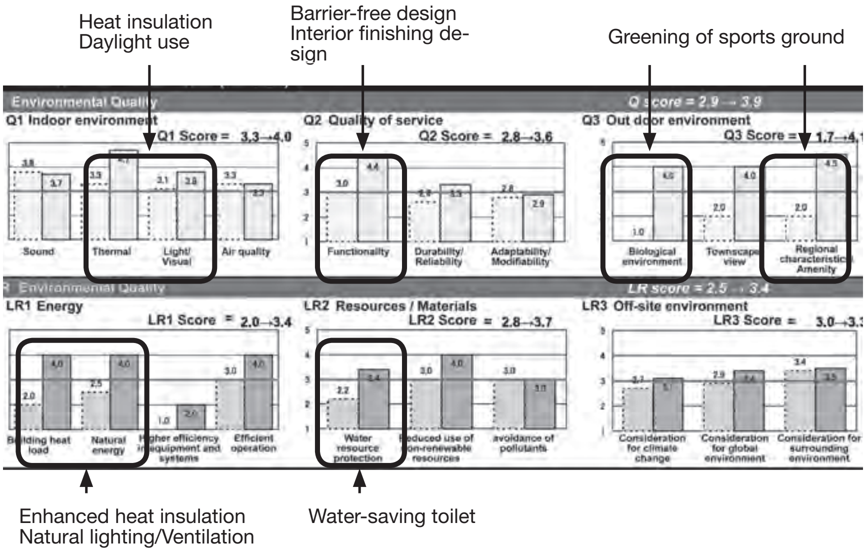

Figure 6.2.9: Assessment result by category

6) Conclusion

The utilization of CASBEE-School is not a compulsory procedure in the school facilities assessment. However, it is extremely important to understand the current situation of the environmental performance of school facilities and to predict the changes after maintenance work in order to promote environmental consideration in schools. Therefore, the utilization of CASBEE-School as an assessment tool is considered to be very effective. We expect that persons in charge of facilities in individual schools will proactively utilize CASBEE-School so the idea of eco-schools is further promoted.

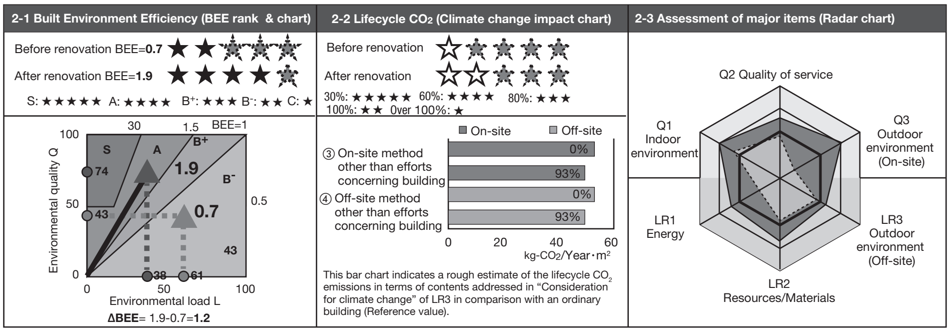

Figure 6.2.10: Assessment result (Overall rating)

<Case-3> Utilization of CASBEE for Cities in the Eco-Future City Assessment

1) Outline of the Eco-Future City promoted by the Japanese Government

In response to Cabinet approval for the new growth strategy in June 2010, Japan has promoted the Eco-Future City Project as a national project. This project aims to create an unprecedented success in terms of common issues for society in the 21st century, such as measures concerning the environment and the aging population, by designating a limited number of certain cities as eco-future cities. (Revitalization Bureau, Cabinet Secretariat, Government of Japan, 2013)

2) Assessment method for Eco-Future Cities

In order to regularly monitor various efforts made in eco-future cities, carefully selected from all over the country, and to measure their outcomes and ripple effects, the Regional Revitalization Bureau, the Cabinet Secretariat, took the initiative in organizing a review meeting for assessment methods for eco-future cities, in which methods for quantifying the policy effects in individual cities are examined. After in-depth discussions for over a year, assessment perspectives for eco-future cities are organized as shown in Table 6.2.1. In addition to assessments concerning the Flow (the progress of efforts) and the Stock (the current city environment), an assessment concerning Governance as the implementation framework is to be included. The individual local governments conduct a self-assessment of the flow in areas subject to the assessment in light of the progress of efforts specified in the city planning, the result of which will be reviewed by third-party experts. The same procedure applies to the Governance assessment. Regarding the stock assessment of the entire local government, an objective third-party review in accordance with CASBEE for Cities is to be conducted. The assessment manual of CASBEE for Cities is already open to the public, and therefore, the utilization thereof will allow us to understand objectively the current city environment in the individual local governments. (The Committee for the Development of an Environmental Performance Tool for Cities, 2012)

Table 6.2.1: Assessment perspectives for eco-future cities (Assessments are conducted in terms of ①, ④, ⑤ and ⑥.)

	District (Areas in which efforts are undertaken)	Local government (Entire area)
(1) Flow (Assessment on the progress of efforts)	① Progress on efforts specified in the city planning	④ Progress on efforts made in the entire local government area (Not specified in the city planning)
(2) Stock (Assessment on the city environment)	② Assessment of the areas in which efforts are undertaken (Statistical data is unavailable.)	⑤ Assessment of the entire local government area (Statistical data is available.)
(3) Governance (Assessment on the project implementation framework)	③ Governance (District)	⑥ Governance (Entire local government)

As the effect of a single-year policy planned and implemented by each city (flow) accumulates, the city’s situation (stock) gradually improves. Therefore, even if we compared assessment results of the flow and the stock by extracting a certain year, they may not correspond to each other in terms of the level of progress. This is due to the fact they focus on a different time axis. However, in the long term, a city achieving a good result in the flow assessment every year is supposed to be also improving in the stock assessment. Therefore, when conducting a city environmental assessment, it is necessary to be aware of the difference in the characteristics of the flow assessment and the stock assessment, and to follow up both of them. Based on such idea, as shown in Figure 6.2.11, the eco-future city project will enable us to compare and confirm assessment results of the flow and the stock.

3) Temporary stock assessment result for eco-future cities utilizing CASBEE for Cities

The result of the stock assessment of the entire local government area, the statistical data of which is publicly available, has been already calculated based on CASBEE for Cities. Figure 6.2.12 shows assessment results of eco-future cities (BEE chart). Table 6.2.2 shows detailed results in terms of major items. Data used for the assessments is based on the national census in 2010, the result of which is obtained before the eco-future city project was launched. It is very important to wait and see how the city environment is improved by various measures promoted in individual cities.

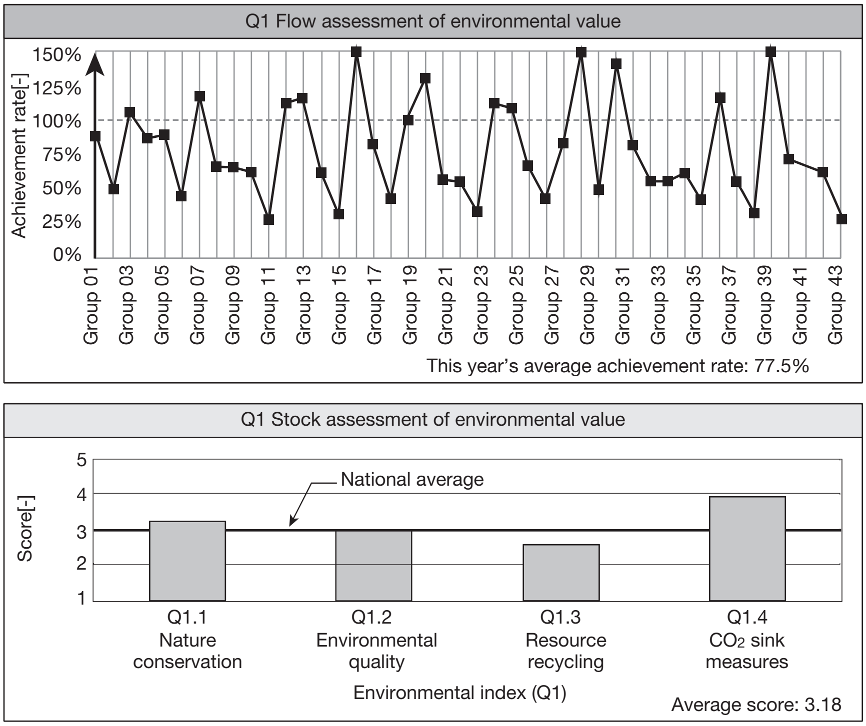

Figure 6.2.11: Flow assessment and stock assessment in eco-future cities

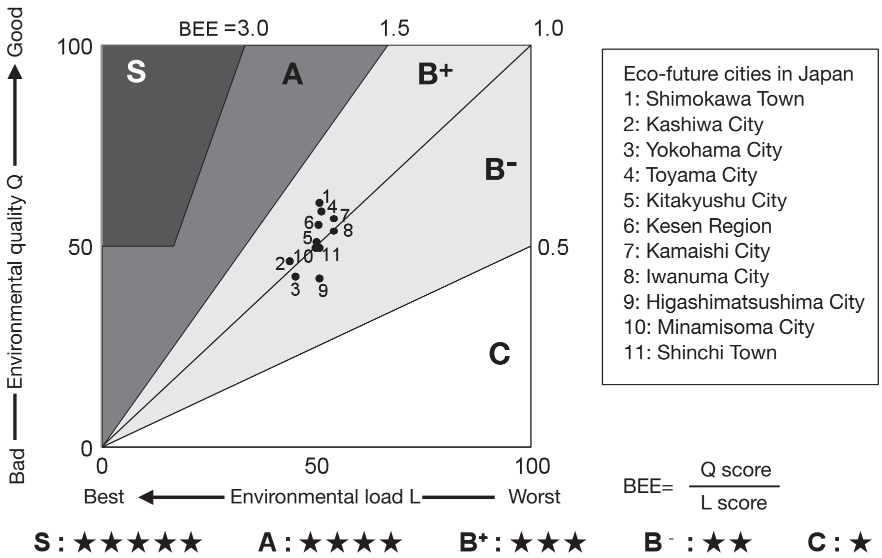

Figure 6.2.12: Assessment result of Eco-Future Cities by CASBEE for Cities (BEE chart)(Based on data obtained from the 2010 national census)

Table 6.2.2: Assessment result of Eco-Future Cities by CASBEE for Cities (based on data obtained from the 2010 national census)

	BEE	Q (Maximum score: 100 points)	L (Maximum score: 100 points)	Q1 (Maximum score: 5 points)	Q2 (Maximum score: 5 points)	Q3 (Maximum score: 5 points)	L ($t\text{-}CO_2$/ Person)
Shimokawa Town	1.1	60.6	50.8	4.4	3.4	2.5	10.1
Kashiwa City	1.0	46.1	43.8	2.4	3.1	3.1	9.0
Yokohama City	0.9	42.1	45.0	2.4	2.8	2.9	9.2
Toyama City	1.1	58.4	51.0	3.4	3.1	3.5	10.2
Kitakyushu City	1.0	50.8	50.1	3.4	2.4	3.3	10.0
Kesen Region	1.0	55.1	50.1	3.5	3.4	2.7	10.0
Kamaishi City	1.0	56.5	53.6	4.1	2.8	2.9	10.6
Iwanuma City	0.9	53.6	54.2	2.7	3.1	3.7	10.7
Higashi-matsushima City	0.8	41.8	50.7	2.9	2.8	2.3	10.1
Minamisoma City	0.9	49.3	49.7	3.1	2.9	2.9	9.9
Shinchi Town	0.9	49.4	50.7	3.0	2.7	3.2	10.1

References

[1] Revitalization Bureau, Cabinet Secretariat, Government of Japan (2013) "Future City Initiative" (available at: http://futurecity.rro.go.jp/) (Last access: 30th July, 2013)

[2] The Committee for the Development of an Environmental Performance Tool for Cities (2012) CASBEE for Cities Technical Manual (2012 Edition), (available at: http://www.ibec.or.jp/CASBEE/english/download/CASBEE_City_manual_2012(E).pdf) (Last access: 30th July, 2013)

6.2.3. Utilization by local governments

Buildings in which CASBEE is actually utilized the most are those reported to local governments in Japan.

As of March 2014, 24 local governments in Japan have been utilizing CASBEE for their environmental performance reporting systems. Since 2004, a number of building plans for new construction and reconstruction have been evaluated based on CASBEE. In environmental administration, CASBEE is a unique assessment system, considering the application not only to public buildings but also to many private buildings (other than detached houses) as its key feature.

Further, it is highly recommended to customize CASBEE programs adopted by local governments depending on the individual regional characteristics.

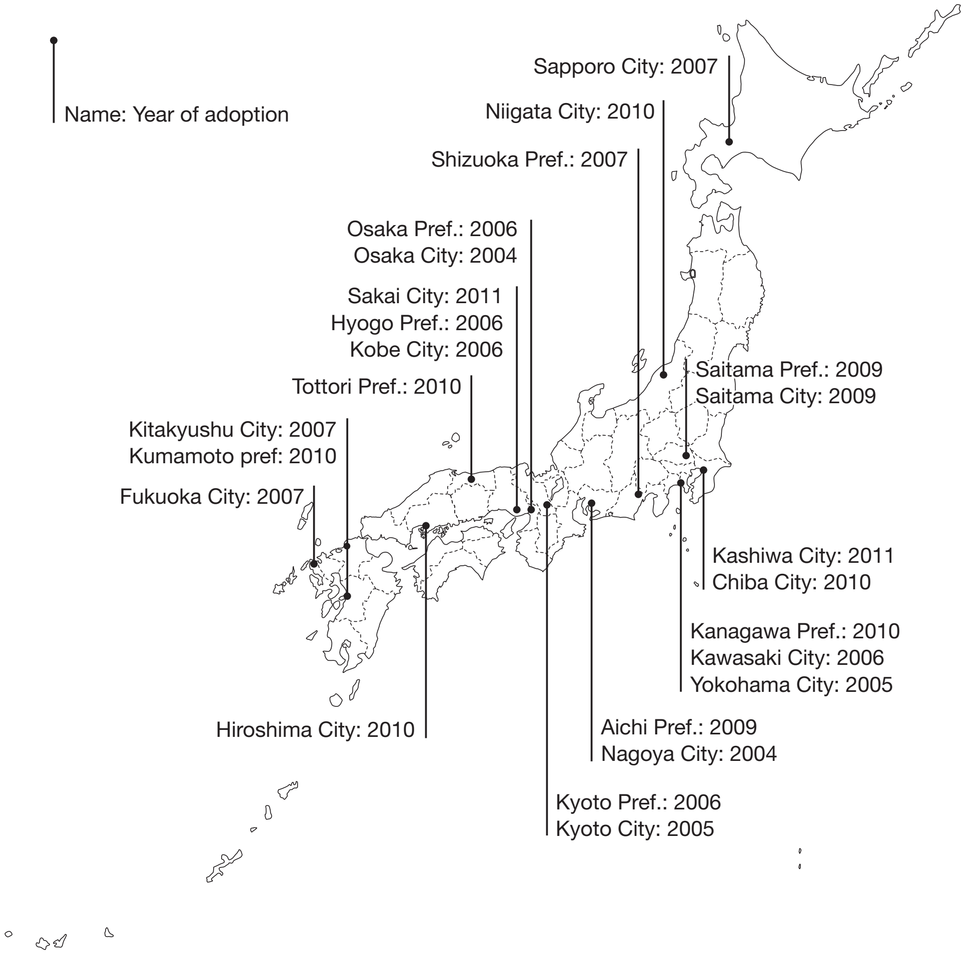

Figure 6.2.13: Utilization of CASBEE for Construction in local governments (reprinted)

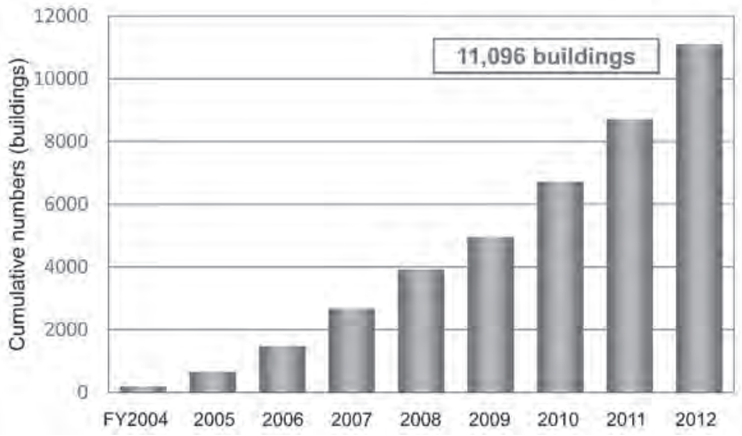

Figure 6.2.14: Number of buildings reported to the local goverments in accordance with CASBEE across the country (Cumulative number as of March 2013)

<Case-1> CASBEE-Nagoya

In June 2004, Nagoya City was the first local government to introduce CASBEE.

1) Background and details of the establishment of the system

Since around 1992, Nagoya City has implemented some programs regarding sustainable buildings only in limited areas, including reduction of the use of building frames made of tropical timber, installation of photovoltaic facilities, and promotion of the use of the blast-furnace cement and recycled crushed stones in public buildings. After that, while public awareness of global environmental protection is increasing, Nagoya City prepared the Nagoya Agenda 21 in 1996, and the Basic Environment Plan in 1999, in order to support various environmental consideration-related projects. In response to such attempts, Nagoya City established the Guideline for Eco-Friendly Development of Public Buildings in 2000, the following year, as part of their efforts concerning buildings, and started to take the leading role in the promotion of sustainable buildings.

Table 6.2.3: Assessment items based on the Eco-Friendly Development Index for public buildings

Consideration for the surrounding environment	Understanding site factors, etc.	17
Energy-saving	Building arrangement, air-conditioning, etc.	25
Energy	Solar power, high efficiency systems, etc.	10
Resource-saving	Reduction of use, promotion of recycling, etc.	14
Long life	Standardized design, construction management, etc.	10
Eco-materials	Use of local materials and recycled products, etc.	9
Waste	Checking on recycling facilities, controlling the use of specified substances, etc.	13
Others	Consensus development in environmental consideration	9

While Nagoya City promotes environmental consideration in public buildings, the private sector has also started making voluntary efforts, including the acquisition of ISO certifications and the voluntary announcement of special measures for environmental consideration in buildings. In 2001, the city stated in the initial action plan of the Nagoya New Century Plan 2010, specifying the basic policies of Nagoya City, that they “encourage development of private buildings with less environmental load.” As an actual measure concerning the statement, in 2003, the city incorporated the Environmental Consideration System of Buildings in the Ordinance Concerning the Environmental Protection for Securing Health and Safety of the Citizens, which is actually the fully revised Antipollution Ordinance.

The ordinance and regulations specify the following:

(1) Building owners are requested to take eco-friendly measures in accordance with the Building Environmental Consideration Guideline stipulated by the mayor.

(2) Building owners who are constructing a new building or an extension, the total floor space of which exceeds 2,000m^2, are obliged to submit a Building Environmental Assessment Plan 21 days before the start of construction.

(3) The outline of the Building Environmental Assessment Plan submitted is made availa-

ble to the public on the Internet.

In Nagoya City, approximately 200 buildings exceeding 2,000m^2 are constructed every year. In other words, about 2% of new buildings are subject to the mandatory notification.

This system does not require specific measures for buildings, but simply asks for efforts concerning environmental consideration based on the guideline. The system also features an evaluation utilizing the assessment tool CASBEE Nagoya regarding the contents of such efforts, which is to be submitted as a Building Environmental Assessment Plan. Nagoya City positions the system as a tool for the purpose of encouraging voluntary efforts, by making the plan available to the public.

In October 2009, the outline was revised so that environmental assessment plans for buildings less than 2,000 m^2, including detached houses, may also be submitted on a voluntary basis. Certain financial institutions have implemented a new system in which a preferential mortgage rate is available depending on the CASBEE assessment result. (No actual example is available yet.)

2) Outline of CASBEE Nagoya

CASBEE Nagoya is based on CASBEE for New Construction (Brief version) which was developed to evaluate the sustainability of buildings according to the environmental efficiency BEE. The BEE is calculated using the environmental quality Q (Numerator) and the environmental load L (Denominator) of a building. CASBEE Nagoya also introduced the following changes:

(1) Conducting a simple check at the design stage (24 items for the numerator and 20 items for the denominator on a 5-point scale)

(2) Conducting an assessment of the building performance including sound isolation using the standards based on the Housing Quality Assurance Act in the case of residential buildings

(3) Adopting guidelines established in accordance with the city ordinance as criteria for Q3 and LR3, in which the on-site and off-site environments are evaluated

3) System implementation

Nagoya City has received a total of 1,095 notifications over 6 years from when the system began at the end of fiscal 2009, which is one of the largest numbers among the local governments that have introduced CASBEE. This is due to the fact that the city introduced the system at an early stage, and that it has also broadened the range of buildings subject to the system, compared to the initial setting, so that it includes those exceeding 2,000m^2.

Consequently, in many building plans, designers and building owners become aware of their ratings in terms of building sustainability through utilization of such tool, which should sufficiently achieve the purpose of the system implementation that was to increase awareness in persons involved at the planning stage. Further, there have been 12 notifications of buildings in Rank S since 2007, positioning Rank S as one of the common targets for all architects, which clearly indicates the effect of increasing the overall level of building plans.

Table 6.2.4: Past assessment results

Rank	2004	2005	2006	2007	2008	2009	Total
C	0	2	2	1	0	1	6
B-	49	89	94	91	55	24	402
B+	79	118	95	104	76	47	519
A	20	25	20	20	37	24	156
S	0	0	0	3	5	4	12
Total	148	234	211	229	173	100	1,096

Detailed breakdowns by rank for buildings notified in 2004 and 2009 indicate that building owners have gradually become aware of the importance of environmental consideration in buildings, as the percentage of buildings classified as between Rank S and Rank B+ increased from 67% to 75%.

Nagoya City has established a preferential treatment for buildings in Rank S, allowing increased relaxation in the floor area ratio required in the comprehensive design system. The special treatment has actually been applied to one building so far.

We will provide detailed analysis of actual measures taken in 2 buildings classified as Rank S.

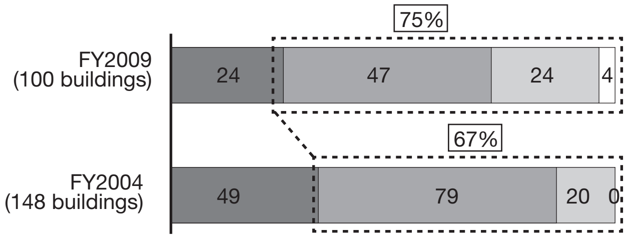

Figure 6.2.15: Breakdowns of CASBEE Nagoya by rank

Assessment results of buildings notified in 2004 and 2009 are plotted respectively on a BEE chart. In 2004, when the system was first introduced, most of the buildings were classified as B- and B+. On the other hand, we can see an improvement trend in the basic level in 2009 as the number of buildings rated as Rank A and Rank S increased. The trend in the average BEE by use shows that ratings for schools (1.3→2.0), retailers (1.1→1.7) and hotels (1.0→1.6) have improved.

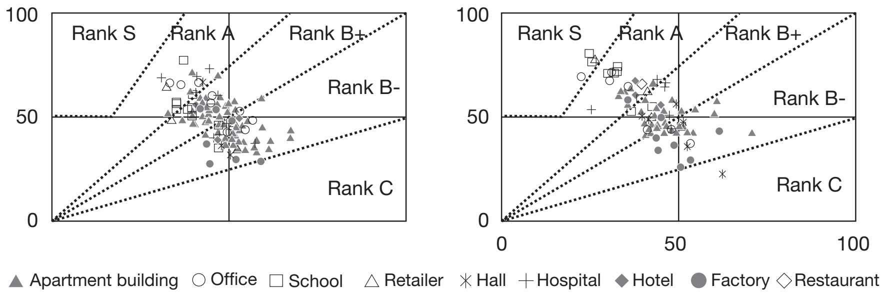

Figure 6.2.16: Ratings of notified buildings according to CASBEE Nagoya (Comparison between FY2004 and FY2009)

<Case-2> CASBEE Yokohama

1) Background of establishment

The introduction of CASBEE in Yokohama City was initiated by positioning the promotion of building environmental friendliness as part of measures against climate change in the Midterm Policy Plan, a basic guideline for local government administration policies, created in December 2002. Behind this background, there was the completion of CASBEE for Office in 2002, an assessment tool for office buildings that had been developed through collaboration between industry, government and academia. There was also the introduction of the Building Environmental Assessment Plan System by Tokyo Metropolitan Government in June 2002.

Yokohama began considering the introduction of CASBEE in 2003, and launched a new system in July 2005 for reporting self-assessment results conducted when planning construction for a large-scale building, utilizing CASBEE. Yokohama was the third city to introduce a system based on CASBEE, after Nagoya and Osaka.

Since 2012, the city has also utilized CASBEE for New Detached Houses, introducing the CASBEE system for detached houses. The utilization of the system is on a voluntary basis; however, the city intends to promote detached houses in high ratings by releasing assessment results of those highly rated by CASBEE.

2) Notification system structure

Similar to many other local governments, Yokohama also requires mandatory notification of a self-assessment result (the Building Environmental Assessment Plan) based on CASBEE to the local government at the planning stage of construction, which is later made available to the public. CASBEE Yokohama software is mostly based on CASBEE for New Construction (Brief version) with a few modifications, including priority items applicable only to Yokohama. The city added 4 priority items without making modifications to the point allocation. Efforts concerning the 4 items are evaluated on a 5-point scale on the publication sheet in which details of the efforts are also provided. The 4 priority items are measures for climate change, heat island effect, long life, and townscape/view. Each item is positioned as a field focusing on regional characteristics, in which the city especially encourages further efforts.

Approximately 80% of all published buildings are rated as B+ and over. Especially, buildings for the purpose of “office-use” and “school-use” generally receive high ratings. On the other hand, we can see that those for “factory-use,” including parking lots, tend to receive low scores.

Table 6.2.5: Number of notifications

	2005	2006	2007	2008	2009	Total
Number of notifications	93	123	113	102	39	470

Table 6.2.6: Ratings of published buildings by use

	S	A	B+	B-	C	Total	Percentage %
Office	8	25	8	3	0	44	10
School	4	9	4	0	0	17	4
Retailer	0	7	6	11	0	23	6
Restaurant	0	0	1	0	0	1	0
Hall	0	3	4	6	0	13	3
Hospital	0	8	34	4	0	46	11
Hotel	0	2	7	3	0	12	3
Apartment	1	57	108	38	0	204	49
Factory	1	8	20	25	6	60	14
Total	14	119	192	90	6	421	100
Percentage %	3	28	48	22	1	100	-

3) Certification system

Apart from the mandatory notification system, in April 2006, Yokohama launched a certification system on a voluntary basis in which the city verifies the appropriateness of assessment only for those who are interested. This certification system aims to encourage efforts concerning the environment, such as Corporate Social Responsibility (CSR), by building owners. Yokohama is the only local government to implement this system in Japan. In this system, the city provides an objective evaluation after examining the assessment in accordance with the Outline for the Building Environmental Consideration Assessment Certification System, and consulting the Building Environmental Consideration Assessment Certification Committee consisting of academic experts. By 2013, 8 buildings had been certified as Rank S, the highest rating. The building owners of those buildings are utilizing them as a public relations tool concerning their environmental efforts. The city also features them as CASBEE best practices in public relations activities.

4) Environmental performance indicators

Since the energy performance of a building has a great impact on utilities costs and occupant comfort, it is one of the most important and useful pieces of information to be provided to the building owner and users. Further, if the information regarding energy performance was provided when buying a property, the consumer will be able to make a better informed choice. We can also expect that, by promoting such market information, the number of energy-efficient buildings will increase.

Accordingly, Yokohama has introduced mandatory disclosure of environmental performance based on the CASBEE assessment result when advertising housing complexes and office buildings for sale or for rent. Consequently, the public is now able to obtain proper information regarding building environmental consideration when they select a house.

Since the launch of this system in April 2010, we have received an increased number of enquiries from designers of condominiums and estate agents, such as “Can we disclose information regarding properties built the year before?” and “What shall we do to get higher ratings?” We are expecting that the increased number of properties appearing in property advertisement magazines will have a ripple effect on consumers/the public.

Kawasaki, another city in Kanagawa Prefecture, had already launched the Environmental Performance Indicator for Condominium Apartments. Accordingly, Kanagawa Prefecture, which introduced CASBEE Kanagawa and the building environmental performance indicator in 2010, and Yokohama City, have made mutual arrangements to use a common design in some parts of the indicator so that consumers/the public can make an easy comparison between multiple buildings.

Figure 6.2.17: Environmental performance indicator in accordance with CASBEE Yokohama

Figure 6.2.18: Environmental performance indicator by Kawasaki City (Left) and Kanagawa Prefecture (Right)

5) Public relations for the system

In response to the change in the floor space subject to the system to include 2,000m^2 and over, which used to be only 5,000m^2 and over, we have an increased number of enquiries from designers who have no experience in the CASBEE assessment, which indicates a certain effect in terms of the promotion of environmental consideration by designers. The CASBEE system is covered in the examination for designers conducted by the central government. While the system has gradually become popular in the building design industry, the remaining issue for the future is its dissemination to the public.

In order to disseminate the system to the public, Yokohama publicly solicited names for a poster child in 2007 and created “Kyasupippi” which looks like the personification of a building combined with the letter “Y” from Yokohama. The city has made various attempts to promote the system by utilizing the poster child in local government advertising media, including PR brochures and TV programs on the local TV station, and utilizing the certified buildings for environment-related events. We expect the environmental performance indicator and “Kyasupippi” will both contribute to the further dissemination of the system.

6) Utilization in other systems

As another way of using the CASBEE system, the CASBEE ratings may be utilized as requirements for other systems. Yokohama utilizes the ratings in the Comprehensive Design Systems (the Urban Environmental Design System in Yokohama) and the City Planning Proposal System. The Comprehensive Design System encourages the creation of a favorable urban environment through comprehensive regional contributions, including construction of sidewalks and open spaces, by allowing relaxation of requirements on building height and floor area ratio. The city requires an assessment result of Rank A and over in CASBEE Yokohama. The City Planning Proposal System is part of the City Planning Law utilized for a large-scale development, in which land owners and NPOs can make proposals regarding the utilization plan of a piece of land over a certain scale. Yokohama requires a high rating (over B+) in CASBEE Yokohama as stipulated in the guideline for evaluating the proposals.

For the future, we intend to expand collaboration with other systems, such as the utilization of CASBEE as requirements for a separate system that subsidizes a part of facility maintenance costs, as already introduced in Osaka City and other local governments.

7) Outcomes of CASBEE system

The CASBEE system was originally introduced as a comprehensive environmental assessment tool, which has been gradually changing to become an important climate change measure. CASBEE Yokohama also made a shift from its 2009 edition to CASBEE for New Construction (Brief version) 2008 in which $LCCO_2$, the lifecycle CO_2, can be calculated. The calculation of reduced greenhouse gases achieved by the introduction of the CASBEE system, which used to be a longstanding problem, is now available by $LCCO_2$ to a certain extent.

In cooperation with Ikaga laboratory of Keio University, we conducted further validation of notified buildings in 2008 (already evaluated by 2007-edition software) with the 2009 edition, which is able to calculate $LCCO_2$. Due to the difference in the software specifications used for the notified buildings in 2008, we can see that the assessment results of the 2009 edition are generally higher than those of the 2007 edition. The scattergram below indicates the correlation between the BEE value and $LCCO_2$, which are the factors of the CASBEE assessment. The correlation is not so strong; however, the gradient of the regression equation indicates the higher rating in CASBEE is contributing to reduced greenhouse gas emissions. The total $LCCO_2$ reduction of the notified buildings in 2008 was 14,258t-CO_2/Year.

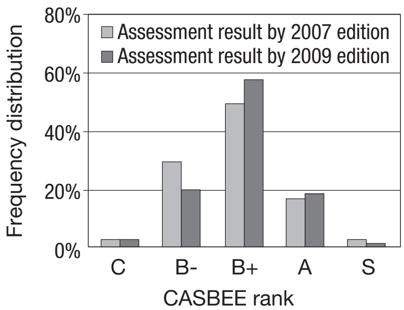

Figure 6.2.19: Assessment results of notified buildings in 2008

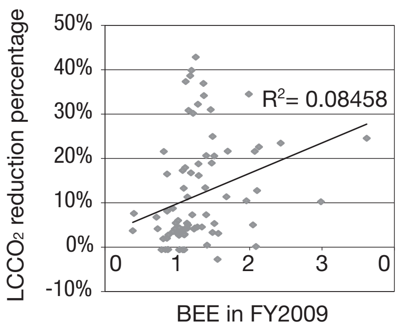

Figure 6.2.20: BEE value and $LCCO_2$ reduction percentage

<Case-3> Resilience assessment by CASBEE-City after the earthquake and tsunami disaster

1) Significance of post-quake recovery process assessment based on CASBEE for Cities

Due to the 2011 Great East Japan Earthquake and tsunami, people in a large area, mainly in the Tohoku Region, were forced to face the situation in which they could no longer perform normal daily activities. The Japanese archipelago is surrounded by the North American Plate, the Eurasian Plate, the Pacific Plate and the Philippine Sea Plate, which overlap one another. The pressure accumulated by the shifting of these 4 large plates has caused numerous severe earthquakes in many parts of Japan, inflicting enormous damage both mentally and physically. However, after every earthquake, Japan has rebuilt destroyed infrastructure in order to promote recovery of the disaster-affected cities, achieving sustainable growth.

It is extremely important to look back on history and examine closely the recovery process in order to prepare for future possible disasters, by studying what kind of efforts were made during reconstruction, and which measure contributed to recovery the most. It would be also very beneficial to keep a careful record of Japanese efforts and transmit the information to the rest of the world in order to contribute to the sustainable development of all the Pacific Rim countries where the chances of major earthquakes are quite high, just as in Japan. This chapter will introduce actual disaster-affected cities in which a comprehensive assessment of environmental performance was conducted, in terms of their past, present and future, utilizing the environmental performance assessment tool CASBEE for Cities. (Kawakubo 2013) (Takigami 2013)

2) Outline of recovery process assessment utilizing CASBEE for Cities

Though Japan has been hit by numerous strong earthquakes, we will introduce a time-series assessment conducted in terms of Kobe City, Hyogo Prefecture, which experienced the Great Hanshin-Awaji Earthquake in 1995 and has been making a recovery since then, and Higashimatsushima City, Miyagi Prefecture, which is currently undergoing recovery from the tremendous damage caused by the 2011 Great East Japan Earthquake and tsunami. The locations of both cities and their overviews are provided in Figure 6.2.21 and Figure 6.2.22, respectively. We retrieved data from the past to present regarding the 2 cities from a statistical database. We also sorted out the future target score based on an interview with each city. We conduct the time-series assessment in individual cities by entering such data into CASBEE for Cities.

3) Assessment result of recovery process utilizing CASBEE for Cities

The time-series assessments in Kobe City and Higashimatsushima City are shown in Figure 6.2.23 and Figure 6.2.24, respectively. Firstly, regarding Kobe, we can see that the assessment result after the Great Hanshin-Awaji Earthquake in 1995 was significantly deteriorated compared to the result of 1990 before the disaster. However, Kobe's various post-disaster recovery efforts helped achieve an improved city environment than that before the disaster by 2010. If Kobe's various future measures are implemented steadily as planned, we can expect the city environment will be further improved by 2025. Secondly, as for Higashimatsushima, we can also see that the assessment result of 2011 after the disaster indicates a dramatic drop compared to 2010, before the disaster, just like Kobe. The environmental load L was slightly improved both in Kobe and Higashimatsushima post-disaster. However, we assume this is due to the stagnation of economic activity in the disaster-affected areas. Further, the decrease in the environmental quality Q significantly exceeds the improvement in the environmental load L, indicating a significant drop of the Building Environmental Efficiency BEE after the disasters in both cities. It is very important to review measures taken in local governments that have helped achieve a successful recovery, such as in Kobe, and to share the findings with other areas currently undergoing recovery, such as Higashimatsushima.

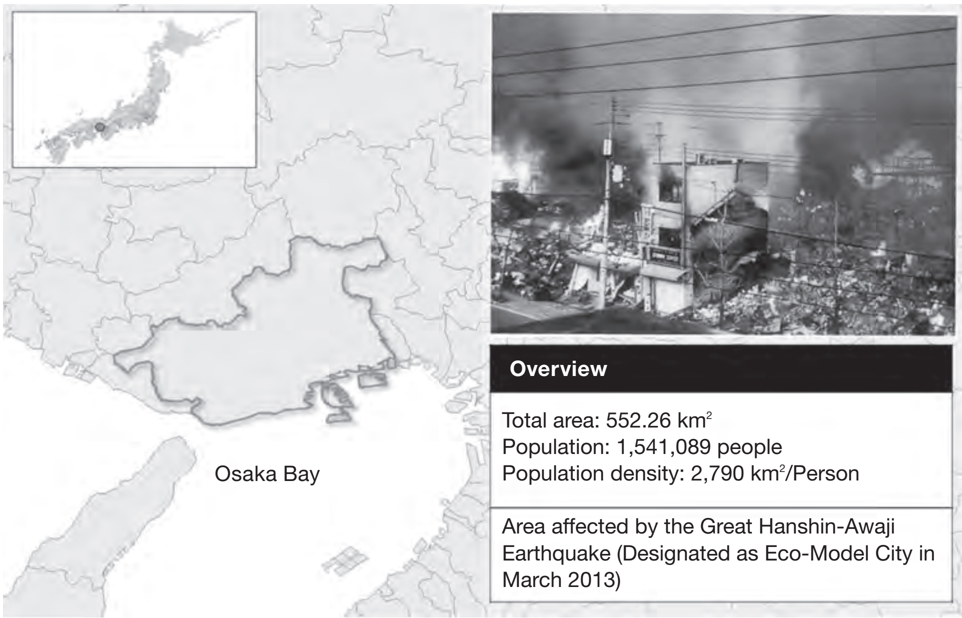

Figure 6.2.21: Location of Kobe City, Hyogo Prefecture, and basic information

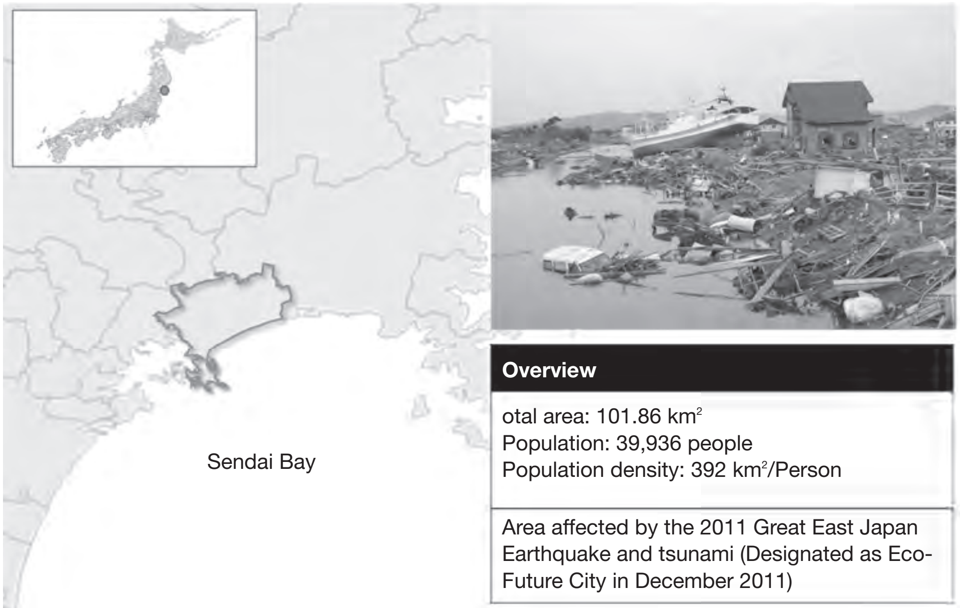

Figure 6.2.22: Location of Higashimatsushima City, Miyagi Prefecture, and basic information

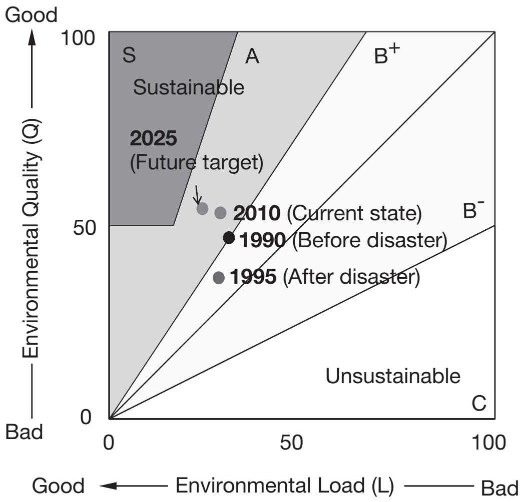

Figure 6.2.23: Result of time-series assessment of Kobe City, Hyogo Prefecture

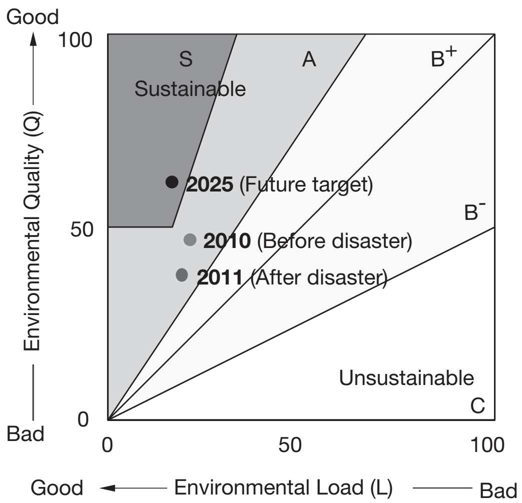

Figure 6.2.24: Result of time-series assessment of Higashimatsushima City, Miyagi Prefecture

Acknowledgement

Research outcomes provided in this chapter were achieved thanks to the cooperation of Kobe City, public administration officials in Higashimatsushima City, and member companies of the Urban Infrastructure Initiative (UII) by the World Business Council for Sustainable Development (WBCSD). We would like to express herewith our sincere gratitude for all persons concerned.

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6.3 Practical application

In current building practices, as shown in Figure 6.3.1 prepared by the Japan Institute of Architects, the importance of building management in accordance with the building life-cycle has been increasing, which includes the upstream, consisting of planning, design and construction, as well as the downstream that covers the operation and maintenance after construction is completed, and property management.

While an increased number of new constructions and renovations are expected, the role of building management, which is connected directly to asset management, is likely to increase further. In this regard, we expect that CASBEE, a system that allows a comprehensive assessment of the building environmental performance, will be utilized in the following situations.

6.3.1. Upstream utilization

1) Utilization as a design support tool

CASBEE may be used when a designer conducts a self-assessment of the environmental performance at the design stage in order to check the design contents, which will help bring the building close to the best practice under the given conditions.

2) Utilization as a communication tool between architects and contractees

CASBEE can be used as an objective communication tool between contractees and designers, in terms of environmental performance.

3) Voluntary utilization in the construction industry

The Japan Federation of Construction Contractors conducts a survey regarding the utilization of CASBEE by its affiliated companies on a regular basis, the result of which is made available to the public.

4) Utilization for voluntary labeling by builders and contractees

CASBEE may be used when builders and contractees voluntarily disclose assessment results of CASBEE in their labeling in order to show their corporate attitude and marketability.

5) Utilization as a self-risk management tool for builders and contractees

Many of the CASBEE assessment items are related to environmental risks. The objective assessment of such items will help builders and contractees, who make large-scale investments, avoid possible risks beforehand.

6.3.2. Downstream utilization

1) Utilization as a tool for asset valuation and rating

CASBEE may be utilized for an objective evaluation and rating regarding the environmental performance of assets.

2) Improvement of corporate image in the real estate market by voluntary labeling
Practical efforts concerning the environment as part of business ethics contribute to the sustainable enhancement of the corporate image.

3) Utilization in ESCO businesses
CASBEE may be used as a measure for new businesses such as Energy Service Company (ESCO) businesses, which are based on profits created by the improvement of environmental performance achieved through renovation of existing buildings.

6.3.3. Others

Utilization of CASBEE is expected to contribute to target setting in terms of the environmental performance and the validation of its achievement, both of which are closely related to investment risk management in various services and business categories relating to construction, including PFI businesses relating to fund procurement for construction projects by public sectors, securitization of private building assets, and due diligence when the purchaser signs a contract.

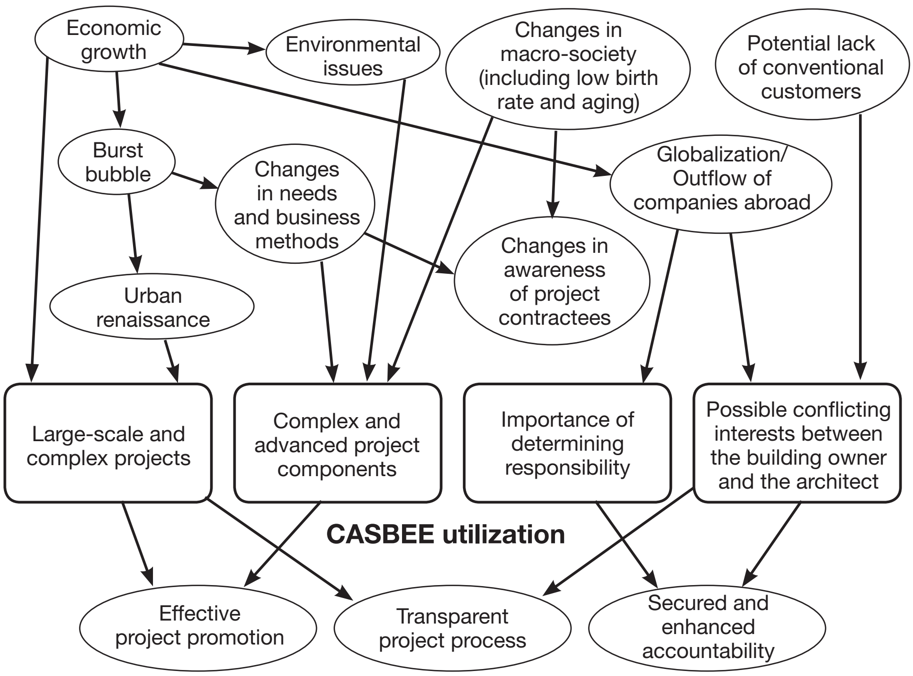


Figure 6.3.1: Picture behind the increased awareness of the need for project management and CASBEE (Source: Information provided by the Japan Institute of Architects)

<Case-1> Promotion of CASBEE utilization and and a Design for Environment (DfE) by the Japan Federation of Construction Contractors

1) Efforts concerning promotion of the use of CASBEE

The number of past CASBEE assessments (Figure 6.3.2) indicates that the total number in this year's survey increased by 26.7% from last year. (The number of data items from 7 companies that were newly added to those surveyed this year is 14 in total.) The number of assessments by use indicates that the increase in apartment buildings is about 48%, and that in multi-purpose buildings it is about 97%. Housing complexes show a significant increase in the number of assessments.

indicates that the number of assessments submitted to local governments and its percentage of the total number of assessments both increased compared to 2010 (from 47.2% to 48.5%).

This seems to reflect an increased number of local governments that require a mandatory submission of CASBEE assessments, as well as the increase in the total number of assessments submitted.

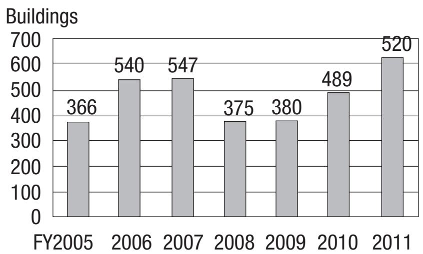


Figure 6.3.2: Number of assessments by financial year (excluding apartment buildings in 2008)

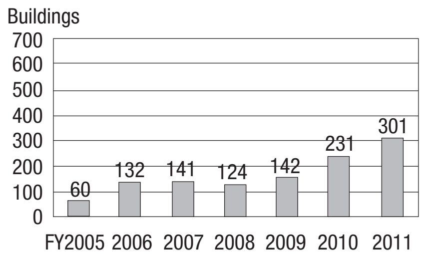


Figure 6.3.3 Number of assessments submitted to local governments (excluding apartment buildings in 2008).

2) Number of buildings assessed

Survey results regarding efforts concerning the promotion of CASBEE utilization by individual companies are shown below. The efforts are classified into 4 levels from the most positive answer, "Conducting CASBEE assessments in all buildings," to the least, "Only buildings requested by local governments or contractees." A total of 23 companies out of 30 actively conducted CASBEE assessments in accordance with respective internal standards. (See Figure 6.3.4)

If we received multiple answers, the most positive one was selected as the company's attitude.

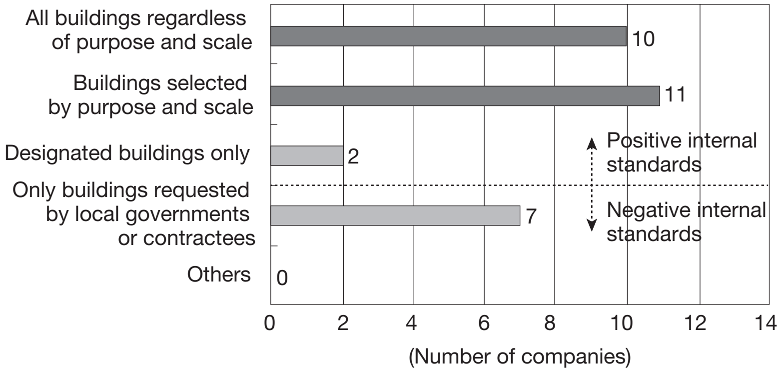


Figure 6.3.4: Buildings subject to the assessment (30 companies)

3) Assessment rank classifications and BEE distribution

Next, in terms of data for all buildings surveyed for 4 years since 2008, a color-coding was applied to those evaluated with the 2010-edition CASBEE assessment tool. (Figure 6.3.6)

Data indicated in dark gray in the Figure represent buildings evaluated with the 2010-edition CASBEE tool. Data indicated in light gray include buildings assessed with tools other than the 2010 edition and those assessed with individual local governments' tools including the latest edition.

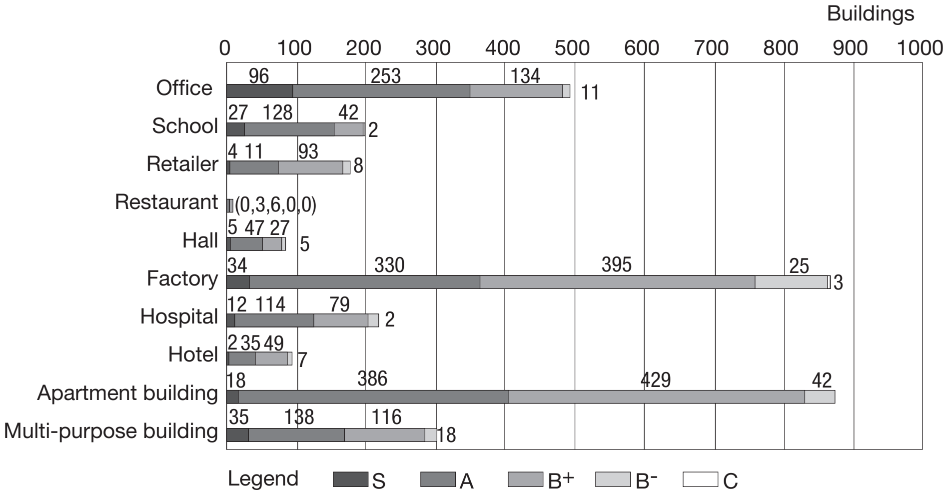
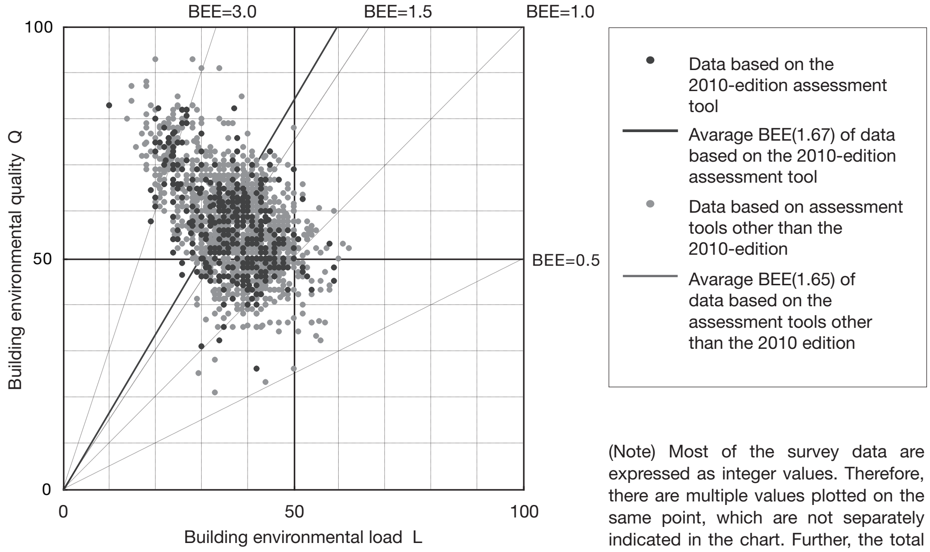


Figure 6.3.5: Number of assessments by use (from 2005 to 2011)



(Note) Most of the survey data are expressed as integer values. Therefore, there are multiple values plotted on the same point, which are not separately indicated in the chart. Further, the total average BEE line 1.66 is not indicated in the chart since it overlaps with individual average lines, and looks indistinctive.

Figure 6.3.6: BEE distribution for all purposes (from 2008 to 2011)

<Case-2> Efforts by building owners

Information provided in this chapter was obtained from the Environmental Action Plan in the Real Estate Industry published by the Real Estate Companies Association of Japan in March 2013.

1) Environmental action goals concerning new office buildings

The building plan and design for construction of a new office building focus on the reduction of energy consumption in view of regional characteristics.

As a general rule, the target scoress are as follows: ERR =15% and over and PAL reduction percentage=10% and over. Large-scale office buildings aim at a higher goal: ERR=25% and over.

The achievement rate will be raised by 2020. The target scoress may also be raised as necessary depending on the achivement rate.

Large-scale office buildings, which take a leading role in environmental measures, also endeavor to acquire certification for low-carbon buildings specified in the Low Carbon City Promotion Act.

2) Active utilization and promotion of environmental value assessment in real estate

Achieving “Compatibility with environment and economy” in real estate through the active utilization and promotion of an environmetal value assessment of real estate in order to encourage proper evaluation of green buildings in the market.

Making efforts in actively conducting an environmental value assessment of office buildings and disclosing the information thereof to concerned parties, in order to receive higher ratings for environmentally friendly buildings.

(1) Actively utilizing environmental performance assessment tools including CASBEE
(2) Actively utilizing and disclosing environmetal ratings provided by local governments and financial insitutions
(3) Widely disclosing assessment results to the public and providing sufficient information to tenants and concerned parties

3) Environmental action goals concerning new condominium apartments

When supplying new condominium apartments, the building plan and design thereof focus on the reduction of energy consumption in view of the regional characteristics.

Specifically, new condominium apartments aim at a higher level of environmental performance; for example, about 5% higher than the Reference Value provided in the Operation Stage in CASBEE-NC.

Condominiums, which take a leading role in environmental measures, also endeavor to acquire a certification for a low-carbon building specified in the Low Carbon City Promotion Act.

<Case-3> New wave of CASBEE utilization in real estate investments

1) Project overview of promotion of creation of earthquake-resistant and green buildings

The project for promoting the creation of earthquake-resistant and eco-friendly real estate was included in the government supplementary budget in 2012. This project intends to promote urban development contributing to regional regeneration and revitalization, and measures preventing climate change by risk capital supplied by the government, serving as an incentive to encourage private investment, in terms of old and little-used or unused buildings, in order to utilize private funds and know-how in promoting the creation of high-quality real estate (renovation, reconstruction and development projects) having earthquake resistance and environmentally friendly performance.

There are many buildings that can turn into investment-grade real estate through the enhancement of value by renovation or refurbishment. On the other hand, we assume there are also many cases in which actual renovation projects are too hard to carry out. In order to support such cases, the government supplies a certain amount of risk capital for the projects.

This project is based on a scheme in which a company subsidized by the government (hereinafter referred to as “a fund-raiser entity”) creates funds and invests them in a limited partnership (hereinafter referred to as “LPS”) that makes investments in businesses engaged in renovation, reconstruction or development of old and little-used or unused buildings.

The project is under the joint jurisdiction of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and the Ministry of the Environment (MOE), receiving a total of 35 billion yen (30 billion yen from the MLIT and 5 billion yen from the MOE) in government subsidies. After open recruitment by the MLIT and the MOE, the Real Estate Sustainability and Energy-Efficiency Diffusion (hereinafter referred to as “the institution”) was elected as the fund-raising entity.

2) Requirements for invested projects

Requirements for projects subject to investment by the LPS are summarized as follows:

1) Target area

Within the Densely Inhabited District (DID) according to the national census.

2) Target project

Businesses engaged in one of the following projects, which includes the acquisition of real estate as part of their business operations. Apart from special services for the purposes of the sex industry, it is generally limited to buildings having a total floor space of 2,000m^2 and over.

(1) The renovation of a building constructed under the former Earthquake-Resistance Standards that is expected to achieve the seismic capacity equivalent to the current standard after the project is completed

(2) The renovation, reconstruction or development of a building expected to meet one of the following standards concerning environmental performance after the project is completed

a. The energy intensity of the entire building is reduced by approximately 15% or more, compared to the condition before the project is completed (limited to cases in which renovation work is conducted)

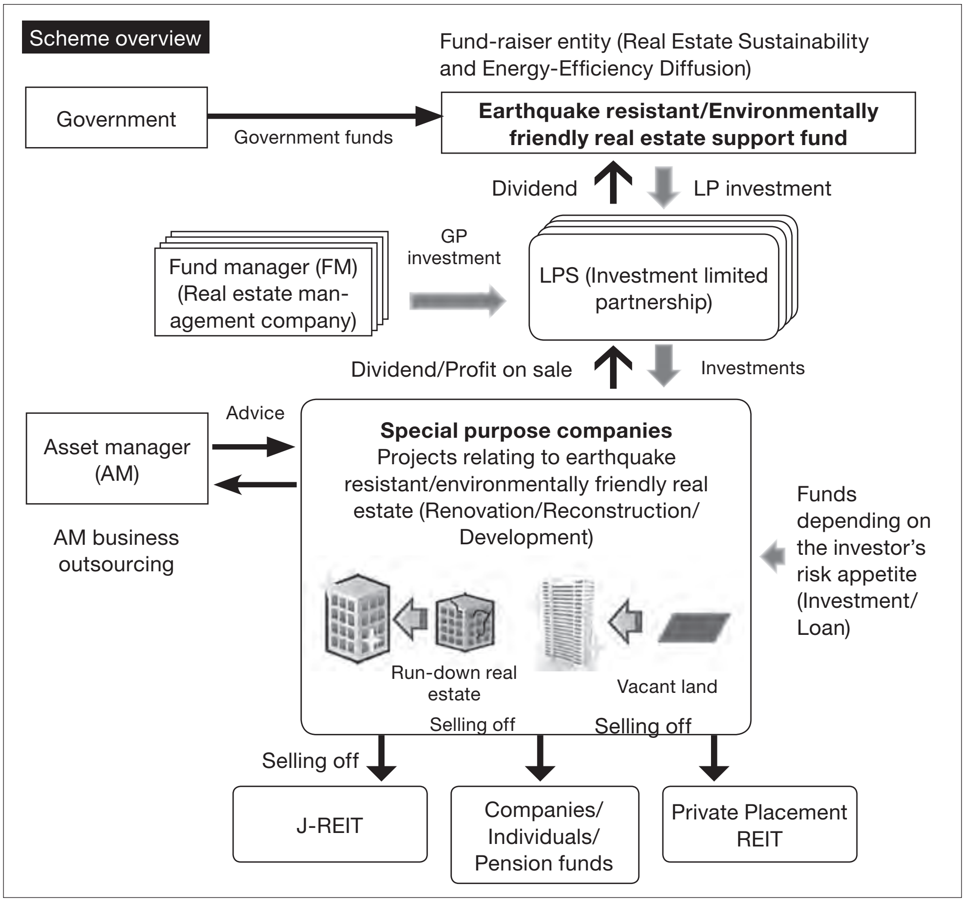
b. The assessment result by CASBEE is Rank A or over

c. The number of green stars in the assessment result of the lifecycle CO_2 by CASBEE is 3 or more

d. The building is certified as a low-carbon building as specified in the Low Carbon City Promotion Act.

The important thing here is that CASBEE is utilized as the environmental performance standard to be satisfied after the renovation, reconstruction or development projects.

This project is expected to contribute to regional revitalization through the regeneration and utilization of old and little-used or unused buildings, and the promotion of low carbonization of existing buildings, which will result in overcoming asset deflation due to increased asset value. We also expect this project will accelerate the establishment of private funds and real estate investment trusts that adopt CASBEE as the environmental performance standard.



Project requirements

Target area

The Densely Inhabited District (DID) according to the national census

Target project

Any of the following

(1) Seismic retrofitting project

(2) Renovation, reconstruction or development projects expected to meet any of the following environmental performance standards:

a. The energy consumption of the entire building is reduced by approximately 15% or more compared to its condition before the project

b. The assessment result by CASBEE is Rank A or over, etc.

*The total floor space after the project is more than 2,000m^2 in principle

Target entities

Tokutei Mokuteki Kaisha (TMK, meaning "special purpose company"), stock companies, limited companies and the like, which exclusively intend to implement the target project

Figure 6.3.7: Scheme overview

6.4 Utilization in education

UNESCO has established jointly with the International Union of Architects (UIA) the UNESCO/UIA Charter for Architectural Education. In the preamble it states, "We feel responsible for the improvement of architectural education and training of future architects to enable them to contribute to the sustainable development in every cultural heritage." A passage from the "General Considerations" in the Charter also states that "the vision of the future world, cultivated in architecture schools" should include the following goals:

(1) A decent quality of life for all the inhabitants of human settlements
(2) Technological application that respects the social, cultural and aesthetic needs of people
(3) Ecologically balanced and sustainable development of the urban, built and natural environment including the rational utilization of available resources

Further, knowledge for students to acquire in environmental studies includes the following:

- Ability to act with knowledge regarding natural systems and urban built environments
- Understanding of resource conservation and waste management issues
- Understanding of the life cycle of materials, issues of ecological sustainability, environmental impact, design for reduced use of energy, as well as passive systems and their management
- Awareness of the history and practice of landscape architecture, urban design, as well as regional and national urban planning and their relationship in local and global demography and resources
- Awareness of the management of natural systems taking into account natural disaster risks

On the other hand, in June 2000, the Research Committee on Global Environment of the Architectural Institute of Japan (AIJ) jointly enacted with 5 related organizations the Architectural Charter for a Global Environment. In order to promote its practical application, the AIJ also published "Architecture for Global Environment Series, Introductory Guide – Towards the Architecture for a Global Environment" (First edition: August 2002, First English edition 2005, Second edition: August 2009), which provides, for the first time, in a systematic manner, the scope and knowledge regarding the architecture for the global environment required in university architectural education. Meanwhile, it is an urgent task to determine the practical approach to offering related lectures as part of architectural education, as well as the publication of the following volumes of the same series for the advanced level.

<Case study>
Utilization in professional architectural education in universities and related institutions

The basic principles of sustainability in the era of a global environment present an idea of fairness between regions and between generations. In other words, in order to secure the relationship between the environment contributing to the establishment of a sustainable society and the architecture/cities, it is necessary to mutually educate and inherit continuous and creative efforts between different generations.

In architecture-related education in Japanese universities, lectures addressing environmental issues have been mainly classified as the Architectural Environmental Engineering field, which has developed out of the building services program. However, the environmental issues we are currently facing cover a very broad range of topics including the global environment, communities and architecture. In order to address such issues, we need, in addition to design, structure and building services, efforts based on interdisciplinary understanding and collaboration, which could not be achieved in the conventional vertical-segmented education system. The CASBEE comprehensive assessment system directly reflects such needs.

In light of the situation above, many universities both at home and abroad, which offer an architectural course, have been trying to add to or revise the existing curriculum and syllabus. The following relates to a Japanese university that utilizes CASBEE as actual course material in design education.

1) Environmental planning seminar utilizing CASBEE in the University of Kitakyushu

CASBEE is utilized in seminars for environmental planning in universities. As the first model example, we introduce the overview of the “Environmental Planning Seminar” for 50 third-year students in the Department of Spatial Environmental Design, the Faculty of Environmental Engineering, the University of Kitakyushu (Lecturer: Professor Yasuyuki Shiraishi).

Third-year undergraduate students, who had learned basic architectural environmental engineering and had completed their design assignments, proved to be capable of understanding the outline of CASBEE and making a proper presentation of the assessment results.

(1) Selecting a building subject to the assessment

The building to be assessed should be the same as housing complexes designed by individual students in Design Drawing II in their second year of the undergraduate course. Each group, consisting of 4 students, selects one of their design pieces as the target building.

(2) Assessment method

<Assessment of draft design in the Design Drawing II>

It is permissible to mark “3.0” for items difficult to evaluate.

<Proposal for improved environmental performance and its assessment>

Assessment items listed in Table 6.4.1 are evaluated based on specific evidence including a simple perspective drawing, a plan and numerical values. Other items may be evaluated according to individuals’ subjective opinions within the realm of possibility. When marking 3.0 and over, a brief overview of the specific Design for Environment (DfE) should be provided.

(3) Role sharing between group members
Group members should share the assessment items.

(4) Performance evaluation criteria
The performance of each group is determined according to a comprehensive assessment of the following 6 aspects.

(1) Preliminary studies, (2) Grounds for assessment, (3) Validity of efforts and the assessment result, (4) Observation contents, (5) Presentation, (6) Q&A.

Table 6.4.1: Items requiring grounds for assessment based on calculations

	Assessment field	Items requiring grounds for assessment
Environmental quality/performance	Q1 Indoor environment	1. Sound environment / 1.3 Acoustics absorption: Calculating the average acoustic absorptivity in the principal living space 2. Thermal environment / 2.1.3 Outer layer performance: Providing specifications for walls and windows in the principal living space in order to determine the heat insulation grade 2. Thermal environment / 2.1.3 Outer layer performance: Providing specifications for walls and windows in the principal living space in order to determine the heat insulation grade 3. Lighting & illumination environment / 3.1.1 Daylight factor: Calculating the daylight factor in the principal living space / 3.1.3 Facilities using daylight: Indicating the facility overview and location 4. Air quality environment / 4.1.1 Chemical pollutants: Indicating building materials used for the principal living space, parts (walls, floors and the ceiling), and the areas to which they are attached
	Q2 Quality of service	1. Service ability / 1.1.3 Barrier-free design: Indicating the number of related items using the standard for easing building use and the guidance standard checklist / 1.2.3 Interior decoration: Providing a brief overview of the interior decoration plan 3. Flexibility & Adaptability / 3.1.2 Shape of space and its flexibility: Calculating based on the definitional equation of the ratio of the wall length
	Q3 Outdoor environment (On-site)	1. Conservation and creation of the biological environment: Indicating practical efforts 2. Consideration for townscape and view: Indicating practical efforts 3. Consideration for regional characteristics and amenities: Indicating practical efforts
Reduction of environmental load	LR1 Energy	2. Use of natural energy / 2.2 Conversion of natural energy into a usable form: Indicating practical efforts
	LR2 Resources/ Materials	2. Use of materials having a low environmental impact / 2.1.2 Recycling efficiency of non-structural materials: Indicating what is used and where it is used in the principal living space /2.6.2 Heat insulation materials: Indicating the types of heat insulation materials / 2.6.3 Coolant: Indicating the types of coolant
	LR3 Off-site environment	3. Control of wind damage and sun-shading: Indicating practical efforts 4. Control of light pollution: Evaluating in accordance with the Guidelines for Countermeasures against Light Pollution (on a voluntary basis) 5. Improvement of decreased thermal environment: Indicating practical efforts

Table 6.4.2: Environmental planning seminar schedule (2003)

Date	Details
November 17 (Mon)	Lecture regarding the overview of CASBEE
January 5 (Mon)	Explanation of assignments/Explanation regarding CASBEE
January 19 (Mon)	Explanation regarding CASBEE/Training in groups (Selecting one design piece subject to the assessment/Preparation of required data and materials)
January 26 (Mon)	Assessment training/Preparation of presentation materials
January 29 (Thu)	Submitting an assignment
January 31 (Sat)	Presentation/Feedback Presentation for 10 min. per group + Q&A for 5 min. 4 Students/Group × 12 Groups

(Note) One lecture consists of 2 slots (3 hours).

(5) Feedback from the lecturer: Utilizing CASBEE in a lecture
Yasuyuki Shiraishi, Full-time lecturer, the Department of Spatial Environmental Design, the Faculty of Environmental Engineering, the University of Kitakyushu (as of 2003)

The environmental planning seminar conducts training for a comprehensive building performance assessment utilizing CASBEE in terms of the housing complex assignment students worked on in the Design Drawing II in the second year of the undergraduate course. The Design Drawing II teaches techniques relating mainly to design aspects including spatial structure, flow planning and expression. This lecture intends to make students review their building designs in light of a wide range of design requirements covered by CASBEE (the indoor environment, off-site environment, etc.).

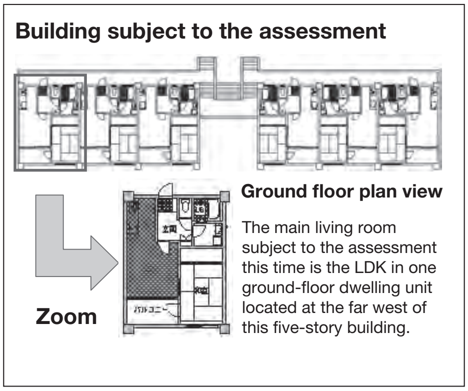
Since the number of lectures was not enough to conduct the assessment according to the manual in terms of all items covered by CASBEE, we classified the assessment items into 2 types: “Items requiring grounds for assessment” and “Items that may be evaluated based on subjective opinions.” In order to help students understand the actual assessment details and methods, I prepared extra materials including a guideline and a glossary that are not provided in the manual, and explained them before the training.

For the future, I feel it is necessary to organize lectures by multiple lecturers with different areas of expertise, rather than focusing on the lecture timetable and the training details such as how to discuss assessment methods.

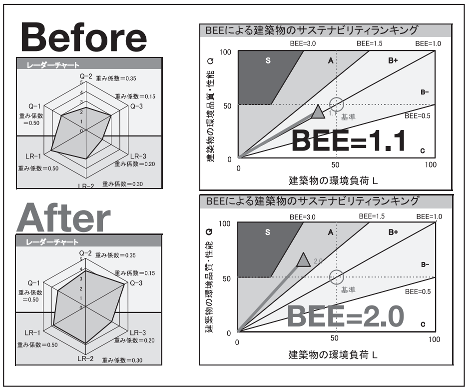
(6) Student’s comments: Impressions of the environmental planning seminar utilizing CASBEE
Rie Kasai, Third year student, the Department of Spatial Environmental Design, the Faculty of Environmental Engineering, the University of Kitakyushu (as of 2003)

We conducted an assessment of one unit of a housing complex, considered and created an improvement plan, and reevaluated it, using CASBEE. The assessment itself was simple and straightforward for anyone who could understand what we were supposed to do. The assessment items were subdivided, however, and not very time-consuming. Items that designers are likely to forget considering are all covered, allowing an assessment regarding how much we think about the environment in terms of various aspects ranging from the indoor environment, energy/resources, service performance to the outdoor environment. I think if we used CASBEE in the planning stage or at the time of renovation, we would be able to produce more eco-friendly designs.

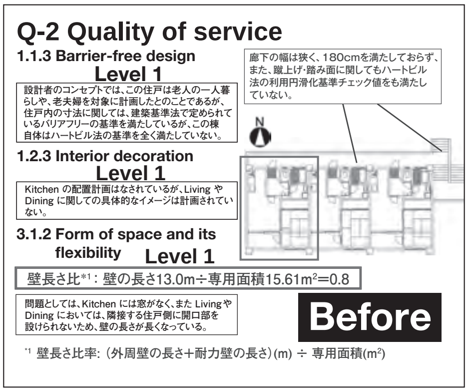
(1) Building subject to the assessment



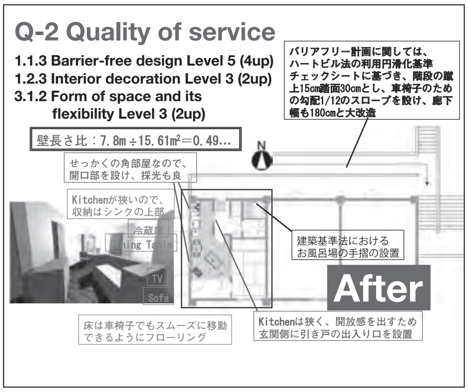
(2) Assessment result
(Before and after improvement)



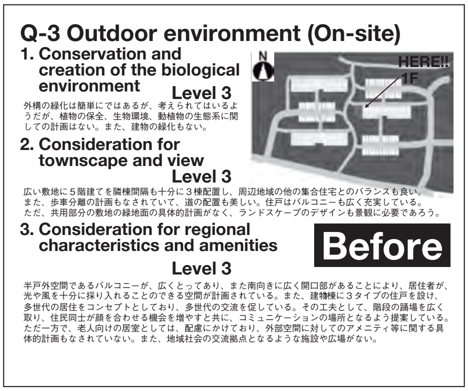
(3) Grounds of assessment for Q-2
Quality of service (Before improvement)



(4) Grounds of assessment for Q-2
Quality of service (After improvement)



(5) Grounds of assessment for Q-3
Outdoor environment (Before improvement)



(6) Grounds of assessment for Q-3
Outdoor environment (After improvement)

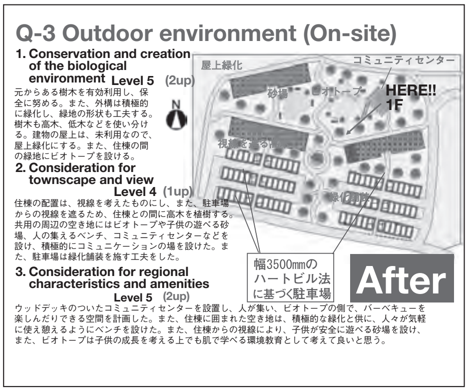


Figure 6.4.3: Extracts from the group presentation in the environmental planning training

Further, CASBEE enables us to indicate levels of building performance, which would serve as a straightforward index for the contractee who is not an expert in architecture. The mandatory disclosure of the performance levels will help designers and builders increase their sense of responsibility and be ambitious in terms of enhanced environmental performance. I think that we can utilize the CASBEE tool not only in building designs but also in the real estate industry, since it can evaluate not just new construction but existing buildings.

2) Utilization in Continuing Professional Development (CPD) for experts

Continuous training and education are also necessary not only for students who will lead the next generation, but also for professional architects who have received an architectural education and are already engaged in the practical side of the business. As the spirit of the times changes, the professional skills required also keep changing. Especially, changes in the extensive environmental issues CASBEE covers, as well as political inducements, are fairly difficult to catch up with in the daily business routine. Consequently, retraining and Continuing Professional Development (CPD) for experts by professional associations and academic societies in the architectural field are needed.

CASBEE organizes an annual workshop and adopts a system in which successful candidates in the examination after the workshop are registered as CASBEE accredited assessors. Including such opportunity, we expect that CASBEE will be widely utilized in the CPD by affiliated organizations.

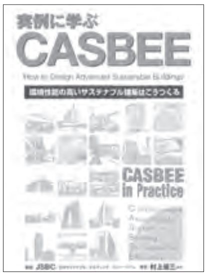
6.5. Publicity and academic releases

6.5.1. Books about CASBEE

CASBEE provides information on various publications and its website both at home and abroad in order to promote the use of CASBEE tools. The publications include assessment manuals for individual tools as well as other related books as follows, in which the use of CASBEE tools has been familiarized to the public. (The following publications are all in Japanese.)

CASBEE Introductory Guide
Edited by JSBC, Written by Shuzo MURAKAMI et al., 2004, Nikkei BP, 198 pages

The first introductory guide gives a simple explanation about CASBEE. This book includes many drawings, practical utilization methods as well as assessment examples, so that it gives a broad understanding of its contents not only to designers and related officials but also to ordinary building owners and citizens.



CASBEE in Practice
Edited by JSBC, Written by Shuzo MURAKAMI et al., 2005, Nikkei BP, 272 pages

A compilation book with case examples of buildings that received a high rating in CASBEE. This book illustrates key points in achieving a sustainable building with a high level of environmental performance in a comprehensible way, using a large collection of pictures and drawings.

CASBEE for Homes (Detached Houses) Introductory Guide
Edited by JSBC, Written by Shuzo MURAKAMI et al., 2007, Kenchiku Gijutsu, 240 pages

An introductory guide providing a simple explanation about CASBEE for Homes (Detached Houses) in terms of its contents and assessment methods, directed to as many users as possible including not only professional designers but also non-specialist users.

CASBEE for Detached Houses – Case Examples
Supervised by JSBC, CASBEE for Detached House Editorial Working Group, Edited by Housing Tribune Editorial Department, 2010, Sohjusha, 188 pages

A compilation book with case examples of 39 eco houses across the country, which introduces detailed environmental technologies adopted in individual buildings, actual assessment results based on CASBEE for Detached Houses, and useful know-how for architects and builders immediately serving to enhance the housing environmental performance.

Environmental Assessment of Vernacular Architecture
Written by Shuzo Murakami, 2008, Keio University Press, 183 pages

A groundbreaking discussion contributing to the development of a paradigm for sustainable buildings through CASBEE assessments of the world's traditional buildings such as igloos (Canada), cave dwellings (Turkey), houses with wind catchers (Iran), stilt houses (Indonesia) and water houses (Malaysia).

Smart & Slim Future City
Written by Shuzo Murakami, 2012, Energy Forum, 221 pages

This book takes a comprehensive view of ensuring the sustainability of the global environment and the enhanced environmental quality in which human beings can live their lives in a humane manner, through an ideal course of buildings and cities based on assessments by CASBEE for Cities, using "Smart" and "Slim" as keywords.

House for Health Maintenance and Promotion – Case Examples
Supervised by Health Maintenance and Promotion Housing Research Consortium, Health Maintenance and Promotion Housing Research Committee, 2013, Sohjusha, 203 pages

This book introduces 47 buildings across the country focusing on improved housing health and know-how relating thereto.

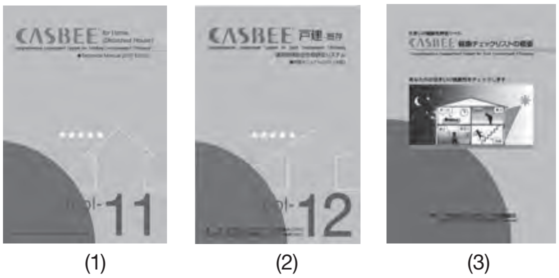
6.5.2. Manuals of CASBEE

Assessment manuals of individual CASBEE tools are bound up as proper books and sold on the website. As part of the international promotion activities, some of the manuals are provided in English, which are available on the CASBEE website for free.

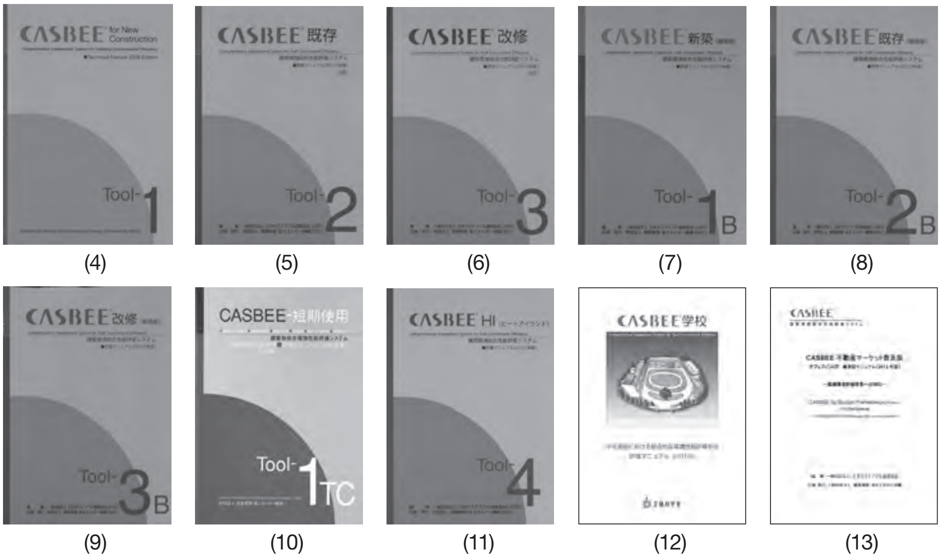
Table 6.5.1: List of published CASBEE manuals

Housing scale	Availability of English version
(1) CASBEE for New Detached House (2010 edition)	Available (2007 edition)
(2) CASBEE for Existing Detached House (2010 edition)	
(3) CASBEE Health Checklist	
Building scale	
(4) CASBEE for New Construction (2010 edition)	Available
(5) CASBEE for Existing Buildings (2010 edition)	
(6) CASBEE for Renovation (2010 edition)	
(7) CASBEE for New Construction (Brief version) (2010 edition)	
(8) CASBEE for Existing Buildings (Brief version) (2010 edition)	
(9) CASBEE for Renovation (Brief version) (2010 edition)	
(10) CASBEE for Temporary Construction (2006 edition)	
(11) CASBEE-HI for Heat Island Relaxation (2010 edition)	
(12) CASBEE for Schools	
(13) CASBEE-for Market Promotion (2012 edition)	Available
Urban scale	
(14) CASBEE for Urban Development (2007 edition)	Available
(15) CASBEE for Urban Development (Brief version) (2007 edition)	Available
(16) CASBEE for Urban Areas + Buildings (2007 edition)	
(17) CASBEE Community Health Checklist	
City scale	
(18) CASBEE for Cities (2012 edition)	Available

<Housing scale>



<Buildings scale>



<Urban scale>

<City scale>

Figure 6.5.1: CASBEE Assessment Manuals

6.5.3. Electronic publicity (website, etc.)

The CASBEE website is kept updated and provides the latest information regarding the development of individual tools, the information of CASBEE-AP's training courses and examination, and the information regarding certified buildings. For overseas users, we have developed the English page of the CASBEE website and the Japan Sustainable Building Database, in which highly rated buildings assessed by CASBEE are introduced.

Figure 6.5.2: English CASBEE website

http://www.ibec.or.jp/CASBEE/english/index.htm

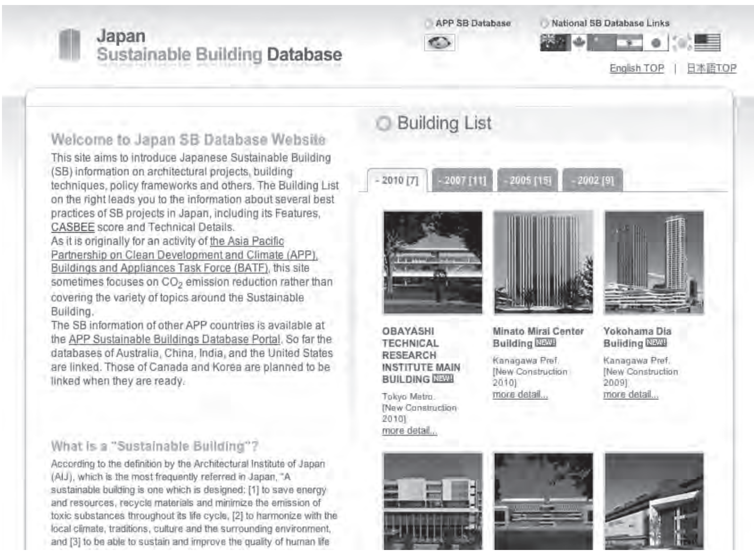


Figure 6.5.3: Japan Sustainable Building Database

http://www.ibec.or.jp/jsbd/

6.5.4. International academic release

In order to inform the international community of CASBEE's research and development, we actively publish articles in related journals and deliver them at international conferences. Major articles that were presented internationally are listed in the table below.

Table 6.5.2: List of major articles presented internationally

	Title	Name of journal	Authors	Publication date	Contents
1	Nationwide Assessment of City Performance Based on Environmental Efficiency	International Journal of Sustainable Building Technology and Urban Development	Shun KAWAKUBO, Toshiharu IKAGA, Shuzo MURAKAMI	December 2011	Details regarding assessments of local governments across the country utilizing CASBEE for Cities (Brief version)
2	Development of a Comprehensive City Assessment Tool: CASBEE-City	Building Research & Information	Shuzo MURAKAMI, Shun KAWAKUBO, Yasushi ASAMI, Toshiharu IKAGA, Nobuhaya YAMAGUCHI, Shinichi KABURAGI	April 2011	Details regarding CASBEE for Cities
3	Time-Series Assessment of All Local Governments in Japan in Terms of Eco-Efficiency	International Conference on Sustainable Building Asia (SB13 Seoul)	Shun KAWAKUBO, Toshiharu IKAGA, Shuzo MURAKAMI	July 2013	Details regarding time-series assessments of local governments across the country utilizing CASBEE for Cities
4	Application of the CASBEE-City Assessment Tool for Disaster-Affected Cities	International Conference on Sustainable Building Asia (SB13 Seoul)	Masaki TAKIGAMI, Toshiharu IKAGA, Shuzo MURAKAMI, Shun KAWAKUBO, Takuhei USHIRO	July 2013	Details regarding assessments of disaster-affected cities utilizing CASBEE for Cities
5	Sustainability Assessment of Local Governments with the CASBEE-City Tool Using Public Statistical Information	The 10th International Conference on Ecobalance	Shun KAWAKUBO, Toshiharu IKAGA, Shuzo MURAKAMI	November 2012	Details regarding the development of assessment tools for CASBEE for Cities utilizing public statistical information
6	Outline of the Approach to Low Carbonization by Strengthening CASBEE for New Construction (2010 Edition)	World Sustainable Building Conference (SB11 Helsinki)	Masaaki SATO, Shuzo MURAKAMI, Toshiharu IKAGA, Takashi YANA, Tatsuya HAYASHI and Junko ENDO	October 2011	Details regarding the assessment of LCCO2 in CASBEE
7	Linking Building Environmental Assessment Tools to Property Appraisal – CASBEE-MP (tentative version)	World Sustainable Building Conference (SB11 Helsinki)	Hiroaki TAKAI, Masato ITO, Shuzo MURAKAMI, Toshiharu IKAGA, Kazuo IWAMURA, Nobuhaya YAMAGUCHI, Junko ENDO	October 2011	Details regarding CASBEE-MP

	Title	Name of journal	Authors	Publication date	Contents
8	Incorporation of $LCCO_2$ Assessment into CASBEE	World Sustainable Building Conference (SB08 Melbourne)	Masaaki SATOH, Shuzo MURAKAMI, Toshiharu IKAGA, Hiroaki TAKAI	October 2008	Details regarding the introduction of LCCO2 assessments into CASBEE
9	Development of Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) for Homes	World Sustainable Building Conference (SB08 Melbourne)	Tsuyoshi SEIKE, Shuzo MURAKAMI, Takashi AKIMOTO, Toshiharu IKAGA, Kazuo IWAMURA, Toshiya CHIKADA, Yuji YAMANAKA, Kiyoshi MIISHO	October 2008	Details regarding the development of CASBEE for Homes (Detached Houses)
10	Estimation for the Environmental Performance of a New College Building at the Preliminary Design Phase	World Sustainable Building Conference (SB05 Tokyo)	Hisashi HANAZAWA, Takashi SATO, Motonori TOJIMA, Ryozo SAKURAMA	September 2005	Details regarding the CASBEE assessment of a new college building of Hokkaido University
11	Comparison of the assessment results of BREEAM, LEED, GB Tool and CASBEE	World Sustainable Building Conference (SB05 Tokyo)	Yukihiko KAWAZU, Nobuhiro SHIMA, Noriyoshi YOKOO, Tatsuo OKA	September 2005	A comparison between assessment results of BREEAM, LEED, GB Tool and CASBEE in terms of 4 buildings
12	Communication Method of the Building Comprehensive Environmental Assessment for Clients/Customers – Proposal and Project Evaluation	World Sustainable Building Conference (SB05 Tokyo)	Hiroaki TAKAI, Akira MATUSKUMA, Hiroshi SATO, Shujirou FURUNO	September 2005	Method for utilizing building environmental performance assessments by assessment tools including CASBEE as a communication tool with clients
13	Extended Framework of CASBEE: Designing an Assessment System of Buildings for all Lifecycle Stages Based on the Concept of Eco-Efficiency	World Sustainable Building Conference (SB05 Tokyo)	Junko ENDO, Shuzo MURAKAMI, Toshiharu IAKGA, Kazuo IWAMURA, Yuzo SAKAMOTO, Tomonari YASHIRO, Kazuaki BOGAKI	September 2005	Development of extended tools of CASBEE in accordance with the building lifecycle and purposes

6.5.5. Domestic academic release

A large number of articles have been presented in Japan as well. Especially, the Architectural Institute of Japan (AIJ) has so far delivered more than 100 articles at their annual academic conference. The AIJ has also presented articles listed in the following table.

Table 6.5.3: List of major articles presented in Japan (only in Japanese)

	Title	Name of journal	Authors	Publication date	Contents
1	Validation of comprehensive environmental performance assessment tools of municipalities based on a large-scale question-naire survey	AIJ Journal of Environmental Engineering	Shun KAWAKUBO, Toshiharu IKAGA, Shuzo MURAKAMI	November 2013	Details regard-ing a validation of CASBEE for Cities as an assessment tool based on a questionnaire survey
2	Visualization of the disaster recovery process based on a time-series assessment of city environment	AIJ Journal of Technology and Design	Shun KAWAKUBO, Toshiharu IKAGA, Shuzo MURAKAMI	October 2013	Details regarding an assessment of a disaster-affected city (Kobe City) utilizing CASBEE for Cities
3	Development of an environmen-tal performance assessment tool for local govern-ments combined with a database and a basic GIS function	AIJ Journal of Technology and Design	Shun KAWAKKUBO, Toshiharu IKAGA, Shuzo MURAKAMI	October 2013	Details regarding the development of CASBEE for Cities combined with a database and a basic GIS function
4	Environmental performance assessments of local governments across the country by CASBEE for Cities	AIJ Journal of Environmental Engineering	Shun KAWAKUBO, Toshiharu IKAGA, Shuzo MURAKAMI, Yasushi ASAMI	January 2013	Details regarding assessment results of local govern-ments across the country utilizing CASBEE for Cities
5	Development of CASBEE for Cities, a comprehensive environmental per-formance assess-ment tool for cities – Principles and a framework of an assessment system	AIJ Journal of Technology and Design	Shuzo MURAKAMI, Shun KAWAKUBO, Yasushi ASAMI, Toshiharu IKAGA, Nobuhaya YAMAGUCHI, Shinichi KABURAGI	February 2011	Overview of CASBEE for Cities
6	Development of a wind character-istics database for CASBEE-HI, an assessment system concern-ing the reduction of the heat island effect	AIJ Journal of Technology and Design	Shuzo MURAKAMI, Katashi MATSUNAWA, Akashi MOCHIDA, Yasushige MORIKAWA, Hironori HAYASHI, Masayuki OGURO	December 2007	Details regarding the wind character-istics database in CASBEE-HI

	Title	Name of journal	Authors	Publication date	Contents
7	Overview of CASBEE for Urban Development tool: Development of the comprehensive built environment performance assessment system (No. 5)	AIJ Journal of Technology and Design	Shuzo MURAKAMI, Nobuhaya YAMAGUCHI, Yasushi ASAMI, Toshiharu IKAGA, Shinichi KABURAGI, Akira MATSUKUMA, Tomohiro UCHIIKE, Takashi HASHIMOTO	June 2007	Overview of CASBEE for Urban Development
8	Development of CASBEE-HI, an assessment system concerning reduction of the heat island effect: Overview and a framework of the assessment system (for non-residential buildings)	AIJ Journal of Technology and Design	Shuzo MURAKAMI, Katashi MATSUNAWA, Akashi MOCHIDA, Hideharu NIWA, Ryuzo OOKA, Yasunobu ASHIE, Jun TANIMOTO, Yasushige MORIKAWA, Ryuji YANAGIHARA	June 2006	Overview of CASBEE-HI
9	Overview of CASBEE for Renovation tool: Development of the comprehensive built environment performance assessment system (No. 4)	AIJ Journal of Technology and Design	Masaaki SATO, Shuzo MURAKAMI, Hiroaki TAKAI, Toshiharu IKAGA, Hisashi HANZAWA, Takashi YANAI, Junko ENDO, Nobufusa YOSHIZAWA	June 2006	Overview of CASBEE for Renovation
10	Overview of CASBEE for local governments: Development of the comprehensive built environment performance assessment system (No. 3)	AIJ Journal of Technology and Design	Junko ENDO, Shuzo MURAKAMI, Toshiharu IKAGA, Nobufusa YOSHIZAWA, Masaaki SATO	June 2006	Details regarding efforts introduced in CASBEE for local governments
11	Development of the comprehensive building environmental performance assessment system (No. 2): Overview of CASBEE for Existing Buildings tool	AIJ Journal of Technology and Design	Toshiharu IKAGA, Shuzo MURAKAMI, Kazuo IWAMURA, Yuzo SAKAMOTO, Tomonari YASHIRO, Kazuaki BOGAKI, Masaaki SATO, Junko ENDO	June 2005	Overview of CASBEE for Existing Buildings
12	Development of the comprehensive built environment performance assessment system	AIJ Journal of Technology and Design	Shuzo MURAKAMI, Kazuo IWAMURA, Yuzo SAKAMOTO, Tomonari YASHIRO, Kazuaki BOGAKI, Masaaki SATO, Toshiharu IKAGA, Junko ENDO	December 2004	Details regarding the framework and assessment method of CASBEE

6.6. Overseas collaborations

6.6.1. United Nations Environmental Programme (UNEP) FI PWG

In 2011, UNEP FI PWG published "An Investors Perspective on Environmental Metrics for Property".

Our activities behind launching a very simple version of CASBEE ("CASBEE-MP") were introduced in this publication.

Investors who are taking environmental issues into consideration will require such concise systems.

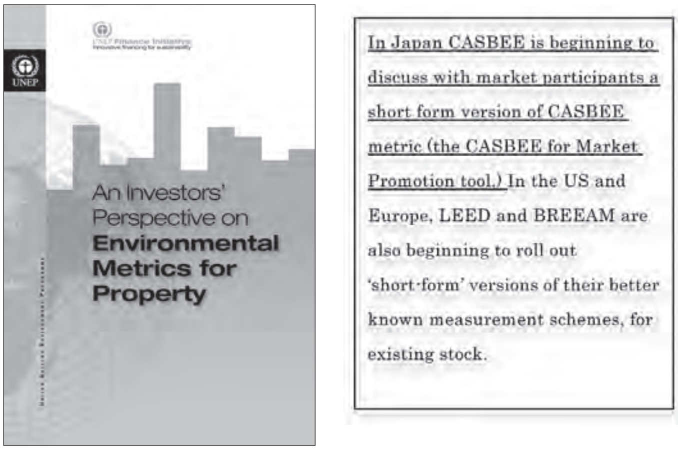


Figure 6.6.1: UNEP FI PWG

CASBEE-MP was also introduced in the UNEP Finance Initiative Newsletter.


UNEP Finance Initiative
Innovative financing for sustainability

UNEP Finance Initiative Newsletter
November 2011

CASBEE releases tool on green property financing

The *CASBEE for Market Promotion* comes after a recent call by the UNEP FI Property Working Group to bridge the gap that separates financial and environmental experts and move the dialogue on environmental metrics for property investment forward.

More information here.

Contact us

For further information, contact communications [at] unepfi.org

Figure 6.6.2: UNEP FI Newsletter

6.6.2. Korea

The Korean translations of 2008-edition assessment manuals for CASBEE for New Construction, Existing Buildings, and Renovation were prepared and published by a research group of the research center for eco-friendly architecture led by Professor Shin of Hanyang University. JSBC Supported Korean insutiution to translate the complete CASBEE manuals and to develop their own rating system.

CASBEE-NC CASBEE-EB CASBEE-RN

Figure 6.6.3: Korean translations of CASBEE for New Construction, Existing Buildings, and Renovation (2008 edition)

6.6.3. China

The Chinese translation of CASBEE was published in July 2005 in response to cooperation in the development of the Green Olympic Buildings Assessment System (GOBAS) by a group led by Professors Yi Jiang and Yingxin Zhu of Tsinghua University, which was applied to the design, construction and operation of Beijing Olympic facilities. The preamble for the Chinese translation by Chairman Shuzo Murakami appears at the beginning of the Chinese manual.

Figure 6.6.4: Chinese translation of CASBEE (2003 edition)

<Column-7>

The Chinese green building labeling system and CASBEE

ZHU, Yingxin,
Professor, Tsinghua University, China

I am very pleased to learn that the 10th anniversary of Japan's CASBEE (Comprehensive Assessment System for Built Environment Efficiency) has come. I believe the birth of CASBEE was not only a milestone in the history of green building in Japan, but also a milestone for the development of green building worldwide. As one of the leading researchers in developing the Chinese green building rating system, I really appreciated the support the CASBEE committee brought to Chinese researchers in this field.

In 2002, we were assigned a project sponsored by the Chinese Ministry of Science and Technology (MOST) for developing the Green Olympic Building Assessment System (GOBAS). It was one of the 10 key research projects sponsored by MOST for the 2008 Olympics. The leader of the working group on this project was Prof. Yi Jiang of Tsinghua University, a member of the Chinese Academy of Engineering. The GOBAS group brought together over 40 researchers from 9 universities and research institutes, and I was one of the key researchers involved. On the basis of our former research experience on green building rating systems, we estimated that the existing checklist system was not practical, and set out to find better examples and a more reasonable system configuration.

Fortunately, when I told my dear friend Prof. Nobuo Nakahara – an emeritus professor at Nagoya University – about our questions, he introduced me to Prof. Toshiharu Ikaga, a key researcher in the development of CASBEE. From then onwards, the CASBEE committee lead by Prof. Shuzo Murakami provided us with strong support, including sharing experience, attending joint seminars, providing suggestions and research literature and prototypes of CASBEE at different stages. We found the system configuration used in CASBEE was very reasonable and could solve the main problems we had encountered, so finally adopted the scoring system framework of CASBEE in GOBAS – 5-point scores and a hierarchical scoring system with weighting coefficients, as well as the 2-D chart for showing the relationship between the quality of the internal environment and the load on the external environment. GOBAS was published in August 2003 and applied during the design and construction process of the Olympic buildings. I am sure that without the support of the CASBEE committee, GOBAS could not have been completed in only one year and two months.

After GOBAS, the framework used in GOBAS was used in some Chinese national and local standards, such as the National Standard for Green Office Building Evaluation (waiting for approval) and the Standard for Eco-housing Labeling by the Chinese Environmental Protection Agency.

In October 2010, I joined a delegation organized by the Chinese Ministry of Housing and Urban-Rural Development (MOHURD) to visit the Japanese Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and the Japan Institute for Building Environment and Energy Conservation. The purpose of this trip was to learn how CASBEE was used in Japan for green building labeling, including the development of the rating system, related operation procedures, policies and regulations. We also visited Yokohama to learn how green building labeling could be promoted in a city and visited some CASBEE-labeled projects as well. This trip was extremely fruitful and instructive for the development of green building labeling systems in China.

Lastly, I would like to express my heartfelt thanks to the CASBEE committee and to my Japanese colleagues for their support and for our successful cooperation over the years. I sincerely hope we can continue this collaboration in the future and open it to the wider field of sustainable construction.■

Picture C8.1: Chinese delegation visiting the Housing Bureau, Ministry of Land, Infrastructure, Transport and Tourism, Tokyo, Japan, October 2010

Picture C8.2: Japan-China joint workshop regarding the actual CASBEE dissemination at IBEC, Tokyo, Japan, October 2012

GOBAS : China Green Olympic Building Assessment System

Yingxin ZHU, Yi JIANG, Youguo QIN
Dept. of Building Science, School of Architecture, Tsinghua University, Beijing, China

Introduction

'Green Olympic' is a promise made by the Beijing Olympic Organizing Committee to the IOC (International Olympic Committee). Green building should be one of the most important tasks in 'Green Olympic'. Furthermore, China has become the largest construction site in the world, and it is predicted that by 2015, more than half of the building floor area in China will have been built after 2000. Therefore, green building development is significant to China's sustainable development as well as to global environmental protection.

Although China has made great economic achievements in the past decade, it is still a developing country. Development levels vary a lot in different areas. Even in developed areas, profit often is the only goal developers pursue. Even though 'green building', 'eco-building', and 'sustainable building' have become buzz words and well accepted by the public, some developers just use 'green building' as a fancy logo on their products for generating bigger profit rather than a technique for global environmental protection or commonweal. There is still considerable misunderstanding about 'green building' or 'eco-building' among the public. For example, planting a large area of lawn or building a bio-circle pond is often considered as a symbol of green building and eco-building, although a lawn and the bio-circle pond do contribute a little to the environment and energy saving.

Therefore, the urgent tasks for us are:

1. to clarify the concept of green building to the public
2. to issue an assessment system for green building
3. to teach the developers, designers, constructers and operators how to design, build and manage green buildings.

Before GOBAS (Green Olympic Building Assessment System), a Chinese Eco-housing Rating System (CERS)[1] was developed by Tsinghua University in cooperation with the Ministry of Construction and China Building Research Academy and issued in August 2001. The GOBAS project was launched from November 2002, and the first version of GOBAS was published in August 2003[2]. This project was funded by China's Ministry of Science and Technology (MST) and 45 experts from 9 organizations were involved. Consigned by MST, Beijing Municipal Science and Technology Commission (BMSTC) was the supervisor of the project, and Tsinghua University took charge of the research. Beijing Municipal Construction Committee (BMCC) has issued official documents to adopt GOBAS as the Beijing local green building standard. Supported by BMCC, Beijing Green Building Association is establishing means to put GOBAS into practice.

During the development of GOBAS, Japan's CASBEE (Comprehensive

Assessment System for Built Environment Efficiency) Committee provided solid support including experiences, suggestions, research literature, prototypes of CASBEE in different stages, and joint seminars. The Natural Resource Defense Council of the USA (NRDC) also offered suggestions and detailed data of their demo building—Administrative Center for China's Agenda 21—for GOBAS's case study.

As the follow-up project of GOBAS, MST sponsored another larger project: Research on the pivotal technologies of green building. There are eight sub-projects under this project. They are the green building assessment system (for different types of buildings in different climate zones), building structure, building material, fabrics and energy system, water resource and utilization, indoor environment quality, vegetation technology, and demonstration and research workshops. The new project was launched in June 2004.

Structure of GOBAS

GOBAS consists of four main parts: green building compendium, scoring system, assessment items description, and assessment software.

The purpose of the Green Building Compendium is to show developers, designers, constructors, operators and owners what is involved in green building and what should be considered in green building design. Each item of the Green Building Compendium includes purpose, requirements and measures. The method of description in the Green Building Compendium is similar to US LEED (Leadership in Energy and Environmental Design)[4] but a score is absent. The scoring system adopted the framework of CASBEE[3].

The purpose of the GOBAS project is to help or promote people to build green buildings rather than awarding a label for existing buildings, because a mistake in an existing building cannot be easily corrected after the construction is finished. Therefore, assessment by stages is the best way according to the reality in China.

The assessment is divided into four stages in GOBAS: planning, detailed design, construction and operation. In each stage, specific items should be assessed and a specific type of data should be provided for assessment. For example, as to the aspect of environment quality, in the planning stage, the original surrounding environmental quality of the building site and the impact of the project on the environment are assessed. In the detailed design stage, the consideration and measures regarding the indoor/outdoor environment in the design document are assessed, while in the operation stage, the measured environmental data are evaluated.

Construction stage assessment is especially important for the Olympic 2008 project, because a great number of buildings will be built in Beijing during the coming three to four years. The large area of construction sites in Beijing may have a great impact on the urban environment including acoustics, discomfort glare at night, dust and considerable energy/material/water consumption in the construction process.

Three types of buildings are considered in GOBAS according to the specialties of the Olympic Park or Olympic buildings including gymnasiums, office buildings and residential buildings. The residential buildings consist of hotels and the athletes' accommodation. The athletes' accommodation will be used as apartment buildings after Olympic 2008. Both building clusters and single buildings can be evaluated by GOBAS.

Scoring and indexes of GOBAS rating

The scoring system adopts the framework of CASBEE – 5 scoring levels and a hierarchy scoring system with weighting coefficients. The assessment results are shown in the same way as CASBEE – a Quality-Load twin indexes chart. But different from CASBEE, the zoning lines are not all from the origin (0, 0), see Figure C8.1. The reason is that classing in the area around the origin (0, 0) is considered too sensitive, and higher class buildings should have increased environmental quality. Classes A, B, C, D and E indicate the green class from high to low. A building with class D or E cannot be considered as green.

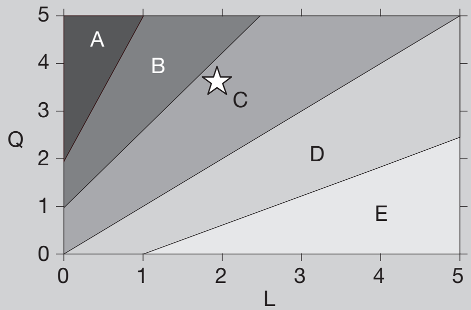


Figure C8.1: Quality-Load classing for a gym in
stage II: gym in detailed design stage

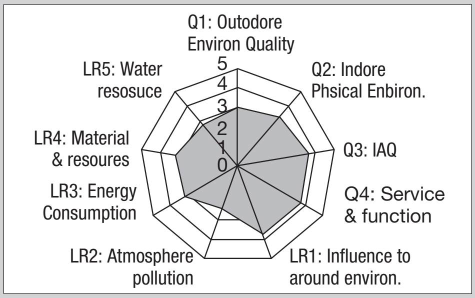


Figure C8.2 Radar chart for assessment results of a stage II

Figure C8.3 and Figure C8.4 show the hierarchy scoring system. Each Q (Quality) or LR (Load Reduction, LR=5-L) item has its own layer number and specific weighting coefficients for each layer.

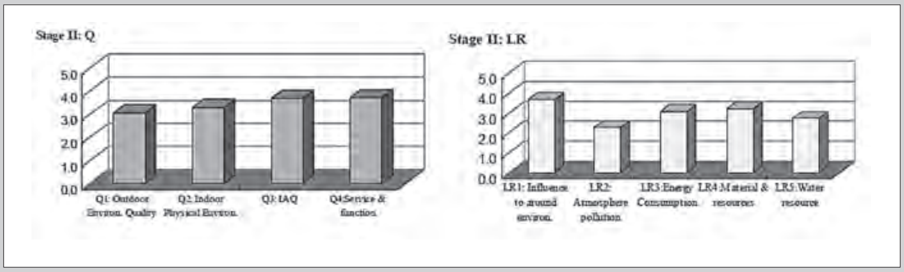


Figure C8.3: Histogram presentation for the assessment result of a gym in stage II

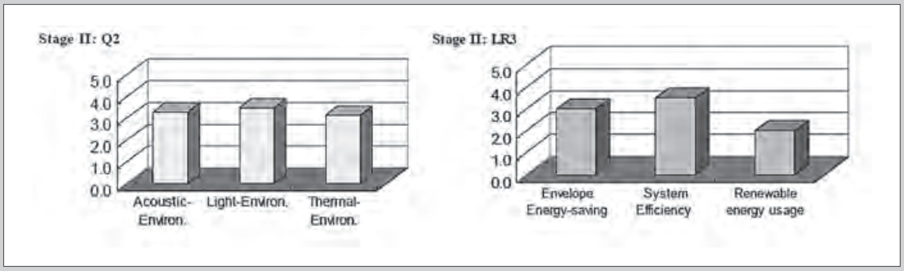


Figure C8.4: The second scoring layer (a gym in stage II)

In each scoring hierarchy, an item of the building reaching the updated highest level is scored at 5. The average score is 3. Score 1 is at the level of the basic mandatory national code or standard. If there is an item that cannot meet the mandatory national code or standard, the building is disqualified from being green.

Assessment indexes and items

In GOBAS, special assessment items and indexes have to be developed to meet the requirements of the current resource and environment situation of China. For example, wood and argillaceous bricks are not considered green material because they consume exiguous resources in China.

Another example is in regard to the energy consumption assessment. Many countries use primary energy consumption as the important index in energy evaluation. However, to heat 1 m^3 of water from 20°C to 100°C and to heat 2 m^3 water from 20°C to 60°C consume the same amounts of primary energy, but the former results in higher energy quality or energy than the latter. To provide 1 kWh of heat for space heating, burning coal and burning gas are very different because the energy provided by gas has higher quality than coal.

Energy composition in China is complicated. Coal accounts for more than 60% of energy consumption and is the main resource for electricity generation. Beside conventional coal and electricity, more and more urban buildings are using gas to provide heating and cooling. It is necessary to find a way to evaluate the total energy efficiency of energy planning.

Hence, ECC (Energy Conversion Coefficient) is defined as an index for rating the efficiency of energy planning and energy plants:

$$ECC = \frac{Q_C \times \lambda_C + Q_H \times \lambda_H + E \times \lambda_E}{\sum_i (W_{HVACi} \times \lambda_i)}$$

where

Q_C – the annual cooling demand of the building cluster or the single building, GJ;

Q_H – the annual heating demand of the building cluster or the single building, GJ;

E – the annual electric power output from the CCHP system, GJ;

W_{HVACi} – the annual consumption of i-type energy for a HVAC system of the building site or single building, GJ; λC, λH, λE, λi – EQC (Energy Quality Coefficient) of cooling demand, heating demand, electricity and i-type energy, dimensionless;

Table C8.1: EQC of different kinds of energy

Energy	EQC in Summer	EQC in Winter
Cooling	0.05	—
Heating	—	0.07
Natural gas	0.51	0.53
Coal	0.34	0.36
Hot water (90°C)	0.1~0.2	0.2~0.3
Vapor (8 bar)	0.2~0.35	0.3~0.4
Chilled water(7°C)	0.07	—

EQC is crucial in describing the quality of different kinds of energy. λE of electricity is defined as 1.0, and then EQC of other types of energy are decided according to how difficult it is for them to be converted into electricity under the current technology level. Based on energy analysis, EQC of different kinds of energy are listed in Table C8.1.

From the point of view of energy analysis, some other energy utilization assessment indexes are derived, such as TDC (Transportation & Distribution Coe.), CEP (Callback Energy Proportion) and RERP (Renewable Energy Replacing Proportion).

Application and further development

GOBAS has been applied to about 10 projects including a gym, dining hall, office buildings and residential buildings. During case studies, the scoring system and weighting coefficients are examined and adjusted. A low energy demonstration building – Tsinghua Green Building Research Center – and the Cubic Water, the National Diving Hall, were designed under the guidance of GOBAS.

In the new MST project, a green building assessment system for different kinds of buildings in different climate zones will be developed based on GOBAS. There are more important factors that should be studied for their peculiarities. For example, water resources are critical in the northwest but there is plenty in the south. The new green building assessment system is expected to play an important role in the sustainable development of both China and the world.■

Acknowledgements
Many thanks to Japan's CASBEE committee, USGBC (US Green Building Council) and NRDC for providing great support in the development of GOBAS.

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[4] LEED, Leadership in Energy and Environmental Design, Rating System Version 2 (LEED™2.0), US Green Building Council, June 2000

6.6.4. Malaysia

Many cities around the world have gradually implemented monitoring of the city environment utilizing CASBEE for Cities. This chapter will introduce the outcome of a case study conducted in Putrajaya, the new capital of Malaysia, as a pilot project for urban environmental monitoring.

6.6.4.1. Introduction

Recently, urban development has been rapidly carried out in Southeast Asia. The development raises concerns about increased environmental load and CO_2 emissions associated with improved quality of life. We need to consider effective measures for achieving the decoupling of the correlation between the economic growth/the improvement of quality of life, and the increase in environmental load. In this situation, the understanding of the city's conditions utilizing CASBEE for Cities, a comprehensive assessment tool for urban environmental performance, may contribute to the sustainable growth of individual cities. It is important to estimate the effect of various measures currently under review, by clarifying existing issues of individual cities, utilizing CASBEE for Cities.

The assessment standard for CASBEE is originally based on the assumptions behind the Japanese city environment. However, the method in which a comprehensive assessment is conducted in terms of the environmental load and environmental quality, and the method for disclosing assessment results, are not necessarily limited to Japan. Rather, they are sufficiently applicable to cities all over the world. Additionally, the assessment standard is also established on the assumption that it may be tailored to fit the various situations of Japanese local governments. Therefore, it is possible to create an independent version for a specific country by modifying the assessment items and standards in order to utilize CASBEE overseas.

In order to achieve both economic growth and reduced environmental load, which are likely to be inconsistent with each other in general, we have a long history of joint discussion on the practical measures between the National Institute for Environmental Studies in Japan and related research institutions in Malaysia. During such discussion, some people suggested the possible beneficial effect of utilizing CASBEE, which had been developed in Japan for the environmental management of buildings, urban areas and cities, with a slight modification in accordance with Malaysian culture and customs. This is how mutual research cooperation between the Japanese and Malaysian governments has been promoted.

The area in which the Malaysian government mainly focuses on development is the Iskandar Malaysia District located near Singapore. The government has rapidly constructed infrastructure while attracting foreign investment. However, due to the increased population, there has been growing concern about the drastic increase in environmental load. Currently, Malaysia is internally discussing practical measures relating to urban environmental management. (Ismail Ibrahim 2012) (Boyd Dionysius Joeman 2012) Though there are multiple measures proposed for various regional comprehensive development plans, environmental management utilizing CASBEE for Cities holds a prominent position among them (Iskandar Malaysia 2012). In addition to CASBEE for Cities, the expanded use of CASBEE construction series for building assessments is currently under consideration. Putrajaya, the new capital of Malaysia, has also conducted urban environmental management utilizing CASBEE for Cities. (Putrajaya 2012) Thus, the utilization of CASBEE is gradually expanding in Malaysia.

Figure 6.6.5: Future plan for Iskandar Malaysia (Left) and for Putrajaya (Right)

6.6.4.2. Designated area

As shown in Figure 6.6.6, Putrajaya is located in the suburbs of Kuala Lumpur. A large-scale relocation of individual public administration functions from Kuala Lumpur, the old capital, has been planned and carried out. Putrajaya Corporation, engaged in town development, has already relocated the prime minister's office, the official residence and most of the federal offices. It started construction of the new capital in 1995, and the relocation of the capital has already been almost completed. The National Institute of Environmental Studies in Japan has been holding advanced discussions regarding measures for low carbonization as part of the feasibility study that aims at sustainable development and growth by 2025. Putrajaya is expected to become a successful example of sustainable development.

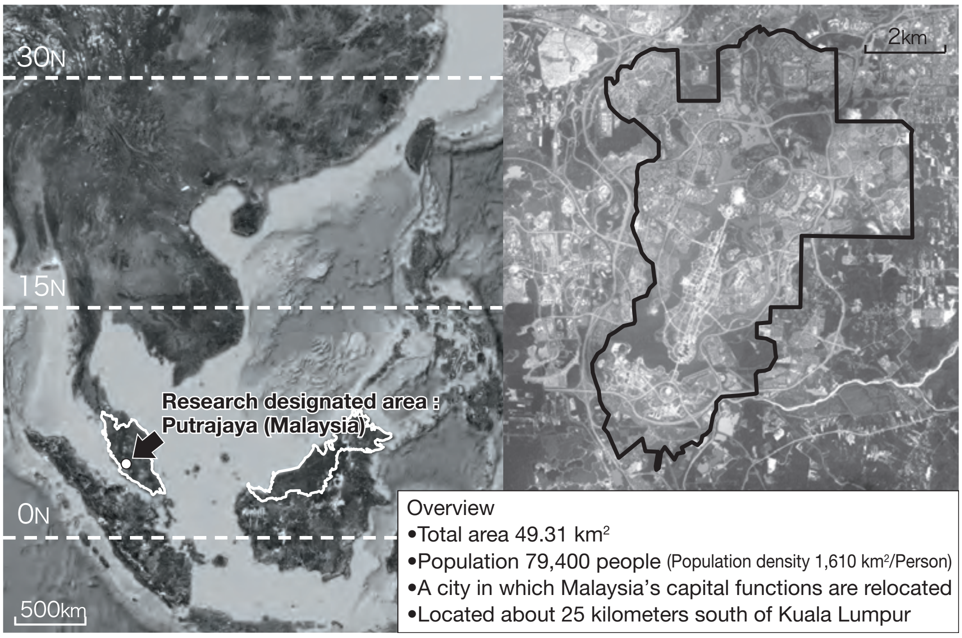

Figure 6.6.6: Overview and location of Putrajaya, Malaysia

Picture 6.6.1: Scenery in Putrajaya, Malaysia

6.6.4.3. Study overview

Data required for the assessment by CASBEE for Cities were mostly obtained from the National Institute of Environmental Studies in Japan and the Universiti Teknologi Malaysia, which have conducted advanced field investigations. Other information, which could not be obtained from the field work, was acquired through interviews with officers from Putrajaya Corporation in charge of public administration. We had to customize the assessment procedure in some respects in view of the local situation. For example, we needed to determine the representative water source we chose to obtain data regarding water quality. Initially, there were several issues relating to the definition and details of an index such as how we should adjust prices of the gross regional product (GRP) adopted as an economic activity index. Secondly, we also had to deal with fundamental issues including whether we could simply compare the levels of a Japanese city and a Malaysian city, which could be quite different depending on the assessment items. Finally, we decided to use one accurately united definition as much as possible to address the initial issues. The second issues still need to be discussed. However, for the time being, we decided to compare the two cities at their current levels.

6.6.4.4. Conclusion

The urban environmental assessment of Putrajaya was conducted after various data regarding the city was processed in terms of the population and the floor space, and was entered into CASBEE for Cities. The assessment result is shown in Figure 6.6.7. Population of Putrajaya is expected to keep increasing until 2025. In order to address such demographic trend, the city is planning development of various infrastructures. Therefore, the total Q score in 2025 will generally remain at the same level as of 2011. However, as shown in Figure 6.6.8, if we look at scores of individual Q items, the residence standard level, disaster preparedness, educational services and childcare services are expected to slightly decrease in terms of the quality if no modifications are made to the current plan, which may possibly need some revisions as necessary. The environmental load L is expected to decrease due to a significant drop in CO_2 emission per capita, in terms of the civilian sector business, transport sector, and other waste treatment. The future scores indicate that the establishment of an eco-friendly city is very likely to be achieved by the steady implementation of the plan. (Ikaga 2013) (Takigami 2013)

As described above, the concept of CASBEE for Cities and its assessment framework are applicable not only to Japanese cities but also cities in other countries having different situations, through a slight modification to the original settings, which indicates possible universal utilization all around the world. Currently, in view of findings from case studies conducted in multiple countries, and taking into consideration the difference in climate and culture in individual countries, a plan focusing on the enhancement of the concept of CASBEE for Cities and its assessment framework is being developed. A system for supporting the establishment of the identities of individual cities has been gradually developed, which enables an accurate comparison between urban environments in the respective countries from a practical viewpoint.

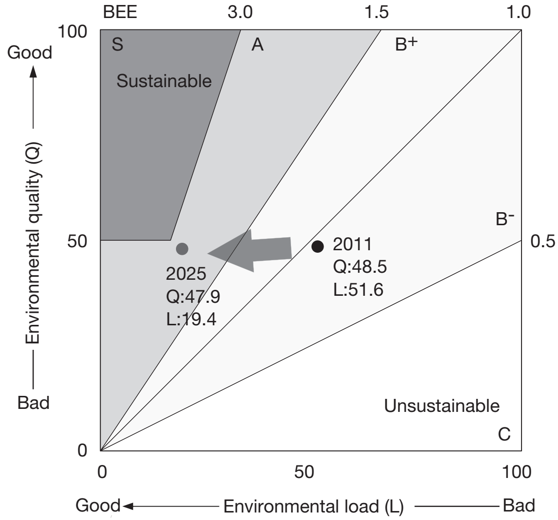

Figure 6.6.7: Assessment result of Putrajaya by CASBEE for Cities

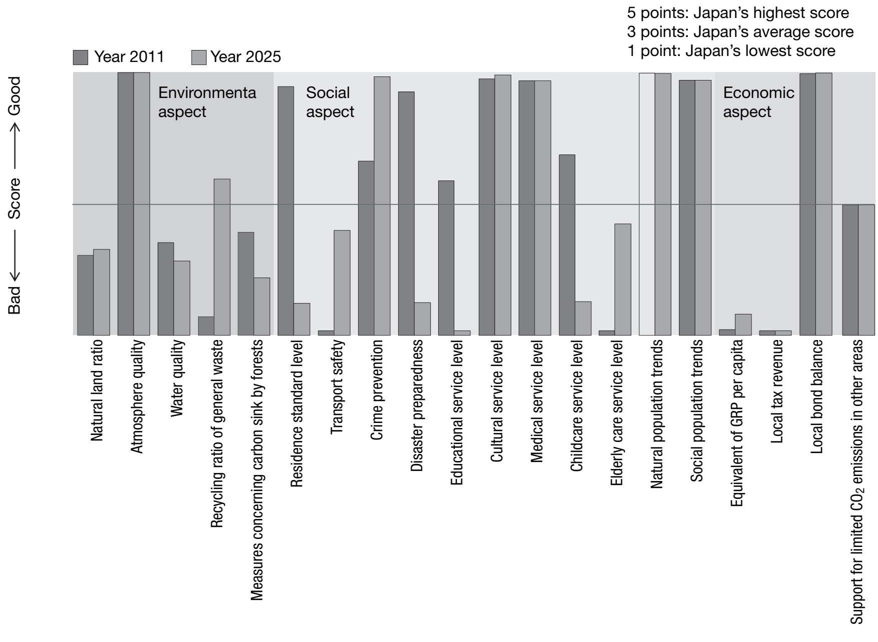

Figure 6.6.8: Assessment result of Putrajaya by CASBEE for Cities (Result of Q)

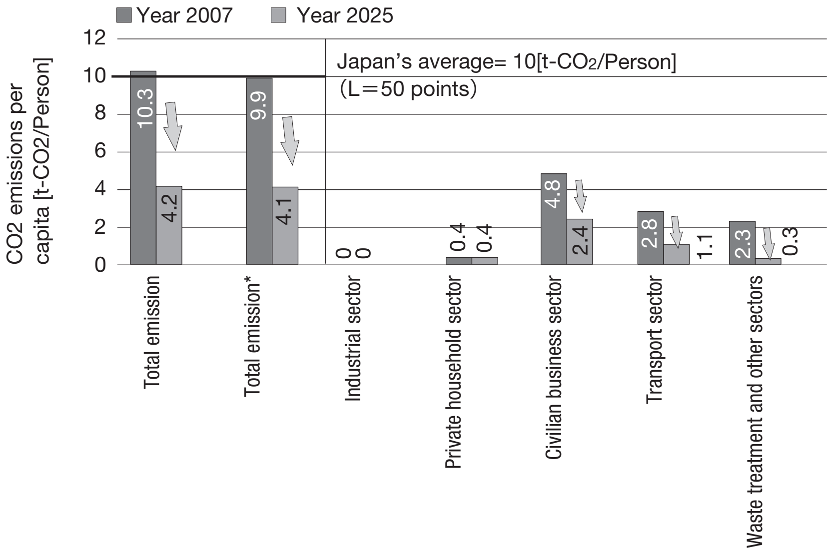

Figure 6.6.9: Assessment result of Putrajaya by CASBEE for Cities (Result of L)

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<Column-8>

CASBEE-City in Putrajaya, Malaysia

Future perspective of implementing CASBEE in Malaysia

HO Chin Siong,
Professor, Faculty of Built Environment, UTM, Malaysia

Introduction

Most governments in the world have recognized the need to establish and implement national sustainable development programs that require high participatory instruments intended to ensure environmentally, socially and economically responsible development.

Malaysia has experienced rapid growth in urbanisation. At the national level, the population of Malaysia increased from 18 million in 1990 to 27.6 million in 2010. Based on the Department of Statistics (DoS), the population of Malaysia is expected to increase to about 34 million by 2020. The urban population in Peninsular Malaysia reached 67% of the total population, and this is expected to grow to 75% by 2020. (Census Data 2010 & 2011 RFN). The above data show that more people prefer to live in urban areas. Thus, cities, sustainability and low carbon societies are inseparably linked. The high rate of urbanisation in Malaysia implies that cities are also centers where most urban infrastructures are built to cater to the needs of housing, commerce, industries, recreation and other services.

Malaysian Government's commitment

Malaysia's commitment to international environmental standards is currently being observed and implemented via its green initiatives and programs. A number of steps have been undertaken by the government to integrate the principles of sustainable and low carbon development into the country's policies and programs to reverse the loss of environmental resources. The Malaysian government made a pledge at the *15th Conference of Parties – United Nations Framework Convention on Climate Change (COP15)* to voluntary reduce its carbon dioxide emissions by 40% per GDP by 2020 as compared to the 2005 level. Malaysia took serious steps to promote green technology and climate change initiatives by unveiling the National Green Technology Policy (NGTP) in 2009. This was the turning point in the country's history of initiatives on sustainable growth and development. At present there are various documents encouraging green development in Malaysia. They are: National Green Technology Policy, National Policy on Climate Change, Low Carbon Cities and Assessment Framework, Green Neighbourhood Planning Guidelines, Green Building Index, Green Building Index Township Tool and Low Carbon Society Scenarios. Each of these look at different elements, strategies and spatial context of the built environment.

In line with NGTP (2009), the Low Carbon Cities Framework was initiated to provide a framework to achieve sustainable development that would subsequently reduce carbon emissions. This framework can be used by all stakeholders in settlements either new or old, to measure the impact of their development decisions in terms of carbon emissions and abatement.

Why are assessment tools important in Malaysia?

After the announcement by the Malaysian Prime Minister on carbon dioxide emissions reduction of 40% by the year 2020 (based on the year 2005), many agencies adopt or use calculators or assessment tools to provide baseline studies of buildings, cities and regional levels. Some tools are purely used to calculate carbon footprints or CO_2 in weight, whereas others rate from 1 star to 5 stars or by simple certification by class category (e.g., Gold or Platinum class). Stakeholders utilize them for the sake of safeguarding the environment and due to incentives provided by the government in terms of tax breaks or for a good marketing image. Comprehensive Assessment System for Built Environment Efficiency (CASBEE) is a tool that evaluates and rates buildings in terms of their environmental performance. It is useful in large-scale projects and can be used together with building-scale CASBEE tools to contribute to the promotion of sustainable urban development and city planning.

Benefits and strengths of CASBEE application in Malaysia

At the crossroads of the implementation of assessment tools, there are many pros and cons for each rating and assessment system. Among the key benefits of CASBEE are:

a) Flexibility at all levels of development because the CASBEE family ranges from building, housing, urban and city scales
b) It can be customized to local or Malaysian conditions
c) It is a free domain and costs less than other systems
d) It uses Global Benchmarking and methodologies using ratios instead of simple summation of marks based on given indicators.
e) It can assess various measures to be implemented by local authorities
f) It can revitalize local authorities by identifying problems and finding solutions for sustainable city development.

With the above advantages, the introduction of CASBEE promotes easier implementation due to lower cost and easier computation. In addition, with wider application, it contributes towards decreased energy consumption and hence lower carbon emissions and higher sustainability.

How can CASBEE work and be used in Malaysia?

CASBEE Development and CASBEE City may incorporate LCCF criteria so that it fulfils the objectives of green city development as envisaged by governments. This requires a close working relationship with the Ministry of Energy, Green Technology and Water (or ‘KeTTHA’, which is its abbreviation in Malaysian) and other related ministries. At CASBEE City level, it may be incorporated as part of the criteria of MURNINET in terms of CO_2 emissions reduction. Alternatively, it can function independently as an independent tool for local authorities in Malaysia for benchmarking their sustainability, as is done for all local authorities in Japan.

Future challenges

Based on several empirical cases in Malaysia, such as in Putrajaya and some of the local authorities in Iskandar Malaysia, there are several challenges to implementing CASBEE in Malaysia.

It is easier to implement CASBEE Building because the common criteria are the same. This can be easily done by starting with state and federal government buildings in Iskandar Malaysia. CASBEE Building can also be promoted by involving private companies, especially local and Japanese companies, to start the accreditation of green buildings in Iskandar Malaysia.

The initiative of Green Building and implementing CASBEE Building is an excellent start by providing property developers with clear guidelines for achieving environmentally friendly neighborhoods and buildings. IRDA will need to have a clear direction, policy and added incentives in order to monitor closely and effectively green building implementation in Iskandar Malaysia.

Being a premier growth corridor in the country, it is appropriate that Iskandar Malaysia is a test bed and pioneer leading the way in contributing to Malaysia's pledge to reduce its carbon emissions by 40% by 2020 as compared to 2005 levels.■

6.7. CASBEE evaluation of vernacular houses

6.7.1. Vernacular houses evaluated from a sustainability viewpoint

People living in the 21st century are given a postmaterialism challenge, namely the pursuit of a sustainable society with reduced environmental load. Under such circumstances, the high environmental symbiotic performance of vernacular houses, which is the basis of sustainable buildings, attracts a great deal of interest. Behind this, we should note there is a sustainability crisis in various lifestyles on the Earth. Vernacular houses here mean traditional buildings designed in accordance with the local climate and culture, and constructed with local materials.

The special significance of vernacular architecture in the global environmental era is its high environmental efficiency. That is, in other words, the high-quality living environment secured only by passive design without using any mechanical energy, which also drastically reduces the environmental load on the Earth through utilization of local materials. Such advantages of vernacular architecture are something that's forgotten in modern architecture, which is actually the basis of sustainable buildings, providing a lot for us to learn in the environmental design of the 21st century.

However, the level of environmental efficiency of vernacular architecture should be indicated quantitatively. We utilized the building environmental performance assessment tool CASBEE for a quantitative performance evaluation. Environmental efficiency as defined by CASBEE is (Environmental quality achieved) / (Environmental load produced thereby), consistent with the ideas of Factor 10 and Factor 4. The incredible level of environmental efficiency of the vernacular architecture visualized by CASBEE actually exposes defects in the environmental efficiency of modern architecture, offering numerous suggestions in terms of the course of modern building design in the future.

6.7.2. Vernacular houses around the world

Some of the world's typical vernacular houses are shown in Figure 6.7.1. All of them are embodiments of individual ethnic identities reflecting the local climate and culture in the form of housing.

For example, igloos are houses made of just snow and ice, used for hunting in winter by Inuits who live in Northern Canada, a very cold region. The fact that the indoor environment of igloos is actually quite comfortable, contrary to most expectations, has been revealed by researchers who stayed in igloos, which is also confirmed by a reproduction of the indoor environment by computer simulations.

There are several types of cave dwelling in the world; however, the most famous one is in the Cappadocia region in Turkey. Some of them are still used today. Cave dwelling is a form of architecture utilizing local materials in places where ordinary frame materials such as wood are less commonly available.

Stilt houses in Indonesia are designed to deal with the hot and humid climate. Walls and floors made of wood or bamboo provide sufficient openings, focusing strongly on ventilation and cooling.

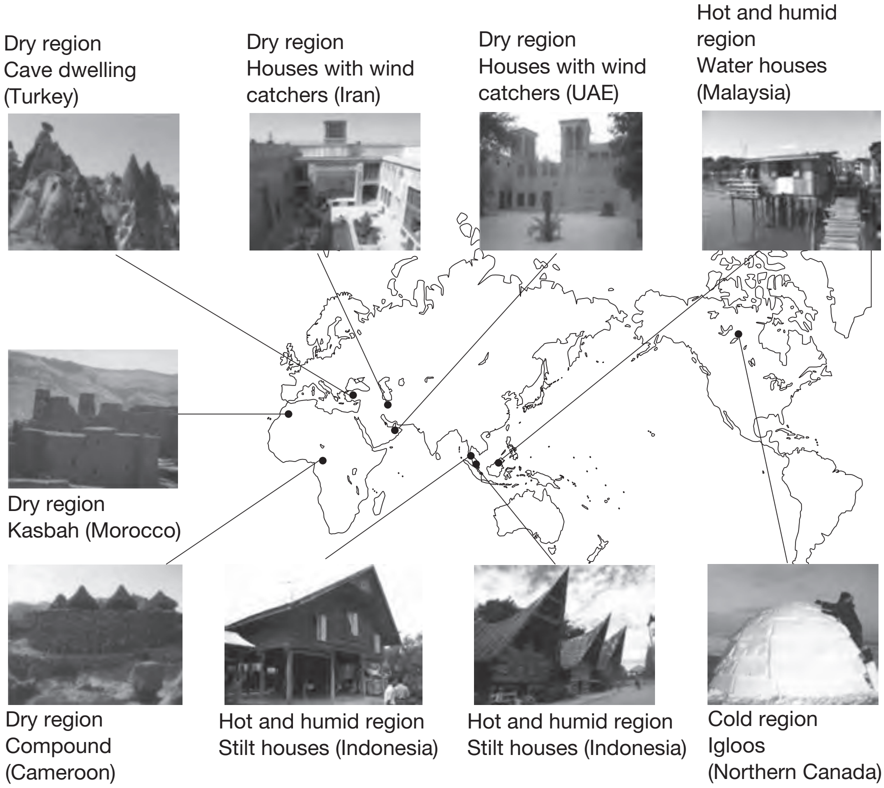
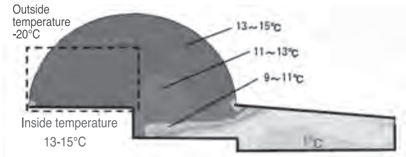


Figure 6.7.1: Vernacular houses around the world

The vernacular houses shown in Figure 6.7.1 have all reached new heights in ultimate wisdom in terms of the so-called passive technology in environmental control. Every vernacular house represents the concentration of passive technologies at the time, aiming at safety, hygiene, health, comfort, and the like, utilizing a limited range of technical methods, when there was no modern technology. This is why those vernacular houses excite the interest of people living in the modern world.

While highly evaluating the excellent passive technologies and the sustainable performance of vernacular architecture, we also often hear praise for the physical environment of vernacular architecture with no scientific grounding. Even if we used every means of passive technology, there are limitations to the level of indoor environment which could be achieved within the limited range of technical methods. In terms of the environmental assessment of vernacular architecture, it is important to make informed considerations in this respect. The next section will evaluate vernacular housing and modern housing utilizing CASBEE, a widely used assessment tool for building environmental performance, in order to clarify the significance of vernacular housing in modern society.

■Computer simulation



Simulation by computational Fluid Dynamics

Igloo (Canada)

■On-site measurement

Cave dwelling (Turkey)

Stilt house on water (Malaysia)

Filed measurements

Figure 6.7.2 Quantitative mesurement of indoor thermal environment

6.7.3. Performance assessment of vernacular houses based on assessment tool CASBEE

The assessment tool CASBEE focuses on the evaluation of 2 aspects: the reduction of environmental load (L) and the improvement of environmental quality (Q). The L and Q define the Built Environment Efficiency (BEE) as Q/L. The larger value indicates the higher level of environmental performance. Figure 6.7.3 shows results of the performance assessment of multiple vernacular houses based on the environmental performance BEE.

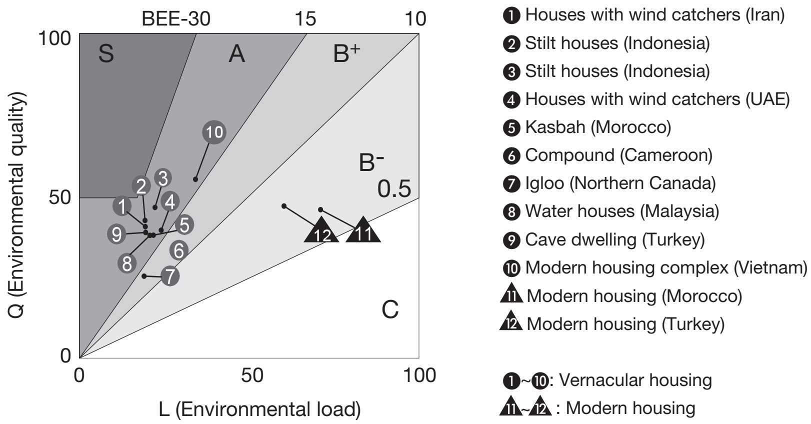


Figure 6.7.3: Performance assessment of vernacular housing by CASBEE

Vernacular houses indicated with ○ all achieved excellent ratings, receiving 4 stars. Modern houses indicated with △ in this case example were rated as Rank B- (2 stars). When focusing on the 2 aspects, namely, the reduction of environmental load and the improvement of housing performance, vernacular architecture is not necessarily inferior to modern housing in environmental efficiency. On the contrary, they are actually much better than modern houses in many cases. It was a surprising outcome that CASBEE, a tool originally developed for the assessment of modern architecture, revealed the high environmental efficiency of vernacular architecture. Just to be clear, please note the following 2 points. Firstly, in terms of Q, the level of vernacular architecture is lower than modern housing, which is far from adequate from the viewpoint of living environment standards. Secondly, there are many modern Japanese houses rated as Rank S, which indicates that modern housing is not always inferior to vernacular architecture in terms of environmental efficiency.

6.7.4. From mass-consumption housing to post-materialism housing

An overview of the changing performance of various housing types from the viewpoint of sustainability promotion is shown in Figure 6.7.4.

(1) represents the vernacular housing described above in which the level of environmental quality Q is not very high; however, the environmental load L is quite low, resulting in Rank A with 4 stars in the environmental efficiency BEE, a very good rating. Japanese traditional buildings including thatched houses also have the same level of environmental performance.

(2) represents mass-consumption-style housing. Postwar Japan worked very hard on house building, utilizing new technologies learnt from American-style mass-consumption. Houses in this style have achieved slightly improved environmental quality; however, the increase in the environmental load exceeded the amount of overall improvement. As a result, these houses received only 2 stars, down by 2 ranks.

Based on the lessons above, Japan has also strived for the promotion of eco-friendly housing indicated as (3) since the end of the 20th century. Consequently, recent Japanese houses have gradually achieved improved environmental quality and reduced environmental load. Their environmental efficiency level has become equivalent to the vernacular housing.

The postmaterialism housing indicated as (4) is an ideal form of future housing. In order to allow both human society and the Earth to remain sustainable, it is necessary to achieve this level in housing environmental performance. The heavily slanted line at the upper left of Figure 6.7.4 indicates Factor 4 proposed by Weizsäcker of Germany. The future post-materialism housing should sufficiently exceed Factor 4.

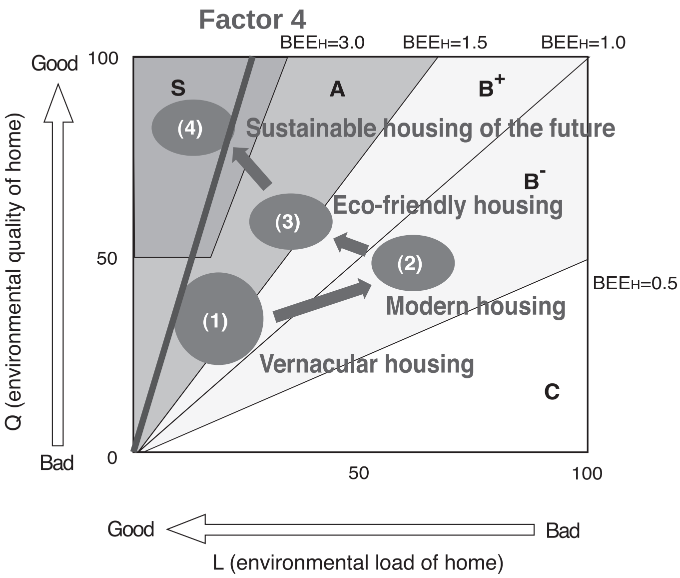


Figure 6.7.4: Promoting sustainable architecture based on the principle of built environment efficiency

The assessment introduced here demonstrates both the outstanding environmental performance of vernacular architecture from multiple perspectives and the effectiveness of CASBEE as an environmental performance visualization tool. Looking ahead, we feel there is a need to guide the construction market towards sustainability through concrete initiatives and proposals for applying such knowledge of the merits of vernacular housing to modern architecture.

Appendix

A-1. Glossary

A-2. Organizational Structure

A-3. Members of the CASBEE Boards and Committees since 2001

CASBEE®

A decade of Development and Application of an Environmental Assessment System for the Built Environment

A-1. Glossary

BEE

BEE stands for Built Environment Efficiency, which is calculated as the ratio between the assessment result of Q (Built Environment Quality) and that of L (Built Environment Load). In CASBEE, the Q value and the L value are obtained according to SQ, the total score of the Q category, and SLR, the total score of the LR category, respectively. The numerator Q is defined as Q=25×(SQ—1), in order to convert SQ, the score for the built environment quality, ranging from 1 to 5, into the Q scale, which is a value from 0 to 100. On the other hand, the denominator L is defined as L—25×(5—SLR), in order to convert SLR, the score for the reduction of environmental load, ranging from 1 to 5, into the scale of the environmental load L, which is a value from 0 to 100. Consequently, the efficiency of environmental performance BEE is obtained by a formula expressed as BEE=Q—L.

BEPAC

BEPAC stands for Building Environment Performance Assessment Criteria, which is an assessment method for the building environmental performance, developed by a group of researchers led by Professor Raymond J. Cole from the University of British Columbia in Canada. Approximately 30 criteria are organized into 5 major environmental topics (ozone layer protection, energy use, indoor environment, resource saving, and location/transport), which are evaluated comprehensively.

BREEAM

BREEAM stands for the Building Research Establishment Environmental Assessment Method, which is a building environmental performance assessment system announced by the Building Research Establishment (BRE) in the United Kingdom in 1990.

CASBEE accredited professional system

Though CASBEE is based on quantitative assessments as much as possible, it also includes qualitative assessment items. Therefore, in order to conduct CASBEE assessments, professional knowledge and skills concerning the comprehensive building environmental performance assessment are required. Consequently, we cultivate “CASBEE accredited professionals” who are professional engineers in CASBEE assessments, for the purpose of facilitating proper CASBEE assessments and operation. Those who wish to become a CASBEE accredited prefessional should take the Assessor Training Course, pass the Assessor Examination, and go through the registration procedure.

Capitalization rate

Also known as “cap rate.” A rate used when producing a property price from the net profit for a certain period of time (usually for one year). The rate includes the fluctuation estimate of factors having an impact on future earnings, and uncertainties (risks) accompanying the estimate.

Coefficient of Energy Consumption (CEC)

An assessment index for efficient energy use specified in the Energy Conservation Law (the Act on the Rational Use of Energy) in terms of individual facility systems such as air-conditioning (AC), ventilation (V), lighting (L), hot water supply (HW) and elevators (EV). CEC is “a value obtained by dividing the annual energy consumption by either the hypothetical annual load of the standard building or its hypothetical annual energy consumption" regarding respective facilities.

Comprehensive Design System

A system in which a specific administrative agency eases restrictions on the floor area ratio, road oblique line, adjacent land oblique line and absolute height, in terms of building plans for sites exceeding a certain size and having a certain percent thereof as an open space, in accordance with the provisions of Part 2, Article 59 of the Building Standards Law, for the purpose of creating sound urban areas.

Construction Waste Recycling Law

The official name is the Law on Recycling Construction-Related Materials, which was enacted in 2000, in order to promote recycling in the construction industry, and to encourage the effective use of resources and proper waste disposal through the sufficient use of renewable resources and waste reduction. The Law requires building contractors to demolish and segregate waste and the recycling of such waste. It also specifies a measure in which contractees are required to notify the respective local governments of their plans regarding the demolition and segregation work.

Direct reduction process

A method for calculating a property price by dividing the net profit for a certain period of time (usually for one year) by the capitalization rate. The fluctuation risk of the net profit needs to be taken into account in the capitalization rate. Accordingly, in terms of a property in which a fixed amount of net profit is expected, when the fluctuation risk is high (low), a high (low) capitalization rate is set, providing a low (high) property price.

Energy-saving standard for buildings

A standard that was announced in 1980 based on the Law Concerning Rational Use of Energy, which specifies criteria for efforts to be made by building owners. The Standard consists of 2 criteria, one applicable to residential buildings and the other to non-residential buildings. For non-residential buildings, a criterion concerning the Perimeter Annual Load (PAL) and the annual primary energy consumption of the entire building has been established. The Standard requires notifying the public administration of energy-saving measures for a target building that has a total floor space exceeding 300m^2.

Environmental Action Plan of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT)

The Plan published in June 2004 indicates measures for "Green administration of land, infrastructure, transport and tourism" as part of the environmental policies of the MLIT. The Plan outlines six reform projects: (1) Introduction of life cycle management in the establishment of social capital, (2) Shift to new forms of transport with less environmental load, (3) Development of a market highly sensitive to the environment, (4) Formation of sustainable national land, (5) Establishment of a recycling-oriented society, and (6) Promotion measures that help achieve the goals.

Environmental assessment

An environmental impact assessment that estimates and evaluates the influence of development activities including the construction of new facilities and buildings on the overall environment. The assessment covers air quality, water pollution, noise and scenery.

Environmental efficiency

Environmental efficiency is a concept for pursuing efficiency through both environmental and economic aspects. The concept is based on the idea that making the best use of resources and energy minimizes the environmental impact and maximizes the production value. Environmental efficiency is expressed as the environmental load per unit of economic activities (GDP, values of products and services, etc.), or the economic activity per unit of environmental load.

ESCO business

ESCO stands for Energy Service Company, a form of business in which organizations and companies having specialized expertise in energy conservation make proposals on energy-saving measures to their clients, carry them out, and evaluate the results in order to achieve energy conservation and reduced energy consumption. The ESCO business provides a comprehensive service based on energy-saving diagnosis, including proposals on operation improvement and a renovation plan, the actual construction, the operation and management after construction, and a guarantee on the energy-saving effect after renovation.

Factor Four (4)

Factor 4 was first proposed in the First Global Revolution (1992), a report prepared by the Club of Rome, established in 1970. Factor 4 is based on the concept that, in order to solve the existing issues in developing countries, it is necessary to double the world's current level of affluence as well as to promote environmental measures. The concept calls for the public to "double the affluence while placing half the load on the environment," thus, increasing environmental efficiency by four times.

Guideline for planning green government buildings

Government buildings focusing on reduced environmental load through the entire life cycle are called green government buildings, which are positioned as model facilities in terms of the reduction of environmental load in the field of architecture. The guideline specifies items to be considered from five viewpoints: consideration of the surrounding environment upon planning and designing government facilities, energy saving and resource saving during the operation phase, long life, use of eco-materials, and proper use/treatment.

ISO14001

ISO14001 is an international standard related to environmental management for organizations. An organization utilizes the environmental management system they selected in order to reduce environmental impact and risks caused by their business activities, products and services, and to examine whether they can continuously improve their actions, thus preventing adverse effects.

Japanese Housing Performance Indication Standard

Standard contents to be disclosed specified by the Minister of Land, Infrastructure, Transport and Tourism, as a common rule for performance indicators in the Japan Housing Performance Indication System.

Kyoto Protocol

The Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) was adopted at the third session of the Conference of Parties to the UNFCCC (COP 3) held in Kyoto in December 1997. The Protocol sets numerical targets for all the developed party countries to cut emissions of greenhouse gases including carbon dioxide, methane and nitrous oxide, to more than 5% below 1990 levels between 2008 and 2012 (6% cut for Japan). The Protocol introduced new mechanisms including emissions trading among developed party countries, and new projects regarding emission reductions between developed countries and developing countries. Japan signed the Protocol in April 1998, the following year.

LCA (Life Cycle Assessment)

LCA is a method for evaluating a product in terms of its environmental impact (environmental load) and costs through its entire life cycle (from manufacturing, use, renovation to disposal). Major LCA indexes include $LCCO_2$ (Life Cycle CO_2), LCE (Life Cycle Energy) and LCC (Life Cycle Cost).

LEED

LEED stands for Leadership in Energy and Environmental Design, which is an environmental performance assessment system developed by the U.S. Green Building Council (USGBC). The first edition was published in 1998. The assessment consists of a self-assessment by a trained expert and an examination of the assessment result by a third party. A building is rated on a scale of 1 to 4 based on the result thereof.

Life Cycle CO_2 ($LCCO_2$)

$LCCO_2$ is the sum of carbon dioxide (CO_2) emissions at every stage of the life cycle of a building, such as construction, operation, renovation and demolition. $LCCO_2$ is recognized as one of the indexes that indicate the total environmental load of the building.

Net profit

A profit attributed to a business transaction relating to real estate, after deducting all costs incurred for maintenance, utilities, taxes and dues, damage insurance and the like, from gross receipts such as rent.

Passive design

A design method in which the indoor temperature control that includes cooling/heating and daylighting is attempted without being over-dependent on equipment, and instead, makes the best of natural energy including solar heat, wind, temperature changes, geothermal heat and natural lighting, through an effective building plan.

Perimeter Annual Load (PAL)

The Perimeter Annual Load (PAL) is an energy-saving index for buildings specified in the Energy Conservation Law. A value obtained by dividing the sum of annual heating and cooling load (the processing heat required for air-conditioning) within the perimeter zone such as the top floor and the upper floor of buildings, by the total floor space of the perimeter zone, indicated as [$MJ/(m^2 \cdot Year)$]. The PAL also includes the heat insulation and sun-shading performance of the building's outer envelope (walls and windows). An announcement according to the Energy Conservation Law specifies the calculation method and the upper limit by purpose of the building (criteria of judgment for the building owners).

Primary energy consumption

An index for evaluating the energy consumption of electricity (kW), gas (kg), oil (liter), and district heat supply (MJ), from the viewpoint of a drain on resources, by converting into common crude oil heat consumption (MJ). The coefficient for converting energy consumption into primary energy consumption is defined in the Energy Conservation Law. For example, the conversion coefficient of electricity is 9.76(MJ/kWh), taking into account the power generation efficiency and transmission efficiency. As for town gas, the latest figure should be confirmed with gas companies as it varies depending on ingredients.

Q and LR

CASBEE establishes a framework for a comprehensive assessment of building environmental performance, based on two factors pertaining to the inside and outside of a virtual enclosed space boundary: taking into account the off-site environmental load and the improvement of on-site amenities. The assessment field of the first factor is called Q (Quality: Built environment quality), and that of the second factor is LR (Load Reduction: Reduction of environmental load).

Sick house

A residential building that has several factors causing the so-called sick house syndrome. The sick house syndrome is not just a single form of medically established disease, but a term representing various types of health disorders stemming from the housing environment. Major factors causing illness include chemical substances such as formaldehyde, as well as molds and mites.

Standard New Effective Temperature (SET*)

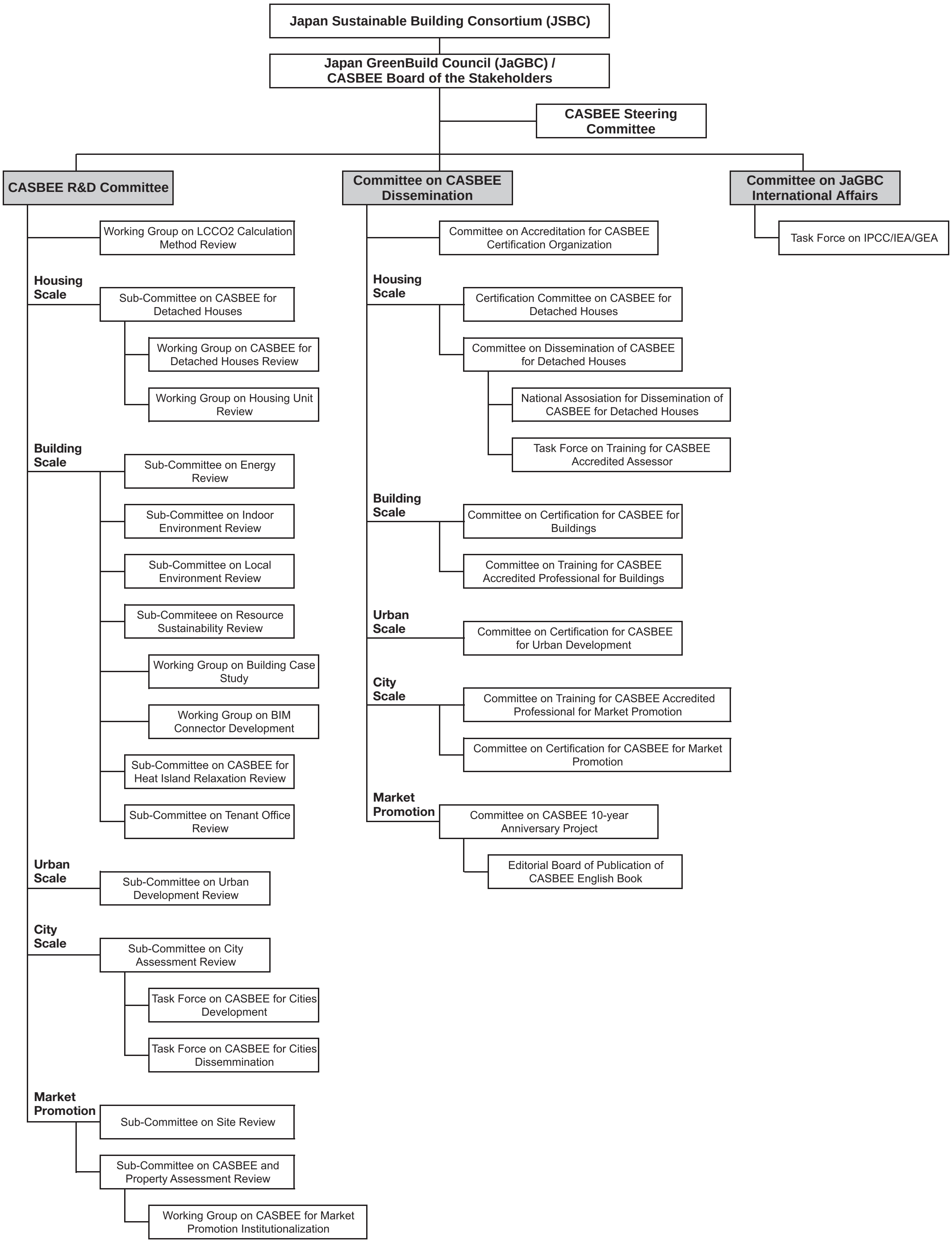
Standard New Effective Temperature (SET*) is an index that expresses thermal environment properties using a thermal model based on a physiological and physical relationship between human beings and the thermal environment. SET stands for Standard Effective Temperature, proposed by Gagge, Stolwijk and Nishi in 1971. The SET is calculated based on multiple factors, such as indoor temperature, radiation temperature, average wind velocity, humidity, clothing insulation and the intensity of activity of the worker. SET*=22.2-25.6 is a range in which more than 80% of people experience thermal comfort and which is adopted as one of the standards published by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).

Virtual enclosed space

A space concept specially defined in CASBEE, as the environmental performance assessment of a building requires a closed-space concept that allows a determination of environmental capacity. The building site boundary, the top height and the lower surface of a foundation batholith are called boundaries (virtual enclosed boundaries). Virtual enclosed space is an enclosed space separated by such boundaries.

A-2. Organizational Structure

as of March 2014



A-3. Members of the CASBEE boards and committees since 2001

(as of March 2014)

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Postscript and Acknowledgement

Kazuo IWAMURA,
Professor, Tokyo City University

Ten years have passed since the first official edition of Comprehensive Assessment System for Built Environment Efficiency (CASBEE) for New Construction of Buildings was released in Japan in 2003, after elaborate preparation and the collaboration of academia, industry and national and local governments. In 2001, the Japan Sustainable Building Consortium (JSBC) was formed as the mother orgainzation, under the auspice of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT).

During this decade, tremendous efforts have been made by a great number of related experts to develop a comprehensive, cross-scale approach to environmental performance assessment that includes new conceptual underpinnings and approaches. From the very beginning, CASBEE has been designed to both enhance the quality of people's lives and to reduce the life-cycle resource use and environmental loads associated with the built environment, from a single home to a whole city.

Consequently, a variety of CASBEE schemes are now deployed all over Japan and supported by national and local governments. While specific innovative aspects of CASBEE have been internationally acknowledged and referenced, JSBC, together with the associated Institute for Building Environment and Energy Conservation (IBEC), the organizations responsible for the ongoing development and operation of CASBEE, has decided to compile and publish a complete book about CASBEE in English, simply titled "CASBEE."

As stated above, CASBEE is the fruit of the collaboration of a large number of associated experts (see pp292-295) for more than ten years including the preparatory period before the official issue in 2003. Along with the zeitgeist and the consequent change of social, industrial and political requirements, CASBEE has been responding and developing accordingly. The comprehensive and flexible structure of the R&D organization made this possible. This book shows the current results of such initiatives as a milestone of an entire decade.

Looking back on this development process to date, it should be noted that the leadership of Dr. Shuzo MURAKAMI has been always pushing forward whatever related R&D and application activities exist from the very beginning, and that the tireless efforts of the R&D members from academia, industry and governments have been continually made.

To commemorate the 10th anniversary of CASBEE's release, the editorial board asked nine renowned experts from abroad to introduce specific and relevant topics. Their valuable contributions provide this book with global viewpoints and are very much appreciated.

In hoping this book will draw attention worldwide, we are all ready to progress further in the next decade and beyond in both a domestic and global context.■

CASBEE Certificate Emblem