The mandatory and voluntary approaches to sustainability: BASIX vs BEAM Plus

Daniel C. W. HO[1], Janet X. GE[2], Ervi LIUSMAN[3]

Abstract Title

Many assessment systems have been introduced to measure the environmental sustainability of buildings that aim to reduce energy consumption and carbon emissions over the last decade. Examples are the BRE Environmental Assessment Method (BREEAM) in the UK, Leadership in Energy and Environmental Design (LEED) in the US and Canada, the Green Star and Building Sustainability Index (BASIX) in Australia, and the Building Environmental Assessment Method (BEAM) Plus in Hong Kong. Some of the systems, such as BASIX, apply a mandatory approach for implementation; others, such as BEAM Plus, are voluntary with incentives. This paper aims to compare the difference between BASIX and BEAM Plus and discuss their different approaches to building sustainability. The comparison is important because it would then be possible to evaluate the implications of the environmental assessment policy tools in which two different approaches are used. The paper will first study and compare both the BASIX and BEAM Plus assessment systems. Second, the advantages and pitfalls of the mandatory and voluntary approaches will be identified and discussed. The paper is based on desk research. The impacts of the environmental policy tools, determined through case studies that will be conducted, should reveal if a voluntary-with-incentives approach is the stronger motivation for the building industry to improve its environmental performance.

Keywords: Environmental assessment tools, Mandatory and voluntary approaches, BASIX, BEAM Plus

1. Introduction

The international debate over sustainable development has emphasized development that "meets the needs of the present generation without compromising the ability of future generations to meet their own needs" (WCED, 1987). This brings up the issue of the importance of environmental sustainability, which prompts the development of environmental assessment systems. The Environmental Impact Assessment (EIA) and Life Cycle Assessment (LCA) are two well-known environmental assessment systems and two basic methodological frameworks. The EIA is an official assessment of the possible outcome of

[1] Associate Professor; Department of Real Estate and Construction; The University of Hong Kong; 5/F Knowles Building, Pokfulam Road, Hong Kong; danielho@hku.hk.
[2] Senior Lecturer; School of the Built Environment; University of Technology Sydney; PO BOX 123, Broadway NSW 2007, Australia; XinJanet.Ge@uts.edu.au.
[3] Post-doctoral Fellow; Department of Real Estate and Construction; The University of Hong Kong; 5/F Knowles Building, Pokfulam Road, Hong Kong; ervi@hku.hk.

the proposed policy, program, and project on the environment to ensure environmentally sound and sustainable development (Gilpin, 1995; UNEP, 1996); while the LCA is a tool for measuring the use of resources and the impact on the environment integrated with a product and process (Park and Seo, 2006). Yet, the building and its activity falls somewhere in between the EIA and the LCA (Crawley and Aho, 1999).

The activities associated with the buildings have a negative impact on the environment (e.g. high energy consumption due to HVAC and lighting, pollution due to building construction; excessive consumption of natural resources due to the manufacture of building products; construction waste, etc.). Building environmental assessment systems are inevitably required for the Earth's sustainable development. Some building environmental assessment tools have been launched since early 1990s. The currently available tools vary greatly, as they are designed for different needs and purposes. Some were developed to gauge different building types; while others focus on different stages of a building's life cycle (Haapio and Viitaniemi, 2008). Examples are the BRE Environmental Assessment Method (BREEAM) in the UK, Leadership in Energy and Environmental Design (LEED) in the US and Canada, the Green Star and Building Sustainability Index (BASIX) in Australia, and the Building Environmental Assessment Method (BEAM) Plus in Hong Kong. A number of studies have discussed and compared these assessment systems (e.g. Cole, 1999; Crawley and Aho, 1999; Forsberg and von Malmborg, 2004; Ho et al., 2005; Seo et al., 2005; Ding, 2008; Haapiio and Viitaniemi, 2008; Reed et al., 2009, 2011; Kajikawa et al. 2011). Yet, little concern has been given to the significance of the mandatory and voluntary approaches of building environmental assessment systems. BASIX in New South Wales (NSW), Australia implementing a mandatory approach and BEAM Plus in Hong Kong adopting a voluntary approach with incentives could be cases worth studying. The main objectives of this paper are to compare the differences between BASIX and BEAM Plus and discuss their different approaches to building sustainability. These two assessment systems are selected due to their popularity as green building initiatives in Australia and Hong Kong. This paper will also identify and discuss the advantages and pitfalls of mandatory and voluntary approaches for building environmental assessment tools. The paper is based on desk research.

2. The need for building environmental assessment tools

Global warming and climate change have been a main concern of nations around the world. Excessive energy use has led to an increase in the Earth's temperatures to critical levels. Energy consumption in the Asia-Pacific Economic Cooperation (APEC) region, which also includes the U.S., Canada, Russia and some countries in South America, continues to escalate. Per capita electricity consumption in countries like China and South Korea has been exceptionally high, rising from 764 kWh in 1999 to 2,287 kWh in 2009 and from 4,594 kWh in 1999 to 8,325 kWh in 2009, respectively (EMSD, 2012). Meanwhile, per capita electricity consumption in Hong Kong and Australia has grown modestly by 13% and 10%, respectively, over the last decade. In contrast, countries like the U.S. and Canada experienced a decrease in electricity consumption – by 2% and 7%, respectively – over the same period.

About 40% of a nation's primary energy consumption comes from buildings (Kua and Lee, 2002). Energy is required for heating, ventilating, cooling, and lighting a building. Most modern buildings rely heavily on artificial heating and air conditioning, which result in high electricity consumption and carbon dioxide generation from the production of electricity. This can jeopardize human health and the Earth's ecosystems. Much effort has been put into reducing energy consumption and carbon emissions and improving the environmental performance and quality of buildings. A growing interest in building environmental assessments has resulted in more qualitative and quantitative assessment tools (Forsberg and von Malmborg, 2004). Before 1990, most benchmarks for buildings were concerned with a single criterion to gauge a particular aspect of building performance, e.g. energy use, indoor comfort, or air quality (Ding, 2008). BREEAM, the first commercially available building environmental assessment tool introduced in the UK in 1990, made the first real attempt to measure a comprehensive range of environmental considerations in buildings (Crawley and Aho, 1999; Grace, 2000). In partnership with private developers in the UK, BREEAM was launched as a credit award system for new office buildings and later extended to all building types, including residential, educational, medical, and industrial units (Ding, 2008). BREEAM has been a reference model for the schemes established in Canada, Hong Kong, New Zealand, Norway, and Singapore (Lee and Burnett, 2008). Thereafter, numerous environmental assessment tools for buildings were developed around the world (Haapio and Viitaniemi, 2008). LEED in the U.S. and Canada is among the most popular building environmental rating schemes. Like BREEAM, LEED is a voluntary program that deals with the entire phases of a building's life cycle and covers individual buildings all the way up to entire communities. In addition, LEED offers tax rebates and zoning allowances.

Other building environmental assessment tools include Green Star and BASIX in Australia, BEPAC in Canada, Eco-Quantum in the Netherlands, GOBAS in China, BEAM Plus in Hong Kong, Greenmark in Singapore, and CASBEE in Japan. These systems provide a wide-ranging assessment of environmental impacts due to the activities associated with buildings by aiming to measure the sustainability of the built environment (Reed et al., 2009). Some of the literature on this field have discussed these building environmental assessment tools (e.g. Cole, 1999; Crawley and Aho, 1999; Ding, 2008; Kajikawa et al., 2011). Some studies even compared these rating tools (e.g. Forsberg and von Malmborg, 2004; Seo et al., 2005; Haapiio and Viitaniemi, 2008; Reed et al., 2009; Kajikawa et al. 2011). Lee and Burnett (2008), for example, compared HK-BEAM (the former version of BEAM Plus), BREEAM, and LEED; while Kajikawa et al. (2011) explained the building environmental assessment tools in detail in their coverage of BREEAM, LEED, GBTool, and CASBEE. In Hong Kong, Ho et al. (2005) compared HK-BEAM, Intelligent Building Index (IBI), Building Quality Index (BQI) and Comprehensive Environmental Performance Assessment Scheme for buildings (CEPAS). Despite these distinctive systems, a comprehensive assessment of a building's environmental characteristics is required for designers and building owners to achieve higher environmental standards so as to be able to protect the environment and achieve sustainability for the built environment (Cole, 1999; Ding, 2008). The assessment tools can raise stakeholders' awareness of environmental issues and provide a verifiable framework for professionals to design, construct, and manage property more sustainably (Reed et al., 2011).

3. Australian context

In Australia, the three most commonly-known systems are Green Star, established by the Green Building Council of Australia (GBCA); the National Australian Built Environment Rating System (NABERS); and the Building Sustainability Index (BASIX). Green Star is the most commonly-used tool there and is equivalent to BREEAM and LEED (Reed et al., 2009). It rates a building in regards to the health and wellbeing of its occupants and their accessibility to public transport; its management, water use, and energy consumption; and the embodied energy of its materials, land use, and pollution (GBCA, 2012). It uses "Stars" to rate these performances, with four, five, and six stars indicating 'Best Practice', 'Australian Excellence', and 'World Leadership', respectively. All dwellings in Australia, except for those in NSW, must achieve 4-5-star thermal performance standards, as regulated by the Building Code of Australia (BCA).

NABERS is another indicator that assesses an existing building's environmental performance during its operational stage. It rates a building by the impacts from its building operations, namely in the energy, water, waste, and indoor environment categories (NABERS, 2012). NABERS was developed for commercial buildings and houses by the Department of Environment and Heritage in 2001 and operated by the government (Ding, 2008). It is a voluntary self-assessment tool with an accredited rating score of 10 being the best (Ding, 2008).

In NSW, BASIX overrules the BCA requirements and sets the required levels of environmental performance in a number of areas, namely energy, water, and thermal performance. Like NABERS, BASIX is operated by the government. It was introduced in July 2004 by the NSW Government to assess the potential performance of residential buildings against a range of pre-determined criteria (Ding and Ge, 2009). It is the first scheme to be introduced to Australia with mandatory requirements, which is implemented under the 1979 NSW Environmental Planning and Assessment Act. BASIX is an online assessment tool accessible to everyone and is easy to use. It applies to all new residential developments with a total estimated cost of A$50,000 or above and all residential alterations and additions (A&A) works with total cost of A$100,000 or above in NSW. Sustainability features must be incorporated into the building's design to meet the water and energy targets. A BASIX Certificate has to be obtained and attached to a development application. The applicant (the building owner, designer or developer) must input the data of the building's design (e.g. building materials, location, size, etc.) into a BASIX tool, in which the data will be automatically analysed and the score for the water and energy targets generated. A BASIX Certificate contains the description of the proposed development, a list of its commitments (covering water, thermal comfort, and energy) from the applicant to promote the sustainability of the proposed development, and a statement to fulfil the sustainability requirements. The certificate can be printed online if the design passes the water and energy targets, which vary by building type and location. Council staff will verify the development application against the certificate and the certifying authority will inspect the agreed-upon commitments at various phases of the construction. An occupation certificate will only be issued upon the satisfactory compliance with the particular commitments stated

in the BASIX Certificate. A BASIX completion report will be issued upon the completion of the development (BASIX, 2012).

4. The Hong Kong Context

In Hong Kong, two assessment schemes have been introduced, namely the Comprehensive Environmental Performance Assessment Scheme (CEPAS) and the Building Environmental Assessment Method (BEAM) Plus. CEPAS, commissioned by the government and announced in 2007, is a voluntary scheme that intends to promote green buildings. It applies to new and existing commercial and residential buildings and provides a common benchmark to gauge a building's environmental performance. It employs an adaptive/weighting approach and has eight performance categories: 1) resource use, 2) loadings, 3) site impacts, 4) neighbourhood impacts, 5) indoor environmental quality, 6) building amenities, 7) site amenities, and 8) neighbourhood amenities (Cole, 2005; Ho et al., 2005). The original plan of promoting CEPAS was to offered exemptions from the calculation of gross floor area (GFA) and site coverage in exchange for building construction with environmentally friendly features. However, the idea was dropped due to objections to spending public funds to subsidize developers (Lee and Chen, 2008).

The former version of BEAM Plus, the Hong Kong Building Environmental Assessment Method (HK-BEAM), was introduced in December 1996 with two assessment methods, namely new and existing office buildings. It was originally initiated by the Real Estate Developers Association of Hong Kong together with the Planning Environment and Lands Bureau, Swire Properties, Hong Kong Land, Hong Kong Polytechnic University, and the Business Environment Council in 1995 (BEAM, 2012). It follows the structure of BREEAM's global, local, and indoor scales by embracing a wide range of environmental issues on buildings. In 2003, the standards were revised to cover all types of buildings during all stages of each building's life cycle. HK-BEAM aims for more environmentally sustainable building designs and operations (HK-BEAM Society, 2004a, 2004b). By the end of October 2009, approximately 199 landmark developments totaling more than nine million square metres of commercial space and 50,000 residential units had been assessed. HK-BEAM clients include the public and private sectors.

The BEAM Society merged with three other industry associations (the Construction Industry Council, the Business Environment Council, and the Professional Green Building Council) to form the Hong Kong Green Building Council (HKGBC) in 2009. The BEAM Society, however, remains the owner and operator of the BEAM assessment system. The revised green building rating systems, BEAM Plus New Building and BEAM Plus Existing Building, were officially launched in April 2010 and endorsed by the HKGBC. The BEAM Plus Version 1.2 for New Buildings and Existing Buildings, introduced in 2012, are improvements over the earlier versions by introducing a holistic element for Passive Design (BEAM Society, 2012).

Similar to CEPAS, the certification of BEAM Plus is voluntary. Its certification enjoys an incentive of 10% GFA concessions upon the submission of a development application to the relevant authorities. Since the incentive means an additional bonus to developers, a BEAM

Plus certification will become a standard requirement for new developments. Currently, there are over 240 projects registered for BEAM Plus assessment. Buildings are assessed by trained assessors called BEAM Professionals (BEAM Pro). The training program was introduced in 2010 and as of now, there are approximately 1,800 BEAM Pro-accredited assessors (HKGBC, 2012b).

The buildings will only be assessed upon their completion to certify their actual performance. However, Ding (2008) criticized that such a system assesses a building 'as it is built' rather than 'as it was designed' and the assessment process is not transparent. An assessment should be undertaken at the early stage of the design to incorporate environmental issues. Nevertheless, BEAM Plus covers the relevant regulatory or basic design requirements, including health and safety issues. It is an instrument for benchmarking building sustainability and improving building performance, thereby ensuring safe, healthy, efficient, and environmentally friendly working and living environments (BEAM Society, 2012). Credits will be awarded if a building's performance meets the defined criteria. Similar to BEAM earlier versions, BEAM Plus employs checklists to facilitate the consistent assessments (HK-BEAM Society, 2004a, 2004b). As a leading building environmental assessment tools in Hong Kong, BEAM Plus and its voluntary approach is worth studying and being compared against the mandatory approach of BASIX.

5. Comparison between BASIX and BEAM Plus

Both BASIX and BEAM Plus are building environmental assessment systems. BASIX is an assessment tool for residential buildings (new and Alteration & Addition works); while BEAM Plus covers all types of buildings (new and existing), including residential properties. Despite their fundamental similarities, BASIX and BEAM Plus are quite different in nature. BASIX is mandatory and was introduced to ensure that dwellings are built to be more energy and water-efficient (BASIX, 2012), while BEAM Plus is a voluntary scheme with diverse objectives. BEAM Plus aims to make building developments more sustainable and ease the long-term impact of buildings on the environment by improving safety, hygiene, and indoor environmental quality (IEQ); minimising pollution; promoting energy efficiency; trimming the consumption of non-renewable resources; and encouraging the recycling and reuse of materials (BEAM Society, 2012). The scope of BASIX's assessment includes the commitments of water use, energy use, and thermal comfort performance, while BEAM Plus covers site aspects, material aspects, energy use, water use, and IEQ. The scope of BASIX looks much simpler than that of BEAM Plus, as some sub-items of BEAM Plus's site and material aspects were actually incorporated into BASIX. No incentive is offered for BASIX; while the certification of BEAM Plus enjoys an incentive of 10% GFA concessions. A comparison of BASIX and BEAM Plus is shown in Table 1.

Table 1: Comparison of BASIX and BEAM Plus

Aspect compared	BASIX	BEAM Plus
Nature	Mandatory	Voluntary with incentives
Launch date	2004	1996
Incentive	N/A	10% GFA concessions
Governance	Department of Planning & Infrastructure, NSW Government	HKGBC
Award classification	N/A	Bronze/Silver/Gold/Platinum
Scoring system	Target for each commitment: • Water: Range between 0% and 40% across NSW • Thermal Performance: Pass or Fail • Energy: Average of 36% across NSW	Percentage of applicable credit gained: • Bronze : 40% • Silver : 55% • Gold : 65% • Platinum : 75%
Type of buildings	Residential (New and A&A works)	All type of buildings (New and Existing)
Assessment stage	Early design stage	All stages; recommended at the planning stage
Assessment method	Feature-specific criteria	Performance-based
Assessment category	• Water Use • Energy Use • Thermal Performance	• Site Aspects • Material Aspects • Energy Use • Water Use • Indoor Environmental Quality
Assessors	• Verification of development applications against BASIX criteria by Council staff; • Inspection of the BASIX commitments during construction by Professional Building Certifiers	By independent BEAM assessors (BEAM Pro) on behalf of BEAM Society Limited
Certification Authority	Director-General of the Department of Planning	HKGBC
Issue of certificate	During design stage	Upon building completion
Certification Fee*	Certificate Issuing Fee: A$50-$120	Registration Fee: HK$20,000–$110,000
		Assessment Fee: HK$90,000–$400,000
Completion Report Fee	Free of charge	N/A
Online registration	Yes	Yes
Online certification	Yes	No
Number of residential units certified**	46,000 individual homes	50,000 residential units***
Availability of assessment tools	Free of charge	Free of charge
Revision of documentation	N/A	Annual

Source: BASIX, 2012; BEAM Society, 2012; HKGBC, 2012a

Note: * Fee for new development, A$1 = HK$8 approximately;
** as of 2009;
*** HK-BEAM (former version of BEAM Plus).

On the subject of governance, BASIX is administered by the state government, while BEAM Plus is managed by the HKGBC, a non-governmental organization (NGO). The certifying authority for BEAM Plus is therefore the HKGBC; while that for BASIX is Director-General of the Department of Planning. The entire certification process (from registration to certification) of BASIX can occur online, while BEAM Plus only provides online registration. A BASIX applicant can input the design data into an online assessment tool that can generate a target score and print out a BASIX Certificate, which will later be verified against the development applications by the council staff; while BEAM Pro on behalf of the BEAM Society undertakes a BEAM Plus assessment. Time required for BASIX certification is shorter, but the applicant will later be involved more in the assessment process than under a BEAM Plus assessment. More time (no fewer than 90 calendar days from the submission of materials for assessment to the issue of a certificate) is required for a BEAM Plus assessment. As of 2009, number of residential units being certified was 46,000 for BASIX and 50,000 for HK-BEAM (former version of BEAM Plus). BASIX was launched in 2004; while BEAM assessment in 1996. BASIX is comparatively much "green" in terms of establishment year. Nevertheless, the number of residential units certified for both assessments are relatively similar. This implies that BASIX certification process is more efficient. In the long term, BEAM Plus should consider shortening the certification process to attain more high quality built environments.

Every applicant for a BASIX certification must submit an application for a new development to the Council attached with a BASIX Certificate. A dwelling is assessed during its design stage and the energy and water reduction targets must be met before printing the BASIX Certificate. In comparison, a BEAM Plus certification is not required before application for a new development. Assessment starts through a developer's initiative to obtain the certification, such as being motivated by the incentives offered. An applicant can register online with the HKGBC during the planning or design stage. Once the HKGBC has received the application, it will disseminate it to the BEAM Society for assessment. The assessment for a new building will only occur upon the building's completion to certify its actual performance (BEAM Society, 2012). The above mentioned indicates that the assessment of BASIX is feature-specific criteria and BEAM Plus is performance-based. In fact, an assessment is recommended before the building's design is conceptualised so that environmental issues can be incorporated into it (Ding, 2008). Such an assessment may be insufficient if it happens when the design is about to completed (Crawley and Aho, 1999; Soebarto and Williamson, 2001; Ding, 2008).

The award classification of Bronze, Silver, Gold, or Platinum is shown in a BEAM Plus Certificate. These ratings are derived from the overall assessment grade determined by the percentage of available credits obtained under each performance category and its weighting factor (BEAM Society, 2012). Each category has its own weighting factor, which is assigned to indicate its significance and global trends. BASIX does not have an awards classification. The BASIX Certificate merely reveals the score of each target. An applicant will not obtain the certificate if the targets of water, thermal comfort, and energy cannot be achieved.

Basically, a BASIX assessment is free of charge. The government only charges a fee to issue the BASIX Certificate. The charge for the certificate is comparatively low, costing from A$50 for a single detached dwelling to A$120 for each of the first three apartments in a building and A$20 for each additional apartment (BASIX, 2012). Another type of charge for BASIX is optional, which is on top of the charge by the government issuing a BASIX Certificate. The applicant may pay for a private BASIX consultant to prepare a set of BASIX documents for submission. The charge to prepare a set of BASIX documents for submission is usually about A$300 for each detached house. The BEAM Plus assessment and certification fee is more expensive than that of BASIX. Its registration fee ranges from HK$20,000 (A$1 = HK$8 approx.) for small projects (with a construction floor area of less than 2,499 square metres) to HK$110,000 for mega projects (with a construction floor area of 200,000 to 400,000 square metres). The assessment fee ranges from HK$90,000 for small projects to HK$400,000 for mega projects. Despite the GFA incentive, the expensive registration and assessment fees often discourage small homeowners from trying to obtain BEAM Plus certification. Nevertheless, small homes only account for a very small portion of Hong Kong's housing stock.

6. Discussions: mandatory and voluntary approaches

The voluntary approach has been gradually accepted around the world since the Earth Summit in Rio de Janeiro in 1992 (Lyon, 2003). A number of manufacturing companies have made voluntary pledges to enact environmentally friendly programs. Additional research studies have emerged to examine how well these voluntary approaches have performed (Gunningham and Sinclair, 2002; Annandale et al., 2004; Arimura et al., 2008). In the mining and forestry sectors, the voluntary approach for improving environmental performance can play a role from the view of foreign direct investment (Gunningham and Sinclair, 2002). Compared to the emergence of the voluntary approach two decades ago, the evolution of the mandatory approach started much earlier. Mandatory codes to control energy use in buildings emerged during the mid-1970s (Lee and Chen, 2008). Both approaches have advantages and pitfalls.

The mandatory versus voluntary schemes of control have been discussed in other disciplines, such as in the disclosure of financial and real externalities (Dye, 1990); food safety (Segerson, 1999); the disclosure of product risks (Polinsky and Shavell, 2006), etc. Within public policies for environmental protection, Lyon and Maxwell (2003, 2007) compared the voluntary approach to a subsidy payable to a plant that adopts environmental technology and the mandatory approach to the adoption of an environmental tax. Lyon and Maxwell (2007) found that a mandatory scheme can yield greater environmental enhancement than the voluntary scheme with incentives, as long as there is no significant political obstruction. But when there is intense political obstruction, the voluntary scheme is more desirable. This confirms the outcomes of Lyon (2003), who investigated the outcomes of voluntary versus mandatory approaches and highlighted that voluntary schemes were unable to reach similar levels of environmental protection than when they were mandatory. Lyon (2003) further argued that a voluntary scheme is a weak mechanism when political resistance thwarts the implementation of a more robust mandatory scheme.

In the area of building environmental assessment systems, only a few places have implemented mandatory systems (e.g. BASIX). The majority of assessment systems adopt the voluntary approach, with some systems offering incentives, such as LEED providing tax rebates and zoning allowances and BEAM Plus offering 10% GFA concessions. The mandatory approach of BASIX sets one environmental standard and well-defined sustainable housing targets to ensure that new built dwellings are more energy and water-efficient (BASIX, 2012). However, the drawback of BASIX is that it applies only to new developments and A&A works. Ninety-eight percent of existing homes consume non-renewable resources and pollute the environment (Ding and Ge, 2009), which means that BASIX does not do much for environmental sustainability. Besides, relying on the design of a project to realize the goal of sustainable development is insufficient to solve current environmental problems (Ding, 2008).

On the other hand, the voluntary-with-incentives approach of BEAM Plus can encourage designs to incorporate more environmentally friendly features. The incentive of 10% GFA concessions is attractive enough to a number of developers in Hong Kong, while the call for environmentally sustainable building designs can be transmitted fully throughout the economy. This extra GFA will mean additional income to developers. It is not surprising that BEAM Plus certification will become a standard requirement for new developments in Hong Kong. However, Haapio and Viitaniemi (2008) argued that it was possible for "low quality buildings" to opt out of the assessment if it is not mandatory. They also pointed out that the assessment will only focus on "high quality buildings" due to their high success rate to obtain higher grades. They suggested that assessments should become mandatory. A standardized framework needs to be developed for the ease of studying and comparing new designs and buildings. Yet, a mandatory approach can only work when there is an absence of political obstruction. When political pressure exists, the voluntary-with-incentives approach governed by NGO will be an effective alternative to achieving environmental sustainability. The effective incentives may include density bonuses, tax rebates and faster building permits (Miller et al., 2008). Furthermore, the certification fee is another aspect to consider. Despite the incentives, the expensive certification fee of BEAM Plus may discourage the small developers to obtain the green building certification. Studies need to be undertaken to promote environmental sustainability to this group of developers. The final question is whether the government will use taxpayers' money to subsidise building owners to undertake their building certifications. To this end, the voluntary-with-incentives approach remains a more desirable tool for the building industry to improve its environmental performance.

7. Conclusion

The comparison of BASIX and BEAM Plus was reviewed in this study. Despite fundamental similarities between the two, both BASIX and BEAM Plus are different in nature and approach. BASIX is mandatory, while BEAM Plus is voluntary with incentives. Each has a distinctive assessment method, scoring system, and certification fee scale. Applicants for BASIX certification are required to include in their dwellings sustainable housing features that meet energy and water reduction targets. A certificate cannot be issued if the targets are not met. This mandatory approach is more likely to be seen as a

form of punishment than as an encouragement to building owners. It can be more effective and deliver greater environmental enhancement than the voluntary-with-incentives approach if there is no political hindrance. On the other hand, the voluntary scheme of BEAM Plus can motivate building owners to incorporate environmentally friendly designs into their structures in order to obtain GFA concessions. This incentive can spread throughout the economy and motivate building owners to improve their buildings' environmental performances. However, due to its voluntary nature and third party (BEAM Pro) certification approach, the registration and assessment fees for BEAM Plus Certification are high. Such costs will discourage many building owners, particularly small developers, from seeking certification. The time-consuming of BEAM Plus certification process will also be a hindrance to achieve building environmental sustainability. Further studies are required to address the issue of high certification fees and length of certification process. Case studies should also be conducted to confirm if the voluntary-with-incentives approach is adequate to motivate building owners to improve the environmental performances of their properties.

References

Annandale D, Morrison-Saunders A and Bouma G (2004) "The impact of voluntary environmental protection instruments on company environmental performance." *Business Strategy and the Environment* **13**: 1-12.

Arimura T H, Hibiki A and Katayama H (2008) "Is a voluntary approach an effective environmental policy instrument? A case for environmental management systems." *Journal of Environmental Economics and Management* **55**: 281-295.

BASIX [Building Sustainability Index] (2012) (available online *https://www.basix.nsw.gov.au/information/index.jsp* [accessed on 17/12/2012]).

BEAM [Building Environmental Assessment Method] (2012) (available online *http://www.beamsociety.org.hk/en_about_us_2.php* [accessed on 6/12/2012]).

BEAM Society (2012) *BEAM Plus for New Buildings Version 1.2*, Hong Kong, BEAM Society Limited.

Cole R (1999) "Building environmental assessment methods: clarifying intentions." *Building Research & Information* **27**: 230-246.

Cole R J (2005) "Building environmental assessment methods: redefining intentions and roles." *Building Research & Information* **33**: 455-467.

Crawley D and Aho I (1999) "Building environmental assessment methods: Applications and development trends." *Building Research and Information* **27**: 300-308.

Ding G K C (2008) "Sustainable construction – The role of environmental assessment tools." *Journal of Environmental Management* **86**: 451-464.

Ding K C and Ge X J (2009) “Green revolution – a challenge to improve environmental performance of existing housing stocks”, *Proceedings of the 2009 Conference on Green Building: Towards Eco-City*, 11-14 October 2009, Taipei, Taiwan.

Dye R A (1990) “Mandatory versus voluntary disclosures: The cases of financial and real externalities.” *The Accounting Review* **65**: 1-24.

EMSD [Electrical and Mechanical Services Department] (2012) *Hong Kong Energy End-use Data 2012*, Hong Kong, EMSD.

Forsberg A and von Malmborg F (2004) “Tools for environmental assessment of the built environment.” *Building and Environment* **29**:223-228.

GBCA [Green Building Council Australia] (2012) (available online *http://www.gbca.org.au/green-star/* [accessed on 4/12/2012]).

Gilpin A (1995) *Environmental impact assessment (EIA): Cutting edge for the twenty-first century*, Cambridge, Cambridge University Press.

Grace M (2000) “BREEAM – a practical method for assessing the sustainability of buildings for new millennium”, *Proceedings of the Sustainable Building Conference*, 23-25 October 2000, Maastricht, the Netherlands.

Gunningham N and Sinclair D (2002) “Voluntary approaches to environmental protection: lessons from the mining and forestry sectors”, *OECD Global Forum on International Investment: Conference on Foreign Direct Investment and the Environment*, 7-8 February 2002, Paris, France.

HK-BEAM Society (2004a) *HK-BEAM 4/04 ‘New Buildings’: An environmental assessment for new buildings Version 4/04*, Hong Kong, HK-BEAM Society.

HK-BEAM Society (2004b) *HK-BEAM 5/04 ‘Existing Buildings’: An environmental assessment for existing buildings Version 5/04*, Hong Kong, HK-BEAM Society.

HKGBC [Hong Kong Green Building Council] (2012a) (available Online http://www.hkgbc.org.hk/eng/index.aspx [accessed 7/12/2012]).

HKGBC (2012b) *HKGBC Journal Issue 1*, (available online http://www.hkgbc.org.hk/upload/e-Journal/Journal-All_FINAL.pdf [accessed 10/12/2012]).

Haapio A and Viitaniemi P (2008) “A critical review of building environmental assessment tools.” *Environmental Impact Assessment Review* **28**: 469-482.

Ho DCW, Chau K W, Yau Y, Cheung A K C and Wong S K (2005) “Comparative study of building performance assessment schemes in Hong Kong.” *Hong Kong Surveyor* **16**: 47-58.

Kajikawa Y, Inoue T and Goh T N (2011) “Analysis of building environment assessment frameworks and their implications for sustainability indicator.” *Sustainability Science* **6**: 233-246.

Kua H W and Lee S E (2002) “Demonstration intelligent building – a methodology for the promotion of total sustainability in the built environment.” *Building and Environment* **37**: 231-240.

Lee W L and Burnett J (2008) “Benchmarking energy use assessment of HK-BEAM, BREEAM and LEED.” *Building and Environment* **43**: 1882-1891.

Lee W L and Chen H (2008) “Benchmarking Hong Kong and China energy codes for residential building.” *Energy and Buildings* **40**: 1628-1636.

Lyon T P (2003) *Voluntary versus mandatory approaches to climate change mitigation*, (available online http://www.rff.org/Publications/Pages/PublicationDetails.aspx?PublicationID=9637 [accessed on 5/12/2012]).

Lyon T P and Maxwell J W (2003) “Self-regulation, Taxation, and Public Voluntary Envrionmental Agreements.” *Journal of Public Economics* **87**: 1453-1486.

Lyon T P and Maxwell J W (2007) “Environmental public voluntary programs reconsidered.” *The Policy Studies Journal* **35**: 723-750.

Miller N, Spivey J and Florance A (2008) “Does green pay off?” *Journal of Real Estate Portfolio Management* **14**: 385-399.

NABERS [National Australian Built Environment Rating System] (2012) (available online *http://www.nabers.gov.au/public/WebPages/Home.aspx* [accessed on 4/12/2012]).

Park J and Seo K (2006) “A knowledge-based approximate life cycle assessment system for evaluating environmental impacts of product design alternatives in a collaborative design environment.” *Advanced Engineering Informatics* **20**: 147-154.

Polinsky A M and Shavell S (2006) “Mandatory versus voluntary disclosure of product risks.” *The National Bureau of Economic Research*, Working Paper No.12776.

Reed R, Bilos A, Wilkinson S and Schulte K (2009) “International comparison of sustainable rating tools.” *Journal of Sustainable Real Estate* **1**: 1-22.

Reed R, Wilkinson S, Bilos A and Schulte K (2011) “A comparison of international sustainable building tools – An update”, *The 17th Annual Pacific Rim Real Estate Society Conference*, 16-19 January 2011, Gold Coast, Australia.

Segerson K (1999) “Mandatory versus voluntary approaches to food safety.” *Agribusiness* **15**: 53-70.

Seo S, Tucker S, Ambrose M, Mitchell P and Wang C (2005) *Technical Evaluation of Environmental Assessment Rating Tools*, Forest and Wood Products Research and Development Corporation, Project No. PN05.1019.

Soebarto V I and Williamson T J (2001) “Multi-criteria assessment of building performance: theory and implementation.” *Building and Environment* **36**: 681-690.

UNEP [United Nations Environment Programme] (1996) *Environmental Impact Assessment: Issues, Trends and Practice*, UNEP.

WCED [World Commission on Environment and Development] (1987) *Our Common Future*, Oxford, Oxford University Press.