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Friends of the Earth (HK)
Position Paper: An overview of building energy efficiency issues in Hong Kong.

Full Paper

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1. Scale of the problem

The issue of green building (GB) design is of increasing concern for Hong Kong as currently 89% of Hong Kong's total electricity consumption is accounted for by buildings[1]. With the primary aims of reducing the overall impact of the built environment on human health and the natural environment, GB principles include: energy conservation, conservation of water and materials, waste minimization and indoor environmental quality, as well as avoidance of the street canyon effect. This paper will concentrate on energy conservation, with some discussion of the street canyon effect insofar as it affects the need for air conditioning and lighting within the building.

Hong Kong's fuel mix is currently considered 'dirty' as coal is the dominant fuel. The

[1] Other developed countries consume about 20-40% of their energy in the building sector (Pérez-Lombard et al, 2009), while in Hong Kong buildings consume 45% of total energy.

Hong Kong power sector alone contributes 89% of the total sulphur dioxide emissions, 63% of the carbon dioxide, 45% of the nitrogen dioxide and 28% of the PM_{10}. In addition, Hong Kong, with no indigenous (locally sourced/available) fossil fuels on which to rely, is in a precarious situation. Energy conservation is recommended by academics and energy experts as the most cost-effective way of tackling energy use and the related environmental issues. Buildings that are more energy efficient could reduce our electricity peak load and hence in the long term reduce the need for building additional power plants, even the most efficient of which are a major source of greenhouse gas emissions. In recent decades Hong Kong has been in transition from a manufacturing-oriented economy to a service-based one, and should therefore be able to attain a reduction in energy consumption. However the rise in commercial sector energy consumption has more than compensated for the gradual decline in the industrial sector since its peak in 1990 (Figure 1).

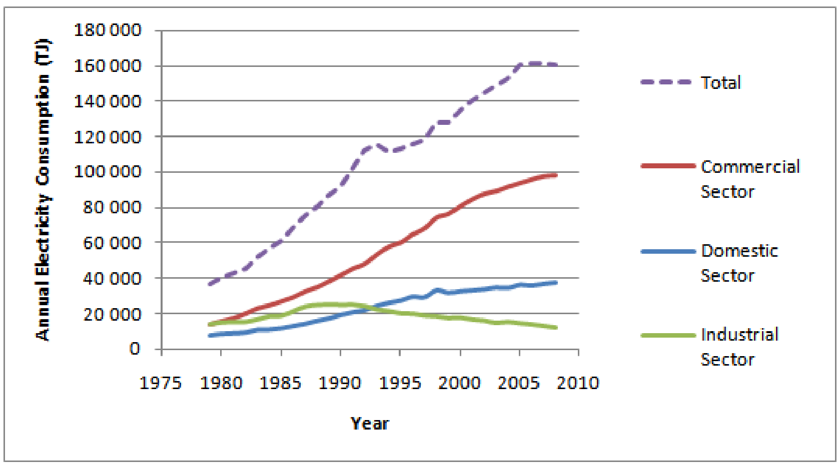

Figure 1: Annual Electricity Consumption

Source: Electrical and Mechanical Services Department (2008); Lam et al (2008a)

2. Measuring the problem

The government points out that Hong Kong has reduced its energy intensity by 13% from 1995 levels (Environment Bureau 2007). Energy intensity is a measure of the energy efficiency of a nation's economy, and calculated as units of energy per unit of GDP (Baksia and Green, 2007; Smil, 2003). However the measure is inappropriate and often misleading when it is applied in Hong Kong which does not rely on heavy industries to support its economy. As Theriault and Sahi (1997) explain, "The international comparison of energy intensity, at the aggregate level, produces misleading conclusions with respect to energy efficiency and the quality of technology used in a particular country." Furthermore, the method of GDP calculation is currently being criticized by energy experts in mainland China as well as European countries. Therefore, the EU approach of using absolute terms in energy reduction targets would be a more suitable approach for Hong Kong to follow.

Lam et al (2008a) describes the energy use situation in Hong Kong from 1979 to 2006. The primary energy requirement (PER) nearly tripled during this 28-year period, rising from 195,405 to 566,685 TJ, while electricity consumption quadrupled. This represented an average annual growth rate of electricity consumption of over 5.7%, while population growth rate was merely 1.2% (almost a five-fold difference, Fig 2). The residential and commercial sectors are the two largest electricity end-users with an average annual growth rate of 5.9% and 7.4%, respectively (Fig 1, Lam et al, 2008a).

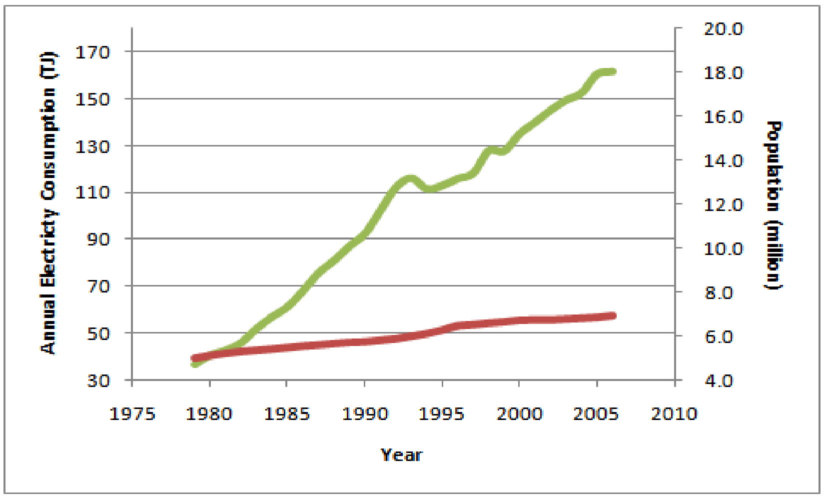

Figure 2: Annual Growth Rate of population and Electricity consumption

Source: Electrical and Mechanical Services Department (2008); Census and Statistics Department (2009); Lam et al (2008a)

Recommendation: We call for an end to misleading information about our energy profile to disguise the relatively heavy consumption of energy by Hong Kong. A normalized electricity consumption database like the EUI (see section 8) is therefore more appropriate.

3. The potential for energy reduction

According to academics and industry, phasing out outdated energy technologies could reduce electricity consumption in Hong Kong buildings by 6-32%, i.e. air conditioning electricity consumption can be reduced by 44% by switching from air-cooled to water-cooled (Ma & Wang, 2009); energy for lighting can be cut by 41% with automatic lighting controls and natural lighting strategies (Yu & Chow, 2007); synchronous motors and control strategies can save 50% on lifts and escalators (Close & Fok, 2008). This will depend on active involvement by individuals and industry as well as policy approaches such as the implementation of the mandatory building energy codes (see section 9).

Table 1: List of EE technologies and their potential for saving building energy (%) in the commercial sector

Commercial	
A/C	**27%:** Change from conventional Variable Air Volume (VAV) system to a low-temperature air distribution system (i.e. downsize of equipment, increase cooling capacity for existing distribution, small booster fan, etc.) (Yu and Chow, 2007) **44%**: change from a conventional constant volume all-air system to HVAC system combining chilled-ceiling with desiccant cooling. (Ma and Wang, 2009)
Lighting	**41%**: Daylighting strategy, an automatic lighting system control with sensor; (Yu and Chow, 2007) **50%**: change CFL from T12 to T8/T5 (HEC, 2005)
Lifts and Escalators	**50%**: Synchronous motors; New frequency controlled hydraulics; Control strategies; Power regeneration via ascending/descending lift motors (Close and Fok, 2008)
Standby power	**12%** (Kam and Ip, 2009)**:** One watt initiative; smart metering
Miscellaneous	**10%:** Building energy management controls including better occupant comfort sensitivity & integrated renewables (Close and Fok, 2008) **15%:** In-house Management action including accounting, audit and control efforts, and encouraging an energy conscious attitude among staff by appointing green managers, etc. (Davies and Chan, 2001)

4. Setting a target

Despite the potential for reductions, there has not been clear and systematic progress in Hong Kong's energy conservation legislation, and Hong Kong lags well behind other countries in setting and achieving environmental goals (Table 2). Developed countries like the US, UK, Australia, Japan and Singapore, have established energy service companies (ESCO) or energy saving regimes run either by the government or private enterprise. Singapore has set a specific target of 80% of total building numbers achieving Green Mark by 2030 (Building and Construction Authority, 2009). Another indication of the weak interest towards GB in Hong Kong was shown by Chan et al (2009) in that building designers in Singapore are more open to GB technology than those in Hong Kong.

Energy conservation programmes can be economically viable as well – according to a UK study (Barker et al, 2007), a 10% reduction in CO_2 emissions and energy savings of 8% were achieved by various energy-efficiency policies in just 10 years with a positive macro-economic effect in the UK[2].

Table 2

Jurisdiction	***Target period***	***Energy reduction target (%)***
EU	9 years	9% energy consumption
Japan	2003-2030	30% energy intensity
APEC	2005-2030	>25% energy intensity
China (excl. HK)	2006-2010	10% energy intensity

Recommendation: Based on the reductions possible through application of existing technologies as described in section 3, FoE (HK) considers a 10% reduction in total building electricity use, using 2005 as a baseline, is achievable by 2015.

5. Lack of coordination

Hong Kong does not have a single independent agency within the government to oversee all aspects of electricity usage (Lo, 2008). Responsibilities are divided among a few government departments: the Economic Development and Labour Bureau (EDLB) is responsible for financial arrangements with the power companies; the Environmental Protection Department (EPD) for the environmental performance of the power companies; Electrical and Mechanical Services Department (EMSD) for the safety of supply and use of electricity, and for the regulation of MBEC. In addition, advisory bodies such as the Council for Sustainable Development (CSD) and the Energy Advisory Committee (EAC) also offer advice to government on energy issues. With no single department or organization taking full responsibility for energy and electricity conservation in buildings, the promotion of sustainable energy consumption remains merely rhetoric and cannot be effective.

[2] The macroeconomic benefit due to deployment of various energy efficiency policies and programmes in the UK over the period 2000-2010 was around 11%, i.e. policies promoting energy efficiency commitment, appliance standards, and frequently renewed building regulations, etc.

6. Leading by example

While all new government construction and major retrofits since 1998 have had to comply with the voluntary Building Energy Codes, it has not been government practice to release building energy efficiency data, either theoretical or actual. Government occupied buildings built between 1995 to 1998 are only compliant with OTTV (Hui, 2003)[3].

Recommendation: FoE (HK) urges the government to lead by example, with a vigorous demonstration of MBEC compliance, Energy Labeling, and green procurement policy by government buildings and buildings of government-funded or government-subsidized organizations, (both new and existing ones).

7. History of voluntary initiatives

The Hong Kong Government and private developers have formulated some voluntary initiatives and benchmarking tools to promote green buildings, such as the Building Environmental Assessment Method (BEAM), Voluntary Building Energy Code, Energy Efficiency Award, energy audit, Appliance Labeling and Standards, etc. However, the effect of these measures, and public involvement in the development of green buildings to date have been limited.

As of December 2009, the Hong Kong Energy Efficiency Registration Scheme for Buildings, an 11-year old voluntary registry, only has 1086 building venues registered out of the total 40,000 buildings in Hong Kong. A study by Friends of the Earth (HK) in late 2007 found that only 10.8% of the certificates granted were for private developments. Furthermore, BEAM (see section 8) has graded just over 199 developments under its voluntary benchmarking scheme since its launch in 1986 (as of October 2009). In contrast, 250 buildings in Singapore have achieved the Green Mark Award since 2005 and the Singapore government has introduced a number of incentive programmes to achieve a target registration rate of 80% by 2030 (Building and Construction Authority 2009).

[3] The OTTV standards were compared with that of other countries, such as Singapore, Malaysia, Thailand, Philippines, and Jamaica by Hui (1997), who showed that the 1995 OTTV limits in Hong Kong are merely moderate for towers, and generous for podiums. This also applied to the mildly revised 2000 OTTV standards, which have the deficiency of excluding daylighting calculations. The use of OTTV for assessing the thermal performance of residential building envelope designs has also been proven to be inadequate (Wan, 2003).

Recommendation: FoE (HK) recommends that the government set a target for registration of new and existing buildings under a benchmarking scheme (e.g. BEAM), and a set out measures to achieve it. The newly launched Hong Kong Green Building Council (HKGBC) may be an appropriate vehicle for this, but unless Government takes a proactive role as a facilitator and legislator, we fear the Council will struggle with low uptake as have the previous voluntary initiatives.

8. Benchmarking

Energy benchmarking tools provide a standard methodology for comparing the energy performance of buildings in a given geographic area (Pérez-Lombard et al, 2009). There are different benchmarking tools around the world. Some are initiated or operated by government such as in the US (LEED), Taiwan (EMGB), Australia (BASIX, NABERS, ABGR), Spain (CEN, CALENER), Singapore (Green Mark), Japan (CASBEE) while others have a private or voluntary origin such as in Australia (GreenStar), and UK (BREAAM), (Ding, 2008). Among these, the most successful ones are usually partially or wholly government-led. LEED is the current leading tool, which may well be due to its being used by the US Green Building Council to promote GB.

Our existing benchmarking tools in Hong Kong lean towards praising the best performers as in BEAM[4] and CEPAS[5]. These environmental building assessment methods have been developed to evaluate how successful any development is with regards to balancing energy, environment and ecology, taking into account both the social and technological aspects of the projects (Ding, 2008). As BEAM and CEPAS seek to measure the performance of buildings over the whole life cycle, the assessment spans the planning stage, through the design, construction, commissioning, operation, maintenance, and management stages, and finally to deconstruction (Table 1) (Ho et al, 2005). Lee and Yik (2002) show that compliance with BEAM could lead to a saving in annual electricity consumption of 31.9%. For example, the measurement of the energy efficiency of lighting installations in BEAM is similar to the MBEC lighting code, except that several target levels for lighting power density are specified beyond the baseline level (Lee and Yik, 2002).

The European standard EN 15217 describes methods for expressing energy efficiency

[4] **BEAM**: The Hong Kong Building Environmental Assessment Method is a voluntary scheme dating from 1996, with 4 grades, Bronze to Platinum.

[5] **CEPAS**: Comprehensive Environmental Performance Assessment Scheme (CEPAS) for buildings, developed by the Buildings Department in 2001. This well researched Government-led assessment method, rather than displacing BEAM in the market, has led to revisions and improvements in BEAM.

and certification of buildings by an overall energy performance index (EPI), also known as an Energy Use Index (EUI) in the United States. It calculates the energy consumption, carbon dioxide emissions and energy cost, per unit of conditioned area and thus allows for a comparison between buildings.

USEPA[6] describes the EUI as the "most common means" of expressing the total energy consumption for each building. Energy service companies also use EUI as a starting point in energy audits (Pérez-Lombard et al, 2009) and to assess saving opportunities by comparison with existing references (benchmarks) of average, above average, and excellent practice[7]. This provides energy end-users or customers with a way to understand their EUI rating, track their energy consumption from year to year in the same building, and estimate potential for energy savings.

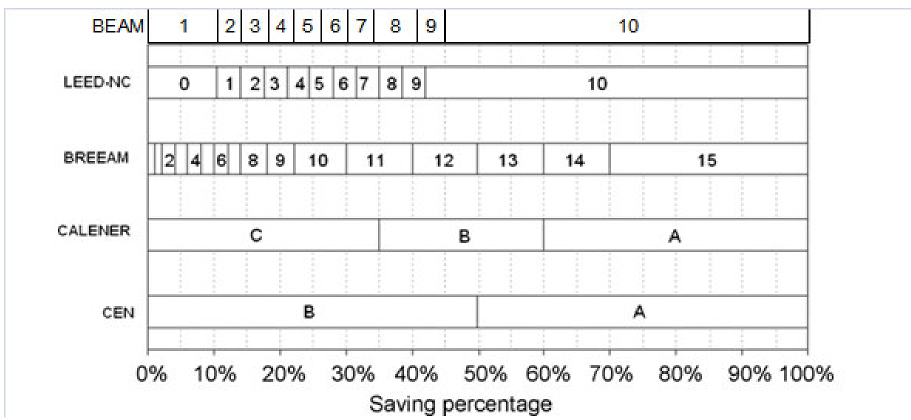

Figure 3: Different Benchmarking Tools for Grading the Energy Saving Percentages (Pérez-Lombard et al, 2009)

The actual EUI rating can be compared with the benchmark table for the benchmark score. It has been used in the Asia-Pacific Economic Cooperation Energy Benchmark System and slightly modified as the basis of the Energy Star benchmark (Chung et al, 2006). EMSD already has a similar database (Energy Consumption Indicator)[8]; it has nine separate sectors, i.e. offices, schools, hotels, supermarkets, etc. with their sub-groups. Research studies by Chung et al. (2006, 2009) which have been adopted by EMSD previously, show that Hong Kong supermarkets for instance have an average EUI

[6] USEPA, http://www.epa.gov/cleanrgy/documents/sector-meeting/6ciii_expanding.pdf

[7] "At the design stage, energy performance indices for different designs are of great use when choosing suitable technologies, particularly if benchmarks for similar buildings are available." (Pérez-Lombard et al, 2009)

[8] EMSD's online benchmarking (EUI), http://202.155.228.28/energy2/introduction.htm

value (Table 3) that is much greater than that of the UK Energy Benchmark (3960 MJ/m²/year), and US Energy Star (3526 MJ/m²/year). This discrepancy might be due to different operating conditions among different countries.

Table 3:

Type of building	**Average EUI (MJ/m²/annum)**		**Difference (%)**
	Actual	Suggested (EMSD)	
Private Office	1051- 1665	1270.6	-17.3 to 31.0
Government Office	827	1043 (excluding common areas)	-20.7
Hotel	1950-2030	1575	28.9
Supermarket	5853	5077-5853	15.3 to 0

Sources: (Deng and Burnett, 2000; Li, 2008; EMSD, 2008; Chung et al, 2006; Deng, 2003; Chung, 2009)

It is clear from the table above that hotels and supermarkets have a great deal of room for improvement, while the standard for government offices could be raised considerably.

The table below shows that BEAM and EUI complement each other, and together provide a more complete picture than either one by itself.

Table 4:

Building Life Cycle								**Types of Building**			
	Design	**Construction**	**Commissioning**	**Operation & Maintenance**	**Management**	**Deconstruction**	**Energy End-use Database**	**Sector diversity (e.g. Hotel, Office, etc.)**	**Existing**	**New / Renovated**	**Energy saving Potential**
MBEC	✓							Variety		✓	5.0-7.9%
BEAM	✓	✓	✓	✓	✓	✓		Specific	✓	✓	31.9%
EUI	✓		✓	✓	✓		✓	Variety	✓	✓	5*-30%

* Installation of smart meters

9. MBEC

Mandatory compliance with Building Energy Codes (MBEC) is to be legislated in the near future in Hong Kong. The MBEC contains four prescriptive codes of practice: Air Conditioning, Electrical Motor, Lift and Escalator, and Lighting. However, it has been predicted these changes will only have a maximum of 5-7.9% electricity saving potential (Hui, 2007; Lee and Yik, 2002). The codes of practice laid down in the MBEC have been criticized for being too simple and easy to achieve. Furthermore, their effects on building energy conservation are uncertain as none of them reviews the building as a whole (Ma and Wang, 2009) whereas the Performance Based BEC (PB-BEC), which joins the four prescriptive codes together with the OTTV standard[9], emphasizes the total energy consumption of buildings and allows certain trade-offs within the system components. This approach provides the means for energy conscious developers to understand the energy performance of their buildings at the planning stage. However, this alternative compliance criterion is admittedly generally complicated and requires extensive work and skills for its implementation (Lee and Yik, 2002).

Furthermore, MBEC is considered inadequate and is in fact a backward step when viewed from a worldwide perspective. The proposed MBEC for Hong Kong is of a lower standard than that used in Australia, India, Mainland China, Singapore and the US. For example, India has a lighting power standard of 10.8 W/m^2 lighting load density for office areas while HK has a 36% less efficient requirement of 17 W/m^2 (Fig. 4). Additionally, Lam et al (2008b) shows that a modest 2 W/m^2 reduction in the current lighting code for office buildings is feasible; and Lee et al (2001) found that the use of traditional lighting technologies gives a lighting power density of 18.4 W/m^2 (range from 14.4 to 25.9) for offices, which can be reduced to 13.8 W/m^2 if electronic ballasts are adopted.

[9] Overall Thermal Transfer Value (OTTV), 1995, is a measure of the energy consumption of a building envelope via the building design and construction. The envelope components include the type of glazing, window size, external shading to windows, wall colour and wall type to meet the maximum OTTV criteria, which is 35W/m^2 for building tower and 80 W/m^2 for podium (upgraded to 30 and 70 respectively in 2000).

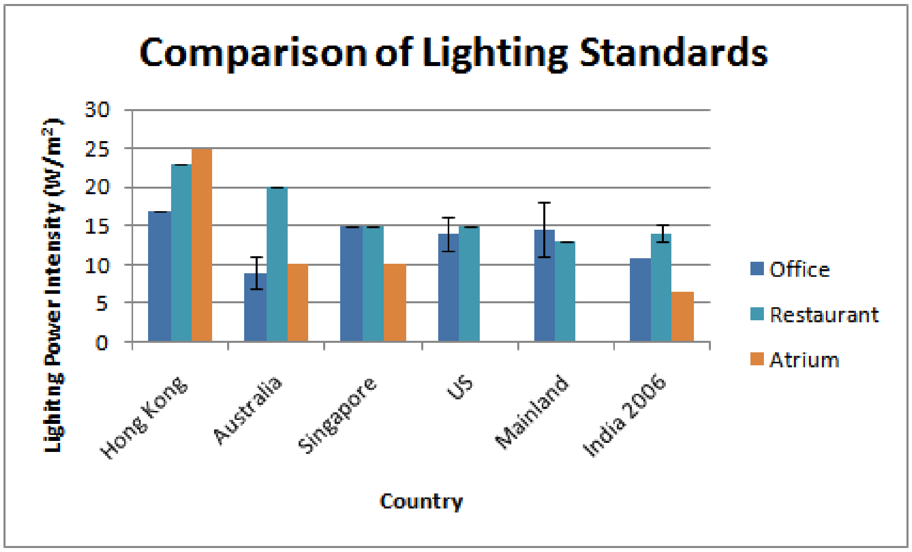

Figure 4: Comparison of lighting power standards in different countries

Recommendation: FoE (HK) believes MBEC should be regarded as a minimum requirement of energy efficiency at the design stage. On completion, a modified form of the MBEC, with a four-tiered grading standard, should be applied, e.g. the lighting standards of $17W/m^2$ would obtain a "Pass" mark; $15W/m^2$ - "Grade 3"; $13.8W/m^2$ – "Grade 2"; and $10.8W/m^2$ – "Grade 1".

10. The importance of a database

Critics (Lee and Burnett, 2006; Ma and Wang, 2009) found that while Hong Kong does not have a comprehensive energy end-use database, the government is taking an important role in supporting and strengthening building performance assessment methods. In a survey, Lee and Burnett (2006) found that the majority of architects, town planners, government officials, and engineers think that using "actual operating figures" was a fairer method to judge the performance of similar buildings rather than "simulation" methods (e.g. PB-BEC). Currently, EMSD is trying to gather such information via MBEC and energy audits. However the voluntary BEC has had a low uptake, and the MBEC will only apply to new builds and major refurbishments, so this is not ideally suited to tackling energy over-consumption in existing buildings. Hong Kong people are entitled to know how their buildings are performing in environmental terms.

Recommendation: FoE (HK) urges the government to provide a transparent online benchmarking system, such as EUI, in a high profile manner for greater public participation, e.g. regular reporting, or large scale appraisal of buildings or individual premises.

11. Sub-metering and smart metering

Good management requires regular and reliable energy data. One possible measure is to install separate meters for different floors and for some of the equipment with large electrical loadings (sub-metering). Remote monitoring technology is used to track detailed consumption patterns over time (smart metering) (Li, 2008).

Government regards energy monitoring as an important tool for end-users that are heading towards green building design or practice. In CEPAS, installation of energy meters in different building components does play a part in Energy Efficiency accreditation RE2.4 (Buildings Department, 2006). Furthermore, according to EMSD energy audit guidelines, as part of an environmental management programme (EMP), building management should install meters (permanent type) or make provisions for ready connection of meters for each main system, its sub-systems and its associated components. These metering facilities will give the building management a better assessment of the energy consumption in the long run (Energy Efficiency Office, 2007). Energy monitoring based on sub-metering can be expensive but offers essential performance information of great use to energy auditors and building maintenance personnel (Pérez-Lombard et al, 2009).

Recommendation: FoE (HK) urges the government to encourage the installation of sub-meters and smart meters.

12. Air Ventilation Assessments

The shape and orientation of large buildings influence not only the demand for air conditioning and lighting in the post-occupancy stage, [10] but the surrounding environment as well. The Hong Kong Planning Standards and Guidelines incorporate the Planning Department's guideline for Air Ventilation Assessments (AVAs), which suggests a wind speed of 1.5 m/s at ground level could be optimal for creating outdoor pedestrian comfort during the hot summer months[11] (Planning Department, 2005).

[10] Post occupancy stage refers to the condition of buildings or premises after they have been built and occupied for some time.

[11] The channeling effect created by the void at ground level helps to improve the ventilation performance for those residential units on the lower floors. For very deep canyons or very tall building blocks, mid-level permeability may be required to improve the ventilation performance for those occupants who reside at mid-floor level.

This AVA guideline is a weak (or low speed) wind design protocol for congested urban planning (Ng, 2009) which has been followed by the Housing Department for all new public housing projects (Ng, 2006). However, very few private projects voluntarily follow this guideline. This should be adopted into the Gross Floor Area (GFA) concession policy; it should cover site coverage, building alignment and disposition, etc. to ensure that buildings and the corresponding urban planning design do not block the ambient wind (Ng, 2009).

We should not set our building separation solely on a 15-meter interval as suggested by CSD[12], nor stipulate height restrictions. These are reactive measures or inferior (or secondary) options, while AVA and an Urban Climatic Map should be adopted which could sustain the wind speed and categorize each district condition specifically. In the figure shown below, Ng (2009) has shown that a terraced podium design of buildings with the same interval distance could improve the air movement. Also, the axis of the building should be parallel to the prevailing wind direction. A holistic approach of AVA for sensitive or dense urban areas has advantages for tackling the street canyon effect and hence reducing energy consumption by air conditioning with lowered city temperatures.

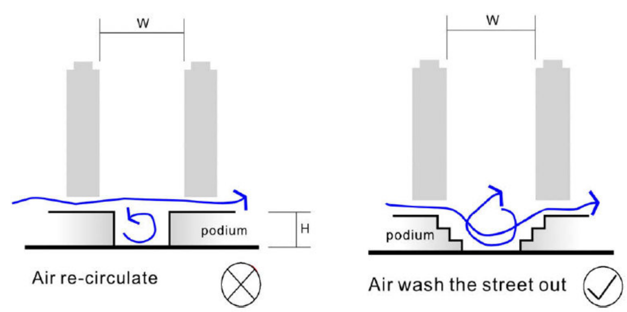

Fig. 5: Scale of Podium (Ng, 2009)

Recommendation: FoE (HK) suggests mandatory Air Ventilation Assessment (AVA) for new large buildings at the planning stage.

12 Council for Sustainable Development (CSD), Building Design to Foster a Quality and Sustainable Built Environment (Invitation for Response Document 2009).

13. Incentives for building designers and managers

Currently, most buildings in Hong Kong are designed and commissioned by organizations that will not be responsible for paying the electricity bills. There is little incentive, therefore, for them to design for energy efficiency. Likewise, many energy efficiency retrofit measures can only be taken by building management, and tenants in a multi-occupancy situation have little power to persuade management to act. Chung et al. (2009) showed that different energy management practices in building offices are critical in energy conservation. For example, Grade A offices generally have a shared air conditioning system for the whole building, where the air conditioning fee is charged inclusively in the management fee without breakdown. Therefore this does not provide a piece of important information and incentive for tenants of the building to be aware and to take proper measures to reduce their energy consumption for air conditioning. On the other hand, Grade C offices generally achieved lower EUI ratings because as tenants they have to foot the electricity bills for their air conditioning which is usually separate from the management fee.

Looking overseas, we can find several ways to highlight the energy efficiency of buildings, and strengthen the economic or PR incentive value.

13.1 Energy labeling

EU Directive 2002/91/EC requires member states to provide minimum energy performance standards for all new buildings and buildings subject to major renovation. In addition, it requires all public buildings to prominently display their energy performance ranking. Buildings that are sold or rented out must have energy performance certificates available. The directive was so successful that it is being 'recast' to expand its scope and harmonise standards between member states.

Recommendation: FoE (HK) believes the mandatory listing of building energy consumption (containing a detailed breakdown display) on sales brochures or energy performance certificates will motivate developers to design buildings with much higher energy efficiency.

13.2 Green leasing

Green Leasing, in which tenants and landlords cooperate to maintain pre-agreed standards of energy efficiency, could be influential in the HK tenancy market for green offices in the near future. In the US, 78% of property managers believe sustainable buildings can command 10% higher rents. This may attract customers such as large corporations with a green mind-set, who are opting for platinum-rated offices. However, some of Hong Kong's Grade 'A' offices still have a long way to go to keep up with the global standard.

Recommendation: FoE (HK) urges the establishment of a government-led green leasing programme, and promotion of green leasing in the developer and real estate community.

13.3 Fiscal incentives

In Singapore, energy efficient equipment and technology are subject to a one-year accelerated depreciation allowance (instead of 3 years) in the Income Tax Act[13]. In Hong Kong, the annual reports of public companies show that the cost of plant and machinery is usually written off over a period of ten years on a straight-line basis, while depreciation for buildings is calculated on the basis of an expected life of fifty years.

In the US, under the Energy Policy Act of 2005, the taxpayers who can demonstrate savings from energy-efficient properties qualify for federal tax deductions (Deru, 2007).

Government has named environmental protection as one of six industries "crucial to the development of our economy" (Tung, 2009). Fiscal incentives would have a co-benefit of encouraging growth in this crucial industry.

Recommendation: FoE (HK) urges the introduction of economic incentives, such as a tax exemption scheme, to stimulate demand for energy efficient buildings.

Conclusion: The over-consumption of electricity is exacerbating the air quality situation in Hong Kong, as well as contributing to global warming. By means of energy conservation, e.g. building EE buildings, using EE equipment, and managing energy usage, we can lessen the prevailing trend of energy wastage. Various proactive policies and aggressive initiatives are crucial to promoting GB and EE technology, while lax measures such as the MBEC (as currently proposed) and voluntary benchmarking schemes will have little effect. It takes only a few years to complete a building, but its long term effect on the environment is immense. Careful design and planning in the early stages is vital to lower its climate change impact.

[13] Singapore, http://www.nccc.gov.sg/incentive/home.shtm

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Appendix:

What can environmentally conscious tenants do?

User's habit: Energy demand can be reduced by 15% without major investment, simply through energy management techniques like:

- Monitoring consumption, improving control, and early recognition and elimination of weak points.
- trying to move the personal comfort zone to slightly higher temperatures, such as >25°C
- Making good use of remote sensing aids, i.e. devices to control lighting and air conditioning depending on occupancy, to conserve energy
- Eliminating unnecessary consumption of standby power
- Purchasing energy efficient appliances, bearing in mind the higher initial cost will be paid back within a short period of time
- Participating in green leasing, i.e. refusing to rent or buy property with low energy efficiency

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