ENVIRONMENTAL SUSTAINABILITY ISSUES IN SINGAPORE

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ABSTRACT

With economic and population growth, it is necessary that sustained increases in developments are also sustainable in environmental terms. This paper covers Singapore's role in environmental management through promoting energy efficiency and encouraging various research and development activities. The energy efficiency programme and study of the Urban Heat Island in Singapore are discussed.

Some significant developments in Singapore will also be covered. These include Pulau Semakau, Singapore's first offshore landfill, Deep Tunnel Sewerage System and NEWater, Singapore's "recycled wastewater".

Another focus of the paper is to outline the development and regulating the built environment in Singapore. This can be seen in the building management system currently in use to ensure well-maintenance of existing buildings and common property.

Finally the paper also covers various systems that have been established to improve quality and productivity in the building industry. These include the Construction Quality Assessment System (CONQUAS), bonus scheme, BCA Quality Mark and legislation on buildable design.

1.0 INTRODUCTION

In the development of the construction industry, Singapore is committed to take pro-active measures to ensure that the sustainability of environment is not compromised. i.e.

> *"Singapore recognises the need to ensure that environmental sustainability is not compromised."*

2.0 SYSTEM FOR ENVIRONMENTAL SUSTAINABILITY

To ensure that increasing development intensity in Singapore will not amplify the harmful impact on the environment, series of programmes are being introduced in Singapore.

2.1 Environmental Protection

2.1.1 Energy Efficiency Programme

Buildings in Singapore consume more than half the electricity generated. In the quest towards an energy efficient Singapore, energy efficient building is one way to achieve the objective. Energy efficiency is also one of the quickest and most cost effective ways to reduce energy associated with global warming, climate change, acid rain and smog. Improving energy efficiency is the key strategy in making the world's energy system more economically and environmentally sustainable.

The National Energy Efficiency Committee formulated a building energy efficiency master plan to enhance existing energy efficiency standards for building design and develop an energy efficiency management programme for the life span of the building to promote the efficient use of energy and resources in buildings. Since 1979 building regulations have been introduced to curtail energy wasteful building design with regular updating of codes and regulations to keep them in tune with the latest technical knowledge and developments.

To create the necessary public awareness, the public sector was used as a role model as well as a showpiece of energy efficiency measures that are viable. Energy audits of buildings are carried out to establish energy efficiency indices (EEI) for performance benchmarking. Banding of public sector buildings based on energy performance are also carried out to provide a rough indication of how they fare in comparison with other buildings of the same type. To promote energy efficiency, a new award, called the Energy Efficient Building Award (EEBA), has been launched.

2.1.2 Study of the Urban Heat Island in Singapore

In view of the increasing development intensity in Singapore and reduction of ground greenery, BCA participates actively in studies to investigate the severity and impact of Urban Heat Island in Singapore and to explore the potential measures that could be implemented to minimise the impact. Two major considerations included were the utilization of plants for roof and sky-rise gardens and light colours for roofs of buildings.

The study on rooftop gardens has found that the green roofs reduce temperature, improve air quality, improve rainwater retention, reduce carbon dioxide and increase oxygen exchange and improve the water quality as they act as a natural filtration mechanism. A handbook “Skyrise Greening in Singapore” was launched in September 2002. This publication gives an insight into skyrise greenery. It outlines the benefits and issues to consider in developing skyrise greenery and aims to be a handy guide and a source of information for parties interested in implementing skyrise greenery.

2.1.3 District Cooling System

A district cooling system supplies chilled water through a network of pipes for the air-conditioning for a group of buildings located within the service area. The conventional

method is to have individual buildings put up their own stand-alone air-conditioning plants. A centralized district cooling system has two major benefits. First, it takes up less land space, an important consideration in land-scarce Singapore. Second, it significantly reduces water and energy consumption through economies of scale. There is also an aesthetic advantage, as the roof-tops of individual buildings can now be better designed, besides being put to better use.

A pilot District Cooling System is slated to be tried out in a section of a new downtown area in Marina South. A giant water cooler will be constructed in the Marina South area. Given the high capital and operating cost, the district cooling system will be viable only if all buildings in the service area subscribe to it. To reap the full benefits of economy of scale of such a system, it is necessary to require all building owners in this zone to subscribe to it. The Singapore government has made the use of this service mandatory by specifying this in the government land sale condition for the designated land parcels in Marina South. The projected saving in gross floor area in the pilot area is about 7000 sq m. The local District Cooling System industry is being regulated by the Energy Market Authority of Singapore (EMA).

2.1.4 BCA ISO 14000 Certification Scheme

BCA ISO 14000 (Environmental Management System) Certification Scheme is administered by the Building and Construction Authority (BCA) for the construction industry to certify construction and construction-related firms to ISO 14000 standards. ISO 14001 contains specified requirements which consists of 5 basic sections:

- Environmental Policy
- Planning
- Implementation and Operation
- Checking and Corrective Action
- Management Review.

The ISO 14000 Environmental Management System is a management system that enables firms to control the impact of their activities, products and services on the environment. The standards provide a framework for firms to establish a strategic approach to their environmental policy, plans and actions. It offers firms a tool to ensure regulatory compliance, maximise efficiency and minimise wastage. It also provides a mechanism for a firm to demonstrate its commitment to environmental control.

The BCA ISO 14000 (EMS) Certification Scheme will certify firms which implement the management system at various levels of environmental maturity. Firms which demonstrate compliance with applicable environmental legislation and regulation with a commitment to continuous improvement will be awarded the certificate.

2.2 Waste Management

2.2.1 Solid Waste - Pulau Semakau

In Singapore, about 90% of the waste are incinerated and the remaining non-incinerable waste is landfilled. During the incineration process, energy is harvested and converted into useful electricity, while ferrous metals are recovered and sold as metal scrap for recycling. Although incineration can reduce the volume of incineration waste, we still need to landfill the non-incinerable waste and incineration ash which is the residue of the incineration process. Our former landfill sites had reached their design capacities. To meet the increasing amount of waste generated, and due to land constraints in Singapore, an offshore landfill was built on reclaimed land.

Pulau Semakau, the first offshore landfill, is currently the only landfill in Singapore. This dumping ground was formed from the amalgamation of Pulau Semakau and Sakeng Island through land reclamation means. It covers an area of 350 hectares and has a capacity of 63 million cubic metres. Operation commenced on 1 April 1999. Everyday, non-incinerable waste and incineration ashes are barged to Pulau

Semakau via the Tuas Marine Transfer Station. The lifespan of Pulau Semakau is expected to last 30 years till 2030.

2.2.2 Wastewater - Deep Tunnel Sewerage System

The Deep Tunnel Sewerage System is a mega infrastructure project aimed to meet Singapore's needs through the 21st century. Two cross-island tunnels and network of link sewers will intercept sewage flows from the existing sewerage reticulation system. These flows will be channeled by gravity via deep tunnels to 2 centralised wastewater treatment plants strategically located at the southern coastal areas, with the treated effluent discharged through deep sea outfalls.

This new wastewater conveyance, treatment and disposal system will eventually replace the existing system consisting of 6 sewage treatment works (STWs), one sludge treatment works and 139 pumping stations located at various parts of Singapore. Some 1000 ha of land at and around these existing facilities will be freed for residential and other developments.

In addition, the phasing out of existing sewage pumping stations and pumping mains all over the Island will enhance the operational reliability of the sewerage system and minimise the risk of sewage overflows. With the water reclamation facilities reduced to two, there will be savings in manpower for operation and maintenance.

The entire DTSS project will be developed in 2 phases over the next 20 years. Currently, Phase I is being implemented. This Phase consists of the construction of the North Tunnel System of deep sewers, the associated link sewers, the Changi Wastewater Treatment Plant and deep sea outfalls.

2.3 Recycling

2.3.1 NEWater

NEWater is the high grade "reclaimed water" produced after treated used water has been further purified using a 3-step process involving advanced membrane technologies like Microfiltration, Reverse Osmosis, and the final disinfection of the product water using ultraviolet light.

The Public Utilities Board (PUB) has embarked on new initiatives to supply NEWater to wafer fabrication plants and other industries for non-potable use. Switching to NEWater will help save large amount of potable water and release it for other domestic purposes. Besides being used in wafer fabrication processes, NEWater can also be used in manufacturing processes and other non-potable applications in other industries such as for air-con cooling towers in commercial buildings, which currently accounts on average for almost up to 30% of water consumption.

Newater has a quality better than the current United States Environmental Protection Agency (USEPA) Drinking Water Standards and World Health Organisation (WHO) Drinking Water Guidelines. NEWater could also be used for indirect potable use by blending with reservoir water.

2.3.2 Research Developments

The growing scarcity of landfills, the higher cost of developing new landfills and the detrimental effects of waste disposal are making it necessary for waste minimising through recycling and reuse. BCA has been keen to facilitate such environmental measures. Some of the various environmental research and development activities under BCA's assistance schemes are as follows:

a. Copper slag

In April 2001, BCA gave the approval for the use of recycled copper slag to replace up to 10% of sand by mass in ready-mixed concrete for structural usage. Research

studies have revealed that concrete containing recycled copper slag is comparable in performance to normal concrete. The copper slag is also found to be a chemically inert and non-toxic product that has no influence to the steel reinforcement in the concrete. However, the supplier is required to conduct regular quality control checks to ensure that the material is free from impurities such as chlorides and sulphates.

b. Waste Concrete Recycling Plant

There are about 1000 cement trucks in Singapore, spread over some 14 ready-mixed concrete companies. Waste concrete from these trucks amount to several hundred thousand tons per year. The disposal cost of these waste amounts to several million dollars per year for the RMC industry

Tri-Mix has introduced concrete recycling at its Tuas site. The recycling equipment cost about $250,000 to set up. It sifts through leftover concrete brought back by concrete trucks and separates the components of stone and sand, as well as filters the water used for the process. The water can be reused in subsequent procedures or to wash trucks, while sand and stone can be recycled to produce fresh concrete.

c. Recycled Wood Flooring

LHT Holdings Ltd has developed an innovative and environmentally-friendly wood product called LHT Technical Wood. This LHT Technical Wood is made from recycled wood waste and can be used for a number of applications in the building industry, such as flooring, doors, door frame, furniture.

3.0 BUILDING MANAGEMENT

BCA ensures that existing buildings and common property are well maintained and kept in a state of good and serviceable repair.

3.1 The Land Title (Strata) Act and the Building and Common Property

With the Land Title (Strata) Act and the Building and Common Property (Maintenance and Management) Act in place, BCA ensures that requires management corporations with the assistance of the managing agents to keep their buildings and common property such as lifts properly maintained and managed.

3.2 Periodical Inspections and Building Maintenance

The completion of a building does not mark the end of the road to building safety. Existing buildings must be well managed and maintained to ensure that they remain structurally sound. Other than the structure, building maintenance also provides a pleasant living environment for all Singaporeans.

BCA administers building law that requires existing buildings to be inspected every 5 or 10 years by structural engineers. These mandatory periodical inspections are part of the systems of checks that ensures that our buildings remain structurally safe. We send out notices to building owners requiring them to engage structural engineers to conduct the mandatory inspections, and we monitor the results of such inspections.

3.3 Advertisements and Signboards

BCA regulates the display of signboards and advertisements to ensure that they do not spoil the streetscape and the surrounding ambience. For example, commercial advertisement banners along roads, except for national events, are prohibited. We carried out the necessary regular inspections to ensure compliance with this regulation. For proper control of illegal display of signs and banners, we also conduct spot-checks throughout Singapore and take enforcement action on any contravention of the regulations.

BCA recognises the advertising needs in doing business. Creative advertisement signs often also promote vibrancy in environment, particularly in the city and town centres. To encourage

more creative and innovative signages, we will allow more advertisements using flickering, flashing or running lights. Vibrant advertisements, such as these in Hong Kong, will soon be found in Singapore as well.

4.0 TECHNOLOGY DEVELOPMENT

To deliver high quality buildings and infrastructure, various systems are established to improve quality and productivity.

4.1 Construction Quality Assessment System (CONQUAS)

The Construction Quality Assessment System (CONQUAS) is a scoring system introduced to access the workmanship standard of contractors. Since its launch in 1989, more than 1,700 public and private building projects with total contract value exceeding S$ 59 billion have been assessed by the BCA. The industry average CONQUAS score improved steadily from 67.9 in FY 1989 to 76.5 in FY 2001. CONQUAS is also a registered trademark in Singapore, United Kingdom, Australia and Hong Kong.

The CONQUAS assessment or scoring system consists of 3 main components:

a. Structural Works
b. Architectural Works
c. M&E Works

Each component is further divided into different items for assessment. The sum of the 3 components will give the CONQUAS score for the project.

The assessment of the building is based primarily on workmanship standards through site inspection. The assessment is done throughout the construction process for Structural and M&E Works and on the completed building for Architectural Works. The assessment also includes tests on the materials and the functional performance of selected services and

installation. These tests helps to safeguard the interest of building occupants in relation to safety, comfort and aesthetic defects, which surface only after sometime.

4.2 Bonus Scheme for Construction Quality (BSCQ)

The Bonus Scheme for Construction Quality (BSCQ) was set up to promote the upgrading of workmanship in the construction industry. Contractors will be paid a bonus by the government if their quality of workmanship exceed a stipulated standard for the relevant building category. However, if their workmanship is poor, they will be penalised. The CONQUAS score will be used as a measure of the building quality. This bonus scheme was implemented in 1998.

4.3 BCA Quality Mark

The BCA Quality Mark for Good Workmanship was launched on 1 July 2002 to help developers meet the rising expectation of Singaporeans for better quality homes. The Scheme is to encourage developers to consistently deliver quality homes.

Under the Scheme, BCA will assess every unit of newly completed residential projects. The Quality Mark for Good Workmanship will be issued to individual apartment unit that achieves the stipulated quality workmanship standard (a minimum CONQUAS score for internal finishes) set by BCA. The Quality Mark certifies the condition of the apartment unit at the time of inspection. Any unit that fails to achieve the standard will not be issued the Quality Mark. Home buyers will be issued the Quality Mark through the developer, but they will not have the specific unit CONQUAS scores.

4.4 Legislation on Buildable Design

BCA also aims to raise the construction industry productivity by promoting advanced construction technology and practices such as buildable design. The Buildable Design Appraisal System (BDAS) was introduced in 1991 to help architects and engineers assess the buildability score. To give the industry a much-needed further push, buildable design has

been legislated since 1 January 2001 as a requirement for building plan approval. A minimum buildable score has to be achieved before building plan approval could be given. This will encourage designers and contractors to switch to more productive construction methods and technologies, such as modular and prefabricated building products.

BCA has been actively involved in promoting higher buildability to the construction industry. Efforts include launching of publications/handbooks on buildable designs, holding seminars and talks and providing training for the industry. As an incentive, BCA even holds an annual competition " Best Buildable Design Award"

Buildable design such as precast concrete building technology had been used in Singapore for quite a while but the perception that precast concrete lacks architectural variety and offers limited flexibility has discouraged its use in private residential projects. As part of the continuing effort to promote the use of precast components, BCA launched a fourth publication "Architecture in Precast Concrete" in 1999 which aims to promote the integration of modular co-ordination and standardisation into design and encourage architects to use precast concrete components at the early planning stage. This would lead to more efficient construction methods, thus resulting in productivity, quality, buildablility and most of all less wastage.

5.0 CONCLUSION

Singapore has gone through a fast pace of industrialisation and urbanisation. Along the way, we managed to ensure that our environment is not compromised, and that Singapore remains a liveable place.