



## SINGAPORE

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<i>Size of the country</i>	600 km <sup>2</sup>
<i>Climate</i>	Equatorial
<i>Population</i>	4 M
<i>Population density</i>	6 616,5 inhab/km <sup>2</sup>
<i>Population growth rate (1993 – 1999)</i>	1,9%
<i>Part of urban population</i>	95%
<i>Life expectancy at birth</i>	78
<i>Infant mortality (per 1000 live birth)</i>	4
<i>Access to improved water sources (% of population)</i>	100
<i>Ethnic groups, their percentages in the population</i>	Chinese: 55%, Malaysian: 15%, Indian: 7%.
<i>Official languages</i>	Mandarin, English, Malais, Tamoul
<i>Religions</i>	Buddhism/Taoism: 54%, Islam: 15%, Christian: 13%, Hinduism: 4%
<i>Gross domestic product</i>	95,4 billion USD
<i>Gdp per capita</i>	29 610 USD
<i>Inflation</i>	1,7 % year
<i>Gdp growth rate</i>	6 % in 1999
<i>Gdp repartition in different sectors (1999)</i>	Agriculture: 0,2%, Industry: 35,8% (manufacturing: 25,9%), Services: 64,1%.
<i>Unemployment rate</i>	3.3 %
<i>Illiteracy (% of population age 15+)</i>	8
<i>Tourism</i>	6, 958 M in 1999

# SINGAPORE – LONG TERM ENVIRONMENTAL POLICIES

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## Introduction

Human activities damage the environment. They generate pollution, deplete resources, cause loss of forests and biodiversity and threaten the water supply. Increasing populations and increased human activities on limited resources now precipitate environmental problems at global levels.

All countries need a sound and effective environmental management system to manage these myriad activities, to ensure that damage to the environment is controlled and, where possible, minimized. The problems are even more acute in cities, where human activities are concentrated, with large populations occupying limited land space and using limited resources. It is therefore essential that cities adopt long-term policies to address their environmental concerns.

As a city-state, Singapore has managed to create a clean living environment with a high standard of public health. Singapore's air and water quality meets WHO (World Health Organization) and US-EPA (Environment Protection Agency) standards, and its water-courses support aquatic life. What is more remarkable is that this was achieved in the

space of some forty years, in the course of transforming herself from a Crown Colony that relied on its entrepot trade for survival, to a newly independent state that embarked on a course of rapid industrialization<sup>1</sup>. This was possible because one of Singapore's goals is to have a healthy economy with a clean living environment.

This paper examines Singapore's policies to manage its largely urban environment, with particular focus on the issues that relate to pollution control. Urban environmental management in Singapore starts with careful land use planning, which separates residential, recreational and commercial areas from highly pollutive industrial areas. Environmental management also requires an effective administrative and legal framework, and considerable investments in infrastructure development to deal with the supply of energy and water, the treatment of effluent from industries and the disposal of wastes. This framework must include the provision of efficient transportation systems for the movement of people and goods. It should also be emphasized at the outset that many of the problems that beset cities relate to

the provision of accommodation for an increasing population in an urban setting with limited resources particularly in terms of land space. Although it is outside the scope of this paper, the provision of an effective public housing system is critical in managing an urban population. This has been solved in Singapore, where its public housing system administered by the Housing Development Board (HDB) houses 86% of the population in high-rise

apartments. These apartments are purchased by citizens and permanent residents, who own a leasehold interest in the apartments for 99 years. Home ownership is made affordable by government subsidies and by a system of compulsory monthly contributions by employers and employees (the Central Provident Fund), which can be applied towards payment of the monthly mortgage installments, thus assisting workers in the purchase of their homes<sup>2</sup>.

## Strategies in Environmental Management

The Singapore Ministry of Environment (ENV) is charged with pollution control and public health. In the case of pollution control, it utilizes three key strategies in managing the environment, viz. prevention, enforcement and monitoring. Prevention is achieved through careful land use planning and the provision of the environmental infrastructure, coupled with the passing of anti-pollution laws. At the same time, a system of controls has been developed to ensure that the pollution control requirements are enforced. The quality of the environment is monitored regularly to ensure that these measures are adequate<sup>3</sup>. It can also be said that Singapore is a firm believer in the "Polluter Pays" principle, and this is implemented in many policies, from its very innovative measures to discourage car ownership by making the costs extremely prohibitive, to charging industries whose effluent exceed the permitted limits according to a tariff scheme.

### Land-Use Planning and Development Control

Environmental controls in Singapore start first with land use planning. Due to the scarcity of land (660 sq. km of land, 4 million people), Singapore's population density is especially

high: 5,900 people per sq. km. It is thus critical that the use of each square inch/centimeter of land be closely regulated.

The allocation of land for various uses is carefully controlled through the Master Plan, the Concept Plan and the Development Guide Plans. The Master Plan is a legacy from the British, using traditional planning concepts. First drawn up in 1958 as a statutory document, the Master Plan was revised in 1965, 1970, 1975, 1980, 1985 and 1998. As a more flexible plan was needed to deal with the country's rapid development and expansion, the Concept Plan was devised in 1971 as a strategic long-range land use and transportation plan to guide Singapore's development. It took into account critical issues such as population growth, industrial development and the limited supply of land, striving to safeguard and provide land for development needs while preserving the quality of living and working conditions<sup>4</sup>. The fine details were worked out in Development Guide Plans (DGPs) that were drawn up for 55 areas, and indicate land use (via zoning) for every plot of land.

The Concept Plan shaped Singapore's New Towns, the new airport, expressways, main roads and the Mass Rapid Transit (MRT) System.

It is reviewed every ten years and was last revised in 1991 when it had three distinct stages: up to the year 2000, to the Year 2010, and to Year X. It was anticipated that Year X would be when the population would reach 4 million. However, this figure was reached in September 2000, taking into account the foreign population living in Singapore.

A new Concept Plan for Year 2001 is now being worked out. Prominent members of the community have been consulted for their views, in two "focus groups." The first group will examine issues of land allocation while the second group will focus on conservation of heritage sites – the need for identity versus intensive land use. Both groups are working on a projection of a future population of 5.5 millions in Year X<sup>5</sup>.

While land use and development control are all handled by a single government agency, the Urban Redevelopment Authority (URA), there is considerable coordination with other government agencies through committees such as the Master Plan Committee. This Committee which is chaired by the Chief Planner, include representatives from the Ministry of the Environment, National Parks Board, Land Transport Authority and the Ministry of Defense.

### *Zoning and the Judicious Siting of Industries*

All land in Singapore is zoned for a particular land-use. Environmental impacts due to particular developments can be mitigated by firstly, ensuring that such developments are sited in designated areas which are away from residential, commercial or recreational areas, and secondly by ensuring that pollution control measures are incorporated in the design of the development. The grouping of highly pollutive industries also facilitate the provision of appropriate infrastructure to control pollution, manage hazardous substances and dispose of toxic wastes. Control at the planning stage is thus important in the prevention of pollution.

The impact of all developments on the environment is assessed and considered before each development is allowed to proceed. The Planning authorities consult the Ministry of the Environment's (ENV) Pollution Control Department (PCD) on proposed new developments. PCD assesses the impact on the environment and ensures that new industrial and residential developments are properly sited and compatible with the surrounding land-use.

### *Classification of Industries According to Pollutive Capacity*

Pollutive industries and activities are sited away from residential and commercial areas. To guide planners and to help industrialists select suitable sites to locate their factories, or to find suitable industrial premises, industries are further classified into four categories according to their pollutive capacity, judged by the impact of residual emissions of fumes, dust and noise on the surrounding land use. Buffer zones are required to separate them from other areas, so as to minimize their impact on the neighbors.

#### *These categories are as follows:*

- Clean Industries: These are industries that do not generate any air or water pollution, or noise or smell. No buffer zone is required. These industries include software design and development, assembly and repair of computer hardware, audio-visual, and other equipment, repair of electrical appliances and house ware (not involving spray-painting, electroplating or galvanizing operations,).
- Light Industries: These industries generate some pollution and noise. They include biotechnology, manufacture of wearing apparel (not involving dyeing or bleaching operations), printing, publishing, and manufacture of paper products without pulping works or bleaching operations. It also includes the packing of food ingredients,

bottling of syrups and juices and the packing of bottling of medicinal herbs and medicated oil. A buffer distance of at least 50m is required between a light industrial building and the nearest residential building. These factories are prohibited from using liquid or solid fuel burning equipment, and from using large quantities of hazardous substances such as solvents, acids and other chemicals.

- **General Industries:** These industries are pollutive. They are required to install, operate and maintain pollution control equipment to minimize air, water and noise pollution. A buffer distance of at least 100m is required between a general industry building and the nearest residential building. These industries include food processing factories, factories for the blending of detergents and cleaning preparations, hair care products, cosmetics and other toilet preparations; vehicle repair and servicing; cutting, grinding and polishing of marble and ceramic tiles and the manufacture of dry cells and batteries (activities must not include the manufacture of metal electrodes).
- **Special Industries:** These activities are highly pollutive and require a buffer distance of at least 500m to the nearest residential building. Those industries that can potentially cause serious pollution such as oil refineries, petrochemical and chemical plants, facilities for the treatment of toxic industrial waste, etc., must be sited at least 1 km from the nearest residential building. Thus, large chemical and petrochemical plants are sited on offshore islands, to minimize risks. These industries are required to install, operate and maintain pollution control equipment as required by the PCD.

Food industries are also classified into light, general or special categories, depending on their scale of operation. To prevent cross-contamination from residual emissions emit-

ting from neighboring premises, food industries are sited in industrial premises in areas designated as food zones or in areas with compatible industrial uses. Only clean and light industries are allowed near residential areas and within water catchment areas. There are also special requirements for industries that use or store large quantities of hazardous chemicals – they may be required to conduct a Quantitative Risk Assessment (QRA) Study, and/or a Pollution Impact (PI) Study. There are also controls on warehouses that store hazardous or pollutive substances.

### *Building Controls and Inspections*

When a new industrial development is proposed, the planning and development authorities consult the Pollution Control Department (PCD) of the Ministry of the Environment (ENV) on its siting requirements as well as its compatibility with the land use in the surrounding areas. At this early stage, PCD also checks to ensure that the level of environmental management and control of the proposed development is acceptable.

The Building Control Act requires that all developers must submit their Building Plans for the building works to the Building Plan and Management Division of the Building and Construction Authority (BCA) for approval. The BCA will not approve unless these plans are first submitted to and approved by other authorities such as the Fire Safety Bureau, National Parks Board, and the PCD of ENV. PCD processes the building plans to ascertain their environmental impact. A proposed industry is only allowed to set up and operate in Singapore if it is able to comply with emission standards, manage its wastes and can be sited in a suitable industrial estate. All plans must first be vetted by ENV officers, to ensure compliance with pollution laws and requirements. PCD will approve Building Plans subject to compliance with their requirements on sewerage, drainage, environmental health and pollution control.

Upon completion of construction, ENV officers

inspect the premises to ensure that it incorporates the requisite pollution controls. Factories are not allowed to operate until they have received clearance from the ENV. Thereafter, they are inspected by ENV officers, the frequency of such inspections increasing with the degree of pollutive capacity.

The move is towards self-monitoring. A Source Emission Test Scheme was implemented after January 1997, whereby industries are required to conduct their own emissions tests or engage accredited consultants to do so. This enables industries to monitor their air emissions regularly and to take measures to ensure they comply with the regulations.

## Air Pollution

The main sources of air pollution in Singapore are stationary sources (such as from power stations, oil refineries, industries), mobile sources (motor vehicles), and other sources (such as open burning of waste materials and cross-boundary pollution, particularly from the burning of forests in Indonesia).

### *Air Emission Standards*

Air emission standards for factories were imposed in 1972 with the passing of the Clean Air Act and the Clean Air (Standards) Regulations. Industries are classified in categories according to pollutive capacity. Industries with a high capacity to pollute and classified as Scheduled Premises are not allowed to operate without prior permission from the Director of Pollution Control. They are also sited away from residential areas.

### *Cleaner Fuels*

The sulfur content in fuels used by industry is regulated (not more than 2% by weight) so as to minimize the content of sulfur in the air. Industries and hotels with fuel burning equipment sited near urban areas are required to use fuel with even lower sulfur content (0.05% or less), or town gas.

### *Open Burning*

Open burning to dispose of wastes has been prohibited since 1973 under the Clean Air (Prohibition of Open Fires) Order<sup>7</sup>.

### *Vehicular Pollution and Singapore's Transportation Policy*

Lead in petrol has been progressively reduced from 0-84g/l to 0-15 g/l since 1st June 1987. Unleaded petrol was introduced in January 1991, and phased out by 1st July 1998. Exhaust emission standards are prescribed for both petrol and diesel vehicles. Drivers of smoky vehicles are prosecuted for breaking the law<sup>8</sup>. To ensure that cars on the road are kept road-worthy, a system of periodic mandatory inspections is established where cars are tested for emissions. As old and inefficient diesel-driven vehicles generate large amounts of pollutants, a new tax incentive scheme was introduced in February 1999, allowing companies to claim a one-year tax write-off for their new buses or goods vehicles if these are purchased to replace old diesel-driven vehicles.

Singapore's land transport policy has contributed to a reduction in vehicular emissions and a better quality of life for the people. Three basic tenets guide this policy:

- Minimizing the need to travel through integrated land use and transportation planning;
- Promoting a viable and efficient public transport system that integrates the Mass Rapid Transit (MRT), Light Rail Transit (LRT) and bus services;
- Managing the growth and use of public vehicles.

Singapore is unique in having taken very innovative steps to curb its car population, by a series of measures aimed at making car ownership highly prohibitive in terms of onerous costs both in its ownership and in its usage. Cars are subject to very steep import duties, registration fees and a vehicle quota system that requires all car owners to bid for a "certificate of entitlement" (COE) which only lasts 10 years. Entry into the Central Business District

(CBD) and into selected expressways is prohibited except on payment of a fee<sup>9</sup>. These restrictions reduce the number of cars on the road, which in turn, reduces pollution and facilitates smoother traffic flow.

At the same time, an efficient system of public transportation is provided, via the mass rapid transit trains, light railway transit system, and buses and taxis. All these measures have improved the air quality, as there is less congestion on the roads. At the same time, they have contributed to greater economic efficiency as fewer man-hours are expended in travel time. It has also enhanced the quality of life, as the time saved can be devoted to more pleasant activities. Schemes for the sharing of cars is encouraged<sup>10</sup>.

### *Monitoring*

The monitoring of air quality is essential for the effective implementation of a city's environmental management policies. In Singapore, ambient air quality is routinely monitored through the Telemetric Air Quality Monitoring and Management System (TAQMMS) that comprises 19 remote monitoring stations linked to a Central Control System via dialup telephone lines. Sixteen stations monitor ambient air quality while three stations measure roadside air quality.

Industries are encouraged to self-monitor for air emissions and trade effluent<sup>11</sup>. In January 1997, a scheme was introduced which requires industries to conduct source emissions tests. This scheme seeks to ensure that industries monitor their air emissions regularly and remedial action if required. At the same time, it raises awareness and helps to ensure compliance with the prescribed air emission standards. ENV conducts regular inspections of stationary sources to ensure that pollution control equipment are properly maintained and operated. They also conduct source tests on gaseous emissions, fuel analyses and smoke observations of chimneys<sup>12</sup>.

### *Tax Incentives*

To encourage companies to use less pollutive

equipment, Singapore provides tax incentives, in the form of 100 per cent tax write-offs, for companies that convert to less pollutive equipment, such as new equipment that reduce air emissions, or reduce noise levels. Such equipment must first be inspected and duly certified as meeting the criteria laid down under the laws, before they qualify for these incentives.

## **Water Pollution**

As a city-state, the main sources of water pollution are domestic wastewater, both sewage and sullage, and industrial effluent. There are also some commercial farms that generate pollutive wastes (chicken farms, dairy farms). Again, the Minister of Environment applies the three principles of Prevention, Enforcement and Monitoring while at the same time building and constantly improving on the environmental infrastructure. Streams in Singapore are categorized into controlled and uncontrolled watercourses. The formers are sources for potable water, and their catchment areas are protected.

Water pollution is controlled first, by the provision of sewerage infrastructure to collect and treat all wastewater and a good waste management system to control pollution at source. Second, industries are required to pre-treat their effluent to the standards stipulated, before discharge into the sewerage system<sup>13</sup>. Third, industries that store or use large quantities of chemicals cannot be sited within water catchment areas.

### *License to Discharge*

Industries must first apply for a license to discharge, giving details of the type of trade or business, the processes used, the materials/chemicals used, layout of the plant and machinery, the estimated amount of water consumed, the physical, organic and chemical nature of the effluent and the direction of its flow.

### *The Discharge of Trade Effluent*

Singapore has a public sewerage system that serves all industrial estates and residential pre-

mises.

All wastewater must be discharged into the public sewerage system. Industrial wastewater must first be treated to specified standards before discharge into a sewer or watercourse. Industries that generate large quantities of acidic affluent must install a pH monitoring and shut-off control system. Trade effluent that exceeds the required standards for biodegradable pollutants (as determined by their biochemical oxygen demand (BOD) and total suspended solids (TSS)) can apply for permission to discharge directly into the public sewers, on payment of a tariff (another example of the "polluter pays" principle). This tariff is levied to recover the costs incurred in treating the additional pollution load at the sewerage treatment works.

The system is continuously reviewed to ensure it keeps up with Singapore's needs. As sewerage treatment works take up valuable land, the long-term solution proposed is a deep tunnel sewerage system, which uses deep tunnels as gravity sewers to eliminate the need for pumping stations. This will reduce the need for sewerage treatment works and free up land for other uses. Phase I for this Deep Tunnel sewerage project commenced in March 99.

### *Farm Wastes*

The major farm waste is from poultry. To ensure that farm wastes do not pollute the land and waters, pollution from poultry farms is controlled by requiring that poultry be reared in covered sheds and the dung removed in solid form. These are then used as fertilizers. Pollution from agricultural and horticultural activities comes from the application of fertilizers and pesticides. Those that are highly toxic and persistent are not allowed to be imported into Singapore.

### **Waste Management**

The management of solid wastes is a major problem confronting all cities. In Singapore, due to the lack of space, almost all solid wastes

that cannot be re-used or recycled are incinerated, and the ashes deposited into a landfill site. Singapore has four incinerators. The latest at Tuas, was recently opened in November 2000. At a cost of S\$1 billion, it is one of the largest in the world. Waste heat generated from the process is used by the plant and the remainder sold to Singapore Power.

A new landfill site was developed in an offshore island, Pulau Semakau at a cost of some S\$610 million (US\$360m) and commenced operations on 1 April 1999. Wastes from the main island are collected by a very efficient municipal refuse collection system, and then transported via barges, to the island. This new facility only has a lifespan of 30 years. With severe limitations on land space, the key to managing solid wastes is to reduce wastes at source. A Waste Minimisation Unit was formed in the Ministry to look into measures to reduce waste generation and waste recycling.

While waste minimisation and recycling continue to be promoted, with ENV encouraging the private sector to set up recycling/processing facilities, there is little recycling of domestic wastes (apart from newspapers). There is no system for the return of bottles, although some machines encourage the return of aluminium cans. Presently, 40.3% of the wastes generated are recovered for recycling, mainly wastepaper and ferrous scraps. But improvements are on the way. It has been announced that with the move towards privatising the waste collection industry, all waste collectors that bid for future projects must undertake the recycling of wastes<sup>14</sup>.

### *Hazardous Substances*

The import, sale, use, storage and transportation of hazardous substances are controlled by ENV under the Environmental Pollution Control Act (EPCA) and the EPC (Hazardous Substances) Regulations. ENV issues licenses for the import and sale of hazardous substances. Permits are required for the use and storage of hazardous substances. Stringent

conditions are imposed for the storage and management of these substances. ENV conducts surprise inspections of premises that store hazardous substances, to audit their inventories and ensure they comply with the conditions.

A Safety Audit Scheme was introduced in October 1996, to encourage industries that handle and store large quantities of hazardous substances, to identify and rectify systematically and regularly any weakness in their management systems and practices in the handling of these substances. Detailed rules regulate the transportation of hazardous substances and ENV conducts road checks with the Land Transport Authority to ensure that tankers and lorries carrying hazardous substances comply with the requirements.

### *Toxic Wastes*

The control, treatment and disposal of toxic industrial wastes are regulated by ENV under the Environmental Public Health (Toxic Industrial Waste) Regulations. Only approved companies may handle these wastes under license from ENV. Such wastes include spent oil, waste solvents, spent etchants and chemical wastes. 70% percent of toxic industrial wastes is recovered or reclaimed for industrial use, while the remaining 30% are treated for disposal by landfill.

Singapore is party to the Basle Convention and passed the Hazardous Waste (Control of Import, Export and Transit) Act in 1997 to implement the Convention.

## **The Singapore Green Plan**

The first Singapore Green Plan was conceived in 1992, and presented at the UN Conference on Environment and Development at Rio, in 1992. It focused on six areas of concern: environmental education; environmental technology; resource conservation; clean technologies; nature conservation; nature conservation and environmental noise. Representatives from government bodies, industry, educational institutions, the private sector and non-government organizations were invited to serve on committees. The recommendations of the committees were implemented in the Singapore Green Plan Action Programmes, published the next year, in 1993.

The advent of the new millennium has prompted a review of the Singapore Green Plan. The Singapore Green Plan 2000 is expected to be revealed to the public later this year. This time, the focus falls on four areas, *viz.*:

- Environmental Education
- Resource Conservation and Waste Minimization
- Environmental and Clean Technology
- Nature Conservation

Committees focusing on these four areas have been formed, again comprising members drawn from various sectors. The four committees review the developments since the First Singapore Green Plan, address the changes that have since taken place, anticipate the future development of Singapore and try to recommend policies that can help ensure that such development is not prejudicial to the environment. More importantly, this new Green Plan will help to ensure that the quality of life in Singapore will continue to improve, along with an improved environment. It is expected that the Reports of these four new Committees will be released very soon.

## Future Concerns and Challenges

### The Need for Water

One of Singapore's major concerns is the supply of water. Singapore's reservoirs only supply about half of its needs. Ground water supply sources are prohibited for individual use and it is now an offence to dig for underground water, although this was not uncommon in the past. The remainder of Singapore's water supply is obtained from Malaysia, through its nearest state, Johore. All water is supplied through pipelines and treated before it reaches the consumers. Singapore has water treatment plants in Johore, which treat and resell the treated water to Johore. This arrangement has increasingly come under criticism from Malaysians, some of whom feel they are being exploited. Negotiations for extension of the water supply contracts are highly sensitive, particularly as some Malaysian states face water shortages.

While water re-use and water conservation measures continue to be promoted, Singapore has to explore the option of using desalinated water from the sea, to provide more options and to reduce its dependence on water being supplied from Malaysia. The first tender has already been called for a desalination plant. At the same time, the possibility of obtaining water from another neighbor, Indonesia, is being explored.

### Reduction of Greenhouse Gases

As a small low-lying island state, Singapore is concerned with climate change particularly as it may result in higher sea levels resulting in loss of land and coastal erosion, and flooding. As Singapore lacks natural resources, it is heavily dependent on fossil fuels for primary activities such as power generation and transportation. Due to its size, Singapore does not have the option of hydro or geothermal energy sources. The only viable alternative energy

source at present, is solar energy. Some private homes and a few commercial facilities use solar heating for the production of hot water, including the Flight Kitchen Building at Changi International Airport. To help mitigate the increase in greenhouse gas emissions, Singapore has undertaken some initiatives, such as the following<sup>15</sup>:

- Liberalization of the energy sector – started in 1997, this aims to promote competition so as to lead to a more efficient energy sector.
- Changing fuel mix – Singapore is trying to move away from heavy dependence on fossil fuels towards greater use of natural gas. It has entered into agreements with Indonesia for the supply of natural gas, to be stepped up over time.
- Supply-side management – Power Generation Efficiency: Singapore encourages power generation plants to use the latest technologies, such as the combined cycle gas turbine (CCGT) and some gas turbines have already been converted into CCGT plants.
- Demand-side management – companies are also encouraged through tax incentives, to adopt energy-efficient technologies and less pollutive equipment. A special scheme has been set up for small and medium size enterprises to provide partial financial grants for consultancy studies.
- Building sector – Since 1979, energy conservation standards for the design of buildings have been incorporated in the building code. The Building and Construction Authority (BCA) is in the course of reviewing and updating energy conservation standards for buildings to make future buildings more energy efficient, to take into account the latest technologies for building materials that reduce heat gain into a build-

ding, and technological advances in lighting equipment and accessories. The BCA is also embarking on a project to develop Energy Efficiency Indices (EEI) for commercial buildings.

- Public housing – the Housing and Development Board (HDB) which houses 86 per cent of Singapore’s population in high-rise apartments has adopted many energy efficient measures in its designs. These include maximizing natural ventilation to minimize the need for air-conditioning and providing sunshades for apartments to reduce direct sunlight into living areas. Energy-saving measures are also undertaken in its mechanical and engineering services, such as: a variable-voltage, variable-frequency lift drive system for lifts to save energy; automatic switch-off of ventilation and lighting in lifts that are not in use; use of low-loss ballasts and energy-saving fluorescent tubes for lighting in multi-story car parks; use of energy-saving lamps for public lighting in parks, playgrounds and landscaped areas; public lighting is switched on and off by use of photocells.

## Nature and Heritage Conservation

Another challenge for Singapore is whether it can continue to keep its promise under the Green Plan, of conserving at least five percent of its natural areas. Presently only three per cent are legally protected as nature reserves or national parks. The remaining two per cent have no legal protection. There are no laws mandating environmental impact assessments for development projects. Singapore also faces

a problem of rapid destruction of its old buildings, to make way for new developments.

In the recent Concept Plan Review, projecting a population of 5.5 million in Year X, it was revealed that some 16,000 hectares of land would be needed for future development, of which 8,000 hectares would be needed for housing, 6,000 hectares for industries and 2,000 hectares for parks. However, only 12,000 hectares of land will be available, leaving a shortfall of 4,000 hectares. Three scenarios were postured to resolve this dilemma:

- Building denser and taller buildings similar to those in Hong Kong
- Encouraging industries to go high-rise
- Providing fewer and smaller parks/developing some of the nature areas and parks into housing and industries

The two focus groups comprising informed laymen drawn from different parts of the community, have soundly rejected alternative three, preferring the option of building taller buildings with denser land use so as to conserve precious space. Their recommendations include preserving the off-shore islands in their natural state for as long as possible, capping the number of golf courses at the present 22, decentralizing by developing regional centers as alternative commercial hubs and preserving old neighborhoods that are rich in character and culture. The report also called for an independent conservation body to be set up as a Heritage Conservation Trust with the President as Patron, which should be involved in planning and the evaluation of all conservation proposals and lead compulsory environmental and social-impact studies near conservation sites<sup>16</sup>.

## Conclusion

In conclusion, it must be emphasized that Singapore's experience is unique because of its special circumstances. What is clear is that efforts to manage the environment in any country must stem from policies that can be determined only after a thorough examination of the problems from a wide variety of perspectives. While the sources of pollution in cities may be largely similar, stemming from industries, power plants, incinerators, motor vehicles and burning of wastes, the solutions may differ depending on the resources of the country, and the special circumstances. For example, Singapore has had to resort to incineration because land is too precious for landfills. What is clear is that the policies to address pollution must include land-use planning, effective governance and the building of the environmental infrastructure.

In the case of vehicular pollution, while there must be stringent laws on vehicular emission standards, long-term policies to address vehicular pollution must relate to the transportation system. Alternative means of transport must be provided, which must be efficient and less pollutive. City planners must re-think traditional planning concepts, where the population is required to commute to the city each morning to work, and back to the suburbs in the evenings. Such systems are no longer workable, particularly in the context of fast-developing cities. Cities must be built for greater efficiency. People must live near their place of work. This reduces the need to travel and saves

time, leading to less congestion on the roads, and increased productivity. Town planners must plan for new towns that are completely self sufficient, thus reducing the need to venture into the city. Alternative means of transport particularly via a mass rail system would be essential. There must also be efforts to improve the roads and rail linkages to ensure greater efficiency.

Political will and commitment are essential for these policies to succeed. There must be follow-through when governments change. Fundamental policies to manage the environment must be carried through, and constantly improved upon to meet changing needs and circumstances.

There should be also be public involvement in the process. Citizens should be encouraged to play their part in safeguarding the environment. Environmental education is a necessity, and the help and expertise of non-governmental organizations should be harnessed. NGOs should be seen as working in partnership with industry and government organizations.

Finally, countries that have successfully managed their environment should offer to share their expertise and help developing countries build capacity in environmental management. A clean environment benefits everyone. Environmental pollution is a matter of global concern. The environment must be viewed beyond national barriers and geographical boundaries.

## Notes:

1. Singapore obtained self-government in 1959, and became a sovereign, independent nation as of 9th August 1965, after a short-lived alliance with Malaysia in 1963-1965.
2. See Housing and Development Board Annual Reports, particularly the latest *Annual Report* (Singapore: Housing and Development Board, 1999-2000).
3. See Ministry of the Environment Annual Reports, particularly the latest *Annual Report* (Singapore: Ministry of the Environment, 1999). Also see *Singapore, My Clean & Green Home* (Singapore: Ministry of the Environment, 1997).
4. See *Living the Next Lap – Towards a Tropical City of Excellence* (Singapore: Urban Redevelopment Authority, 1991); Sumiko Tan, *home.work.play* (Singapore : Urban Redevelopment Authority, 1999).
5. See *Skyline, " Consulting the Community on Singapore's Future: Bringing Life Back to Heritage Buildings "* (Singapore: Urban Redevelopment Authority, September-October 2000).
6. Despite the repeal of the Clean Air Act in 1999 by the Environmental Pollution Control Act, the standards prescribed by the Clean Air (Standards) Regulations still apply, until these Regulations are repealed.
7. This is now contained in the Environmental Pollution Control (Prohibition on the Use of Open Fires) Regulations, 1999 (S 161/99).
8. The law governing emissions from motor vehicles is contained in the Environmental Pollution Control (Vehicular Emissions) Regulations, 1999 (S 291.99).
9. The fee is automatically deducted via an electronic system. Each vehicle is fitted with an electronic gadget called the IVU or " In Vehicle Unit. " A pre-paid cash card is slotted into the IVU. Each time the vehicle passes an electronically operated gantry point (these have been set up at the entrance of the CBD and at the entrance to selected expressways), a fee is automatically deducted. A vehicle that did not have a cash card slotted in, or had a card that did not contain a sufficient amount of money for the sum to be deducted, will trigger an electronic camera that will take a picture of the car's number plate. The owner of that vehicle will then receive a summons for entering a restricted area without making appropriate payment. In practice, the offence can be compounded by paying a fee comprising an administrative charge of \$10 and the actual amount for entry at that particular time. The use of electronics has enabled fine-tuning of the fees that can be levied, so that entry fees need not be standardized (as in the past) but can vary from time to time, depending on road conditions.
10. One innovative scheme was recently introduced by the National Trades Union Congress, entitled NTUC Income Car Co-operative Limited, a not-for-profit cooperative where members pay a joining fee and can apply to use a car at any time, upon payment of a fee. They can make bookings via phone or via the Internet, and collect their car at eight different sites spread throughout the land. See <http://www.carcoop.com.sg>
11. See S. 37, Environmental Pollution Control Act, 1999. This applies not just to air emissions but also to trade effluent and hazardous substances.
12. The power to conduct such inspections and prescribe controls is contained in the Environmental Pollution Control Act, Parts III and IV, sections 6-14.
13. The effluent standards are contained in the Environmental Pollution Control (Trade Effluent) Regulations, 1999 (S 155/99) and the Sewerage and Drainage (Trade Effluent) Regulations, 1999 (S 170/99). See also The Code of Practice on Pollution Control, Ministry of the Environment, Third Edition, Feb. 2000 (available on ENV's web site at <http://www.env.gov.sg>).
14. See Speech by Mr. Lim Swee Say, Acting Minister for the Environment, at the Opening of the Tuas South Incineration Plant on 25 November 2000 at <http://www.env.gov.sg/info/press/main.html>.
15. See Singapore's Initial National Communication under the UN Framework Convention on Climate Change, dated August 2000, published by Ministry of the Environment.
16. See " Concept Plan: First review unveiled, " " A Map of the Future ", *The Straits Times*, 24 November 2000.