## FORWARD

The National Environment Agency (NEA) was established on 1 July 2002.

The NEA took over the operational functions of environmental protection and public health from then Ministry of the Environment (ENV) so that ENV could focus on strategic and policy planning. For better synergy, the Meteorological Services Department, which used to be part of the Ministry of Transport was integrated into NEA.

As a statutory board, NEA has greater administrative autonomy and flexibility, making it more nimble and innovative in the discharge of its responsibilities. NEA is also better placed to promote ownership of the environment among the people, private and public (3P) sectors.

Within NEA, the Environmental Protection Division (EPD)'s role is to ensure that Singaporeans continue to enjoy a quality living environment for generations to come. It will continue to implement programmes to monitor, reduce and prevent environmental pollution. In addition, it will spearhead new initiatives to enhance sustainable development. Its key goals in resource conservation include waste minimisation, recycling and energy efficiency.

This is the sixth Annual Report of EPD of NEA and it outlines the programmes implemented and targets achieved in 2007.

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## HIGHLIGHTS OF 2007

The ambient air quality in Singapore remained good for the year and compares favourably with major cities of the world.

As our industry base expands and vehicle population increases, we have ensured that the sources of air pollution are kept in check and the quality of our ambient air remains good. Air quality is often cited as one of the key factors contributing to a world-class living environment, as evidenced by Singapore's consistent high ranking for overall quality of the environment among Asian countries for the past 7 years in the surveys conducted by the Political and Economic Risk Consultancy Survey.

The water quality of inland and coastal waters remained good and supported aquatic life. As part of our continuing effort to reduce the ambient PM2.5 level in our air, the EURO IV emission standard for diesel vehicles was implemented with effect from 1 October 2006.

During the year, NEA has also operationalised its new capability on terrain decontamination to handle chemical incidents. This capability enables NEA to restore the affected area for normal activities as soon as possible. During the year, NEA has also operationalised its new capability on terrain decontamination to handle chemical incidents. This capability enables NEA to restore the affected area for normal activities as soon as possible.

On 1 January 2007, NEA implemented the Chassis Dynamometer Smoke Test (CDST) as a standard requirement during mandatory periodic inspection for all diesel-driven vehicles, in place of the free acceleration smoke test (FAST).

The Environmental Protection and Management Act (EPMA) was gazetted on 22 Jun 2007. The title of the Environmental Pollution Control Act (EPCA) was amended to the Environmental Protection and Management Act (EPMA) on 1 Jan 2008, mainly to provide for the protection and management of the environment and resource conservation.

To streamline control on radioactive and nuclear materials in Singapore, the Centre for Radiation Protection (CRP) was transferred from HSA to NEA on 1 July 2007 to form a new department under NEA called the Centre for Radiation Protection and Nuclear Science (CRPNS).

As a non-Annex I Party to the Kyoto Protocol, Singapore is eligible to host Clean Development Mechanism (CDM) projects. These projects are able to earn UN-issued carbon credits for real and measurable reductions in their greenhouse gas emissions. The NEA is the Designated National Authority for CDM projects in Singapore.

To better understand the likely effects and impacts of climate change on Singapore, a study on Singapore’s vulnerabilities to climate change was commissioned by NEA in Mar 07. The results of the study, which is being conducted by both local and foreign experts, are expected in 2 years time.

## HIGHLIGHTS OF 2007

On 23 May 07, the Energy Efficiency Programme Office or $E^2PO$ was set up to drive energy efficiency improvement in Singapore. Chaired by NEA, it is an interagency committee with representatives from the Ministry of Trade and Industry, the Economic Development Board, the Building and Construction Authority, the Housing Development Board, the Land Transport Authority and the Agency for Science, Technology and Research.

Waste recycling is a key thrust of NEA's strategy to reduce waste. The overall recycling rate has increased to 54% in 2007 compared to 51% in 2006. Participation rate by households in the National Recycling Programme increased from 59% to 63%, the percentage of condominiums with waste recycling programmes increased from 43% to 50% and schools participating in the Recycling Corner programme increased from 84% to 95% between 2006 and 2007.

To complement the National Recycling Programme, NEA has worked with the Public Waste Collectors and the Town Councils to provide 1,600 sets of recycling depositories in HDB estates.

On 5 June 07, the Singapore Packaging Agreement was signed. The Agreement, a collaborative effort between the government, industries, and NGOs to work towards reducing waste at source in Singapore, was signed by NEA, 5 industry associations representing more than 500 companies, 19 individual companies, 2 NGOs, the Waste Management & Recycling Association of Singapore, and 4 Public Waste Collectors.

On 30 July 07, a coral nursery was launched at Semakau Landfill by Grace Fu, Minister of State for National Development. A strategy to enhance hard coral cover and diversity in Singapore would involve the propagation of new colonies onto our reefs. The establishment of the coral nursery at Pulau Semakau seeks to provide suitable propagules to 'seed' the reefs on a long-term and sustainable basis. This is analogous to a horticultural nursery providing seedlings to be planted in forest sites that need to be reforested.

On 17 Nov 07, 150 participants from 42 corporations took part in the first-ever charity run on Semakau Landfill - the inaugural Semakau Corporate Environmental Outreach (CEO) Run. The run raised $389,000 for six environmental Non-Governmental Organisations (NGOs) - Singapore Environmental Council, Restroom Association of Singapore, Climate Change Organisation, Singapore Institute of International Affairs Haze Programme, WaterWays Watch Society and Environmental Challenge Organisation. These NGOs will help run programmes which encourage the public to embrace environmental responsibility. The Semakau CEO Run 2007 was organised as part of the Clean & Green Singapore programme.

To attract more visitors and to improve further the quality of educational and recreational activities, the construction of a Visitor Centre was completed in December 2007.

The Design Build Own and Operate (DBOO) 5$^{th}$ incineration plant (Keppel Seghers Tuas Waste-To-Energy Plant) is in the construction stage and it is expected to be ready for operation in 2009 to replace the Ulu Pandan Incineration Plant which is nearing the end of its operational lifespan. The plant will provide NEA with an incineration capacity of 800 tonnes per day for a period of 25 years.

## INTRODUCTION

Singapore developed its industrial base and achieved high economic growth within a short span of three decades. In tandem with Singapore's rapid economic growth and industrialisation, programmes were also implemented, at a very early stage, to protect the environment.

The success of these environmental protection programmes is evident today and Singapore has an environment that compares favourably with the best cities in the world. Levels of major pollutants, viz. sulphur dioxide, nitrogen dioxide, respirable suspended particles (PM10), ozone and carbon monoxide, in the ambient air are within the United States Environmental Protection Agency (USEPA) standards. All inland waters in Singapore support aquatic life.

To ensure that rapid economic growth and industrialisation could be achieved without compromising the environment, the Anti-Pollution Unit (APU) and the Ministry of the Environment (ENV) were formed in 1970 and 1972 respectively to protect the environment. APU was subsequently merged with ENV in 1986. ENV was renamed as the Ministry of the Environment and Water Resources (MEWR) in September 2004 and its operational functions were taken over by its two statutory boards viz. the National Environment Agency (NEA) and the Public Utilities Board (PUB). The two statutory boards protected the environment and environmental health by planning, developing and operating sewerage, drainage and solid waste disposal facilities, controlling air and water pollution, hazardous chemicals and toxic wastes, and providing environmental public health services and public health education.

The Environmental Protection Division (EPD) of NEA is responsible for protecting the physical environment in Singapore.

EPD comprises the following departments:

a) Pollution Control Department (PCD)

b) Resource Conservation Department (RCD)

c) Waste Management Department (WMD)

d) Centre for Radiation Protection and Nuclear Science (CRPNS)

The organisation chart of EPD is in **Appendix 1**.

PCD is responsible for air, water and noise pollution control; and also hazardous substances, toxic waste control. It also carries out monitoring of ambient air and inland and coastal water quality. It is also responsible for the formulation and implementation of joint programmes to mitigate transboundary pollution with the neighbouring countries. The organisation chart of PCD is in **Appendix 2**.
RCD is responsible for promoting waste minimisation and recycling in order to reduce the waste disposed of at the incineration plants and landfill. It is also responsible for promoting energy efficiency, clean energy, and other measures to minimise the emissions of greenhouse gases. The organisation chart of RCD is in **Appendix 3**.

## INTRODUCTION

WMD is tasked with the responsibility for providing refuse disposal services (incineration plants and landfill) and for licensing general waste collectors and regulating refuse collection for the domestic and trade premises. The organisation chart of WMD is in **Appendix 4**.

CRPNS is responsible for the safe use of ionising and non-ionising radiation in Singapore and the implementation of various international conventions relating to radiological and nuclear matters. The organisation chart of CRPNS is in **Appendix 5**.

The Second Schedule of the EPCA was amended on 1 Jul 2007. 13 chemicals have been removed from the EPCA and EPC (Hazardous Substances) Regulations. These 13 chemicals were then listed under Police's Arms and Explosives Act.

The Environmental Pollution Control Act (EPCA) was renamed the Environmental Protection and Management Act (EPMA) with effect from 1 Jan 2008, to better describe its purpose i.e. the protection and management of the environment and resource conservation.

Other major amendments of the Act include the insertion of a New Part (Part XA - Energy Conservation) immediately after Section 40 with effect from 1 Jan 2008, and the amendment of Section 72 (Composition of offences) to raise the maximum composition fine with effect from 1 Oct 2007.

# 1

# Environmental Planning and Building Development Control

# ENVIRONMENTAL PLANNING AND BUILDING DEVELOPMENT CONTROL

## Environmental Land Use Planning

Environmental problems can be prevented through proper land use planning and the imposition of appropriate controls. NEA, therefore, adopts an integrated approach in the planning control of new developments. This is to ensure that environmental considerations and factors are incorporated at the land use planning, development control and building control stages, so as to minimise pollution and to mitigate pollution impact on surrounding land use.

The Urban Redevelopment Authority (URA), which is the land use planning authority in Singapore, consults the Central Building Plan Unit (CBPU) of the Pollution Control Department (PCD) on land use planning issues. The Jurong Town Corporation (JTC), Housing & Development Board (HDB) and private sector developers also consult CBPU on the allocation of industrial premises.

CBPU assesses and evaluates the hazard and pollution impacts of the proposed industries to ensure that they do not pose unmanageable health and safety hazards and pollution problems. A proposed factory will only be allowed to be set up if it is sited in an appropriate industrial estate and can comply with pollution control requirements.

During the year, CBPU processed 11,814 plans for residential and industrial developments. In addition, CBPU also processed 4,760 applications for allocation of industries in JTC, HDB and private industrial estates. A breakdown of residential and industrial development plans and applications for allocation of industrial premises processed by CBPU is in **Tables 1, 2** and **3**.

## Major Planning Proposals

During the year, CBPU evaluated the Quantitative Risk Assessment (QRA) studies of 28 chemical plants. The proposals were supported as they could comply with the siting and technical requirements.

## Consultation on Building Developments

Technical requirements on environmental matters are imposed at the Building Plan (BP) stage so that the proposals would be designed to comply with environmental requirements and guidelines.

For industries, the building plans are checked at the BP stage to ensure that the necessary pollution control equipment and facilities are incorporated.

Upon completion of a project, the Qualified Person (QP) applies to CBPU for clearance of either the Temporary Occupation Permit (TOP) or the Certificate of Statutory Completion (CSC).

When compliance with the imposed technical requirements has been confirmed through site inspections, CBPU issues TOP/CSC clearance on behalf of the technical departments (Sewerage, Drainage, Environmental Health and Pollution Control Departments).

During the year, CBPU processed 9,004 building plans and detailed plans, and issued 4,840 TOP/CSC clearances

# ENVIRONMENTAL PLANNING AND BUILDING DEVELOPMENT CONTROL

## Provision of Drainage and Sewerage Interpretation Plans

CBPU provides drainage and sewerage information for property transactions and building developments.

During the year, CBPU processed 41,703 applications for Drainage Interpretation Plans and Sewerage Interpretation Plans.

**Table 1**
**Planning Consultations on Land Use**

| Classification | Total |
|---|---|
| Public Housing Development | 150 |
| Private Housing Development | 3224 |
| Industrial Development | 1365 |
| Commercial, Institutions, others | 7075 |
| **Total** | **11,814** |

## Table 2
**Planning Consultations for Scheduled Premises**

| Scheduled Premises | Total |
|---|---|
| Concrete/Cement works | 9 |
| Chemical works | 2 |
| Plants using scheduled oil-fired boilers (steam generating capacity of 2300 kg or more per hour) | 2 |
| Storage of more than 100 tonnes of one or more chemicals | 3 |
| Abrasive blasting works | 18 |
| **Total** | **34** |

## Table 3
**Breakdown of Consultations on Factory Allocation**

| Type Of Industry | Total |
|---|---|
| Engineering works | 1527 |
| Shipbuilding/repairing | 32 |
| Food | 267 |
| Timber-based products | 285 |
| Paper products | 11 |
| Electrical and electronic products | 129 |
| Textile and garment | 25 |
| Plastic | 38 |
| Printing and publishing | 68 |
| Jewellery, watch and clock | 1 |
| Building and construction | 72 |
| Concrete and cement | 12 |
| Chemical | 226 |
| Rubber processing & rubber products | 1 |
| Photograph & optical goods | 21 |
| Ferrous & non-ferrous metal works | 188 |
| Leather goods & footwear | 28 |
| Miscellaneous | 1829 |
| **Total** | **4760** |

# 2

# Pollution Control

# POLLUTION CONTROL

## Air Pollution Control

### Overview

The ambient air quality remained good for the year. The levels of major pollutants such as sulphur dioxide, nitrogen dioxide, carbon monoxide, ozone and respirable suspended particles (PM10) were within the acceptable limits prescribed by the United States Environmental Protection Agency (USEPA).

### The Environmental Pollution Control Act and its Regulations

Air pollution in Singapore is regulated under the Environmental Pollution Control Act and its Regulations in 2007. The Environmental Pollution Control (Air Impurities) Regulations 2000, which came into force on 1 January 2001, stipulate revised air emission standards for air pollutants. The purpose of revised standards is to reduce the air emissions from industries so that our ambient air quality continues to remain good. The standards are listed in **Appendix 6.**

Industries, which have the potential to cause serious air pollution, are classified as Scheduled Premises under the Environmental Pollution Control Act. The list of Scheduled Premises is in **Appendix 7**. The owner or occupier of Scheduled Premises is required to obtain a Licence from PCD before commencement of operation. PCD grants the Licence only after all pollution control requirements have been complied with.

### Compliance Testing And Checking At Factories

PCD carries out regular inspections on industrial and non-industrial premises to ensure compliance with pollution control requirements.

During the year, 17,423 inspections were conducted on industrial premises (e.g. factories, trade premises, etc) and 4,239 inspections on non-industrial premises (e.g. farms, domestic premises, etc.).

Under PCD's source emission testing scheme, industries are required to conduct source emission tests to ensure that they monitor their emissions regularly, and take remedial measures to comply with the prescribed air emission standards. During the year, 175 companies were required to conduct source emission tests. Altogether, they conducted a total of 1063 tests comprising 371 isokinetic tests and 692 tests on gaseous emission. Of these, 3 failed the prescribed standards. Enforcement action was taken against the offenders and they were required to take remedial action to comply with the prescribed standards. There was a decrease in the number of companies conducting the tests compared to the previous year. This was attributed to more companies switching from the use of fuel oil to natural gas which is a cleaner fuel.

During the year, PCD also conducted 680 fuel analyses and smoke observations of chimneys. Of these, 1 failed to comply with the prescribed standards. The offender was prosecuted and required to take remedial action to comply with the standards.

# POLLUTION CONTROL

## Air Pollution Control Equipment

Industries are required to install air pollution control equipment to comply with emission standards. During the year, CBPU approved the installation of 114 pieces of air pollution control equipment. The types of control equipment approved are in **Table 4**.

**Table 4**
**Air Pollution Control Equipment Approved**

| Equipment | No. Approved |
|---|---|
| Bag filter dust collector | 16 |
| Scrubber | 28 |
| Miscellaneous | 70 |
| **Total** | **114** |

## Control Of Fuel-Burning Equipment

Fuel-burning equipment uses either gaseous fuel or fuel oil. The main air pollutants arising from fuel-burning are sulphur oxides and smoke. The emission of sulphur oxides is controlled by limiting the sulphur content in the fuel.

Industries located in designated industrial estates are required to use fuels containing not more than 1% sulphur by weight. Industries on Jurong Island and Tuas industrial estate can use natural gas, a clean fuel which is available there. Those located near housing estates or residential premises are required to use cleaner fuels, e.g. town gas or ultra low sulphur diesel. In addition, the height of chimneys and the exit velocity of the flue gases are checked by PCD to ensure proper dispersion of flue gases.

Operators of industrial boilers with a steam generating capacity of 2,300 kg/h or more are required to monitor their smoke emissions. Smoke density meters are installed in the chimneys to continuously monitor the smoke intensity to ensure compliance with the Ringelmann No. 1 standard. During the year, 42 pieces of new fuel-burning equipment were approved by CBPU. They included 35 boilers, 5 ovens, 1 furnace and 1 incinerator.

## POLLUTION CONTROL

### Open Burning

Open burning of waste materials gives rise to serious air pollution. In Singapore, open burning of trade and industrial refuse such as construction wastes, is prohibited under the Environmental Pollution Control (Prohibition on the Use of Open Fires) Order, 1999. Most open burning incidents occur at construction sites where timber waste and construction debris are burnt illegally to save on disposal costs. During the year, a total of 9 open burning incidents were detected and action was taken to prosecute the offenders.

### Control Of Fugitive Odorous Emissions

Fugitive or residual emission of odorous substances can be a major source of smell nuisance from factories. These factories are required to install odour control equipment to minimise the nuisance.

### Complaints And Incidents Of Air Pollution

During the year, PCD received 961 complaints on pollution, of which 52 were incidents of air pollution. The main causes of these incidents were poor maintenance, improper operation and/or overloading of air pollution control equipment.

PCD required the owners or occupiers to take immediate remedial action to ensure compliance with the allowable emission limits. A breakdown of air pollution complaints and incidents in 2006 and 2007 is given in **Table 5**.

**Table 5**
**Complaints And Incidents Of Air Pollution**

| Type Of Air Pollution | No. Of Complaints | | No. Of Incidents | |
|---|---|---|---|---|
| | 2007 | 2006 | 2007 | 2006 |
| Odour | 538 | 434 | 11 | 9 |
| Fumes/Dust | 179 | 199 | 17 | 8 |
| Smoke/Soot | 167 | 242 | 17 | 30 |
| Others | 77 | 0 | 7 | 0 |
| **Total** | **961** | **875** | **52** | **47** |

# POLLUTION CONTROL

## Control Of Vehicular Emissions

### Control Of Smoky Vehicles

PCD is responsible for carrying out enforcement operation against smoky vehicles on roads. In 2007, a total of 4918 motor vehicles and 4376 motorcycles were booked and fined for emitting excessive smoke. A breakdown of the survey results and number of enforcements of smoky vehicles in Singapore in 2006 and 2007 is given in **Table 6** and **Table 7** respectively.

### Vehicle Emission Standards

With the continuing growth of vehicle population in Singapore, total emissions from vehicles have to be kept in check through the implementation of stringent emission standards for new vehicles. Over the years, NEA has tightened the emission standards in tandem with advances in vehicle technology. With effect from 1 January 2001, all new vehicles registered for use in Singapore must comply with the Euro II emission standards. With effect from 1 July 2003, all motorcycles/scooters must comply with the exhaust emission standard as specified in the European Directive 97/24/EC before they can be registered for use in Singapore.

In Singapore, diesel vehicles contribute to about 50% of the total PM2.5 emissions. To bring down the PM2.5 levels in Singapore to within acceptable standards, the NEA implemented the Euro IV emission standard for all new diesel vehicles registered from 1 October 2006 onwards. The emission standards are summarised in **Table 8**.

In addition, in-use vehicles are required to undergo mandatory periodic inspections. These vehicles are tested for compliance with regulations on in-use vehicle emission. This is to ensure the proper maintenance of engines and efficacy of catalytic converters.

To provide vehicle owners with a better standard of maintenance, PCD had initiated the formation of an industry-led Motor Industry Certification Board (MICB) (Singapore) for the administration of the Certification Scheme for Motor Workshop on 1 September 2000. Under this scheme, certificates are awarded only to motor workshops with trained mechanics, proper equipment and procedures, and quality assurance checks for the maintenance of diesel-driven vehicles to prevent black smoke emission. To date, more than 30 workshops have been certified under the scheme.

The chassis dynamometer smoke test (CDST) has been used to test diesel vehicles that have been booked for smoke emission in Singapore since 1 September 2000. Results have shown that the CDST is an effective test for weeding out smoky diesel vehicles. With effect from 1 January 2007, all diesel-driven vehicles are required to undergo the CDST during their mandatory periodic inspections, in place of the existing free-acceleration smoke test (FAST). The CDST is a more representative test method as compared to the FAST, as it measures smoke emission level of a diesel-driven vehicle under actual driving conditions. The CDST system is able to place a diesel vehicle under simulated “load” conditions to measure its smoke emission during on-the-road driving. This is a more accurate reflection of the actual performance of a diesel-driven vehicle on the road.

## POLLUTION CONTROL

Up to 31 December 2007, 74,809 vehicles were sent for CDST testing and an average of about 75% of the vehicles tested was able to pass the CDST on the first attempt.

CDST Testing

### Control Of Automotive Fuel Quality

The quality of fuel used by vehicles in Singapore is controlled because of its impact on vehicular emissions. Unleaded petrol was introduced in January 1991 and leaded petrol was phased out on 1 July 1998. To reduce smoke emission from diesel vehicles, the permissible sulphur content in diesel was reduced from 0.3% to 0.05% by weight on 1 March 1999. Smoke emission from diesel-driven vehicles is harmful as the fine particulate matter present in smoke has a significant health impact on people. The reduction of the sulphur content in diesel had paved the way for the introduction of the more stringent Euro II emission standards on 1 January 2001. A further reduction of the sulphur content in diesel to 0.005% by weight was effected in December 2005 to pave the way for the smooth implementation of Euro IV emission standard for new diesel vehicles, which took effect from 1 October 2006.

### CNG Vehicles

Natural gas is a clean fuel. In Singapore, diesel buses and taxis are large contributors of PM due to their high mileage and getting them to switch to natural gas will significantly reduce our ambient PM 2.5 level. Therefore, MEWR and NEA have been promoting the use of CNG vehicles and encouraging the private sector to set up CNG refueling stations as part of our effort to improve good air quality.

Promoting the use of CNG vehicles and encouraging private sector to set up CNG refueling stations were among the first of the partnership and ownership programmes that then ENV had embarked on to bring the 3P sectors (i.e. the public, private and people sectors) on board as partners and co-owners of the environment. The thrust of co-ownership of the environment by private sector is for fleet operators and gas suppliers to take the lead to bring about wider use of CNG vehicles and to set up CNG refueling stations in a business-viable manner.

SMART Taxi Company registered and deployed 102 CNG Mercedes taxis by December 2006 with plans to operate more CNG taxis in the future. NEA approved $2 million under IES Fund to support SMART in its project to set up CNG refueling stations on mainland Singapore.

## POLLUTION CONTROL

As at end 2007 there were 486 CNG vehicles comprising 220 CNG taxis, 250 cars, 12 CNG buses and 4 goods vehicles.

Between March 2003 to March 2004, taxi companies have also conducted a pilot Project involving road tests on 10 CNG taxis. SMART Taxi Company registered and deployed 111 CNG Mercedes taxis by December 2007 with plans to operate more CNG taxis in the future. NEA approved $2 million under IES Fund to support SMART in its project to set up CNG refuelling stations on mainland Singapore.

CNG refuelling station in Jurong Island

Mercedes CNG Taxis

## POLLUTION CONTROL

### Tax Incentives

In 2005, the government revised the various tax incentives to promote the early introduction of Euro IV diesel vehicles, CNG vehicles and green vehicles. The incentives are summarised in the table below:

| Vehicle Type | Tax incentives / changes for vehicles registered from | | | |
|---|---|---|---|---|
| | 1 June 2004 – 31 December 2005 | 1 January 2006 – 30 September 2006 | 1 October 2006 – 31 December 2007 | 1 January 2008 – 31 December 2009 |
| **CNG, Hybrid and Electric Passenger Cars** | • ARF rebate of 20% OMV<br>• 20% road tax rebate (CNG and electric cars) and 10% road tax rebate (hybrid cars) until 31 Dec 2005 | • ARF rebate of 40% OMV | • ARF rebate of 40% OMV | • ARF rebate of 40% OMV |
| **Euro IV Diesel Passenger Cars** | • Special tax equivalent to 6 times its road tax until 31 Dec 2005<br>• Special tax equivalent to 4 times its road tax from 1 Jan 2006 | • Special tax equivalent to 4 times its road tax | • Special tax equivalent to 4 times its road tax | • Special tax equivalent to 4 times its road tax |
| **CNG Taxis** | • ARF rebate of 100% OMV<br>• 20% road tax rebate until 31 Dec 2005<br>• Special tax exempt until 31 Dec 2009 | • ARF rebate of 80% OMV<br>• Special tax exempt until 31 Dec 2009 | • ARF rebate of 40% OMV<br>• Special tax exempt until 31 Dec 2009 | • ARF rebate of 40% OMV<br>• Special tax exempt until 31 Dec 2009 |
| **Euro IV Diesel Taxis** | • ARF rebate of 100% OMV | • ARF rebate of 80% OMV | • ARF rebate of 40% OMV | • No ARF rebate |
| **CNG Buses & Commercial Vehicles (CVs)** | • ARF rebate of 5% OMV<br>• 20% road tax rebate (CNG vehicles) until 31 Dec 2005, pegged to that of petrol-driven equivalents as of 1 Jan 2006* | • ARF rebate of 5% OMV<br>• Road tax pegged to that of petrol-driven equivalents | • ARF rebate of 5% OMV<br>• Road tax pegged to that of petrol-driven equivalents | • ARF rebate of 5% OMV<br>• Road tax pegged to that of petrol-driven equivalents |
| **Hybrid and Electric Buses & Commercial Vehicles (CVs)** | • No rebate | • Road tax pegged to that of petrol-driven equivalents | • Road tax pegged to that of petrol-driven equivalents | • ARF rebate of 5% OMV<br>• Road tax pegged to that of petrol-driven equivalents |
| **Euro IV Diesel Buses & CVs** | • ARF rebate of 5% OMV | • ARF rebate of 5% OMV | • ARF rebate of 5% OMV | • No ARF rebate |

* Road tax of petrol-driven buses and commercial vehicles are 20% lower than their diesel-driven equivalents. Thus, effectively there is no change to the road tax payable by CNG buses and commercial vehicles from 2005 to 2006.

## Table 6
### Survey Results of Smoky Vehicles on Singapore Roads

| Origin & Type Of Smoky Vehicle | % of Smoky Vehicles in 2006 | % of Smoky Vehicles in 2007 |
|---|---|---|
| Singaporean | | |
| (i) Motor vehicles | 0.4 % | 0.3% |
| (ii) Motorcycles | 0.7 % | 0.7% |
| Malaysian | | |
| (i) Motor vehicles | 1.6% | 1.4% |
| (ii) Motorcycles | 3.0 % | 2.9% |

## Table 7
### Enforcement of Smoky Vehicles on Singapore Roads

| Origin & Type Of Smoky Vehicle | No. of Enforcement in 2006 | No. of Enforcement in 2007 |
|---|---|---|
| Singaporean | | |
| (i) Motor vehicles | 3,314 | 2,044 |
| (ii) Motorcycles | 3,834 | 2,433 |
| Malaysian | | |
| (i) Motor vehicles | 2,671 | 2,874 |
| (ii) Motorcycles | 2,411 | 1,943 |

## Table 8
### Summary Of Emission Standards For Motor-Vehicles

| Type of Vehicle | Emission Standard | Implementation |
|---|---|---|
| Petrol-driven vehicles | All new petrol-driven vehicles are required to comply with the EC Directive 96/69/EEC. | 1 January 2001 |
| Diesel-driven vehicles | All new diesel-driven passenger cars are required to comply with the EC Directive 96/69/EEC. | 1 January 2001 |
| | All new light commercial vehicles 3.5 tonnes or below are required to comply with the EC Directive 96/69/EC. | 1 January 2001 |
| | All new heavy duty vehicles exceeding 3.5 tonnes are required to comply with the EC Directive 91/542/EEC Stage II. | 1 January 2001 |
| | EU Directive 98/69/EC-B(2005) for vehicle 3.5 tonnes or below (EURO IV)<br>EU Directive 1999/96/EC-B1(2005) for vehicles greater than 3.5 tonnes (EURO IV) | 1 October 2006 |
| Motorcycles & scooters | All new motorcycles and scooters are required to comply with the EC Directive 97/24/EC. | 1 July 2003 |

# POLLUTION CONTROL

## Water Pollution Control

### Overview

Water quality of the inland and coastal waters remained good. All inland waters supported aquatic life.

### Acts And Regulations

The Environmental Pollution Control Act (EPCA) and the Sewerage and Drainage Act (SDA) and their regulations are used to control the discharge of wastewater from domestic, industrial, agricultural and other premises into public sewers and watercourses. The Environmental Pollution Control (Trade Effluent) Regulations (TER) and the Sewerage and Drainage (Trade Effluent) Regulations stipulate the standards for trade effluent discharged into watercourses and public sewers respectively. The discharge standards stipulated in both the regulations are in **Appendix 8**.

Industries must comply with the discharge standards of the TER. Where necessary, they shall install on-site treatment plants to treat their effluent to the stipulated standards. Industries may also apply to PUB for permission to discharge trade effluent, which contain biodegradable pollutants, as measured by biochemical oxygen demand (BOD) and total suspended solids (TSS), into the public sewers on payment of a tariff when the BOD and TSS exceed the stipulated limits in the TER. The current schedule of trade effluent tariffs is in **Appendix 9**.

In general, industries with the potential to cause pollution are located in designated industrial estates such as Jurong/Tuas Industrial Estates, which are outside water catchments and served by public sewers. Only clean or light industries are allowed within water catchments but must be sited in proper industrial estates served by public sewers.

### Sampling Of Trade Effluent

During the year, PCD collected 246 trade effluent samples for analysis. Of these, 9 samples or about 3.7 % failed to comply with the stipulated standards. PCD required the offenders to take measures to prevent recurrence and initiated enforcement action against those found exceeding the standards.

### Trade Effluent Treatment Facilities

Industries are required to install pre-treatment facilities to treat their trade effluent that exceeds the limits of discharge stipulated in the TER. The pre-treatment plants would have to be installed prior to the commissioning of the factories.

During the year, CBPU approved 34 trade effluent treatment facilities. A breakdown of the treatment facilities approved is in **Table 9**.

## Table 9
**Trade Effluent Treatment Facilities Approved**

| Treatment Facility/Method | No. Approved in 2007 |
|---|---|
| Oil interceptor | 6 |
| Neutralisation | 1 |
| Chemical | 27 |
| Total | 34 |

### Emergency Response Plan For Oil/Chemical Spills On Land

During the year, there was no major incident of chemical spill on land.

### Complaints And Incidents Of Water Pollution

PCD received 179 complaints of water pollution during the year, of which 18 were substantiated. Most of the incidents were due to illegal discharge or spillage of industrial wastewater or chemical/oil into drains. PCD required the offenders to clean up the pollution and legal action was taken against them for causing pollution.

A breakdown of the water pollution complaints and incidents in 2006 and 2007 is in **Table 10**.

## Table 10
**Complaints and Incidents of Water Pollution**

| Type Of Water Polution | No. of Complaints | | No. of Incidents | |
|---|---|---|---|---|
| | 2007 | 2006 | 2007 | 2006 |
| Chemical/Oil | 51 | 37 | 3 | 5 |
| Industrial waste water | 105 | 52 | 10 | 3 |
| Farm wastes | 7 | 0 | 2 | 0 |
| Domestic wastewater | 14 | 20 | 2 | 1 |
| Others | 2 | 7 | 1 | 9 |
| **Total** | **179** | **116** | **18** | **9** |

# POLLUTION CONTROL

## Hazardous Substances and Toxic Wastes Control

### Overview

PCD controls the import, transport, sale, storage and use of hazardous substances. PCD also controls the disposal of toxic industrial wastes. The controls implemented ensure the safe and proper management of hazardous substances and toxic industrial wastes in Singapore.

Besides regulatory controls, PCD also works with international organisations, relevant government agencies and industry groups to organise seminars and briefings to help companies and traders manage hazardous substances and toxic industrial wastes safely.

Hazardous installations, which store hazardous substances in bulk quantities, are also required to carry out safety audits to systematically identify and rectify weaknesses in their management systems and practices of handling hazardous substances.

### Hazardous Substances Control

The import/export, transport, sale, storage and use of hazardous substances are controlled under the Environmental Pollution Control Act and the Environmental Pollution Control (Hazardous Substances) Regulations.

Any person or company planning to engage in such activities must obtain a Hazardous Substances Licence or Permit from PCD. The chemicals controlled under the Environmental Pollution Control Act are listed in **Appendix 10**.

During the year, PCD issued **619** Hazardous Substances Licences and **937** Hazardous Substances Permits. PCD also processed electronically **73565** inward/outward declarations for the import/export of chemicals and chemical products through the TradeNet computerised network system.

Also, under the Environmental Pollution Control (Hazardous Substances) Regulations, PCD's approval is required for the transportation of hazardous substances in quantities exceeding the limits stipulated in the Regulations. The specified limits for each hazardous substance are listed in **Appendix 11**.

During the year, PCD issued **170** transport approvals. Requirements on packaging, maximum allowable load, route, timing and emergency plans were imposed to ensure the safe transportation of hazardous substances.

Surprise road checks were also conducted jointly with the Land Transport Authority and the Singapore Civil Defence Force (SCDF) to ensure that companies transporting hazardous substances complied with the safety requirements imposed.

During the year, PCD conducted **1047** surprise inspections to audit the records of hazardous substances kept by the holders of Hazardous Substances Licences and Permits. Of these, **37** were not in order. PCD took legal action against **3** offenders and issued written warnings to **34** offenders.

## POLLUTION CONTROL

### Application of Hazardous Substances Licence/Permit via the Internet

Applicants can submit an electronic application via the Internet, and check the status of their electronic applications online at their own convenience. The website address is: **http://app1.env.gov.sg/pcls/controller?event=WELCOME**

All the necessary guidance and information for filling up the electronic application are available on-line to applicants. Applicants need not travel to PCD to collect application forms, seek clarification or submit application forms.

### Training For Tanker Drivers

Drivers of road tankers and tank containers carrying hazardous substances and dangerous petroleum products are required to undergo a special one-day training course jointly organised by Singapore Civil Defence Force (SCDF) and PSA Institute. Those who have successfully completed the course are granted a HAZMAT Transportation Driver Permit (HTDP). All drivers conveying controlled hazardous substances listed in the Environmental Pollution Control (Hazardous Substances) Regulations are required to possess a HTDP that is valid for 2 years. They are also required to undergo a one-day course every 2 years as a form of refresher training for the renewal of their HTDP.

### Toxic Industrial Wastes Control

The Environmental Public Health (Toxic Industrial Waste) Regulations require all toxic industrial waste collectors to be licensed. Approval is also required to transport toxic industrial wastes exceeding the quantities stipulated in the Regulations.

The types of toxic industrial wastes controlled under the Regulations are listed in **Appendix 12**.

During the year, PCD granted and renewed licences to 167 toxic industrial waste collectors to carry out treatment, reprocessing and disposal of toxic wastes. PCD also required licensed toxic waste collectors to obtain approval to transport toxic industrial wastes that exceeded specified quantities.

### Control of Tanker Cleaning Activities

Since 4 April 1993, Singapore has implemented a scheme to tighten control on tanker cleaning activities and the disposal of sludge and slop oil generated from tanker cleaning activities. Under the scheme, the Maritime and Port Authority (MPA) will only issue permits to contractors registered with PCD to carry out tanker cleaning activities in designated areas.

Sludge and slop oil generated from tanker cleaning activities are required to be sent to approved reception facilities for treatment and disposal.

Also under the scheme, any ship or vessel entering Singapore in a "clean condition" for repairs would be allowed entry only if it could show proof that the sludge from its tanker cleaning activities had been disposed of at approved facilities.

During the year, 41 companies were registered to carry out tanker cleaning activities. About **25,700** tonnes of oily sludge were sent to the approved reception facilities for treatment and disposal.

## POLLUTION CONTROL

### Collection of Industrial Waste Chemicals

The main types of industrial waste chemicals include waste solvents, spent etchants, acids, alkalis and expired chemicals. PCD encourages the reuse, recycle and recovery of waste chemicals to reduce the amount of wastes that require treatment and disposal.

During the year, licensed collectors collected about **491,000** tonnes of waste chemicals from local industries.

### Control of Biohazardous Wastes

Biohazardous wastes from hospitals and polyclinics are segregated at source and stored in colour-coded plastic bags. The wastes are then put in secured containers and collected by 2 licensed biohazardous waste disposal companies for disposal in dedicated high temperature incinerators.

For the year 2007, about 18,400 cubic metres of biohazardous wastes were collected and disposed of locally by licensed biohazardous waste disposal companies.

### Terrain Decontamination

Terrain decontamination is a new capability which the NEA is building up. In the event a toxic chemical is released, the Singapore Civil Defence Force (SCDF) will carry out the initial response to save lives and mitigate the source of release which will also involve preliminary site decontamination to contain the affected area. Once the area is secure, NEA will move in to carry out terrain decontamination to restore the affected area to normalcy as soon as possible.

# POLLUTION CONTROL

## Environmental Noise Management

### Industrial Noise Control

PCD controls noise from factories by siting them in designated industrial estates and where appropriate, requiring them to implement noise abatement measures to comply with allowable boundary noise limits. PCD conducts regular checks on factories to ensure noise control equipment is operated and maintained properly. The boundary noise limits for factory premises are at **Appendix 13**.

During the year, PCD received 431 complaints of noise pollution from factories, of which 19 were substantiated incidents. The main causes of these incidents were improper siting of mechanical equipment and/or poor maintenance of mechanical equipment. The owners or occupiers were required to take remedial action to reduce noise to comply with the allowable noise limits.

### Traffic Noise from Expressways

NEA strategy is to reduce traffic noise from expressways through the use of cost-effective measures.

In land-scarce and highly urbanised Singapore, some degree of traffic noise pollution is inevitable. NEA, together with the Ministry of Transport (MOT) and the Ministry of National Development (MND), use the following cost-effective measures to alleviate the problem:

- tightening noise emission standards for vehicles;
- using noise-absorptive porous asphalt material for road surfacing;
- siting multi-storey carparks, electrical substations or other non-residential structures to screen traffic noise from new residential buildings;
- setting a minimum set back distance for new residential buildings from expressways; and
- designing new flat layouts such that living rooms and bedrooms are located away from traffic noise

### Construction Noise Control

PCD enforces The Environmental Pollution Control (Control of Noise at Construction Sites) Regulations to control noise pollution from construction sites. In 2007, a review was conducted on the regulatory control measures on construction noise in consultation with various government agencies and industry partners, taking into consideration public feedback on noise pollution from construction sites. The review identified two key areas of concerns, and these were construction noise at night and on Sundays and Public Holidays. To address these areas of concerns, the NEA had revised and tightened the permissible construction noise limits for construction sites within 150m of residential premises as follows:

a) Lowered the maximum allowable noise limits for night-time (10.00pm to 7.00am) for all days from the current 60 dBA (Leq 5-min) to 55 dBA (Leq 5-min)

b) Lowered the maximum allowable noise limits on Sundays and Public Holidays for the period between 7.00am and 7.00pm from the current 90 dBA (Leq 5-min) to 75 dBA (Leq 5-min)

c) Lowered the maximum allowable noise limits on Sundays and Public Holidays for the period between 7.00pm and 10.00pm from the current 70 dBA (Leq 5-min) to 55 dBA (Leq 5-min)

The revised construction noise limits were imposed on construction sites that commenced work on or after 1 October 2007. The revised permissible noise limits for construction sites are at **Appendix 14**.

In addition, the maximum fine for violating the permissible noise limits was also increased to $40,000 for court prosecution, up from the previous maximum fines of up to $10,000 and $20,000 for the 1st and 2nd prosecution respectively. The penalty for a continuing offence after conviction was also increased from $500 to $1,000 for every day the offence continued. The increase in penalties came into effect on 1 October 2007.

In conducting the review, NEA took into consideration the expectations of Singaporeans for a quiet living environment. There was an increase in the number of complaints on construction site noise pollution, from 6,160 complaints in 2006 to 9,228 complaints in 2007, in particular, against construction noise at night and on Sundays and public holidays. These complaints were mainly from residents staying within 150m from construction sites. Noise measurements by the NEA showed that for more than 95% of the complaints received in 2007, the noise levels were found to be within the legal permissible limits.

The regulations require contractors to schedule their construction activities and to take noise abatement measures to comply with the permissible noise limits. However, the Regulations do not restrict the working days or operation hours of construction sites.

During the year, PCD received 9,228 complaints of noise pollution against construction sites. Of these, 466 complaints against 165 construction sites were substantiated, i.e. the noise levels had exceeded the permissible noise limits. The main cause of these substantiated cases was from concreting work carried out late at night. The contractors were prosecuted and reminded to reschedule their activities to ensure compliance with the permissible noise limits.

The increase in complaints was due to the buoyant construction sector and the many en-bloc developments, many of which were built near to existing residences. The noise from these construction sites had affected a greater number of people.

# 3

# Environmental Monitoring

# ENVIRONMENTAL MONITORING

## Overview

Singapore has, over the years, managed to maintain an impressive environmental record despite the increase in industrialisation and urbanisation.

Our success in keeping the environment clean and safe is partly due to regular monitoring and assessment of the quality of ambient air and water. The results have helped in the development and review of pollution control measures.

PCD outsourced its laboratory-based functions of environmental quality monitoring to the private sector in 2006. This is in line with the Government's Best Sourcing initiative for the public sector to market-test non-core functions and outsource those functions that the private sector can do more cost-effectively.

## Ambient Air Monitoring

The ambient air quality in Singapore is routinely monitored through the Telemetric Air Quality Monitoring and Management System (TAQMMS).

The system, which comprises 13 remote air quality monitoring stations linked to a Central Control System (CCS) via dial-up telephone lines, provides an efficient means of obtaining air quality data. The locations of the monitoring stations are shown in **Chart 1**.

Eleven of the stations monitor ambient air quality and two stations measure roadside air quality. Automatic analysers and equipment are deployed at the stations to measure the concentrations of major air pollutants such as sulphur dioxide, oxides of nitrogen, carbon monoxide, ozone and respirable suspended particles (PM10).

In 2007, the air quality remained good and the overall average levels of sulphur dioxide, nitrogen dioxide, carbon monoxide, ozone and PM10 were within the ambient air quality standards established by the United States Environmental Protection Agency (USEPA). The USEPA ambient air quality standards are summarised in **Appendix 15**.

The Pollutant Standards Index (PSI), an indicator of air quality developed by the USEPA, was 'Good' for 95 % and 'Moderate' for 5 % of the days measured during 2007as shown in **Table 11.**

## Chart 1
### Location of Air Quality Monitoring Stations

## Table 11
### Summary of Pollutant Standards Index (PSI)

| Year | Days | No. of Days in which the PSI was Classified as | | | Percentage | | |
|---|---|---|---|---|---|---|---|
| | | Good (0-50) | Moderate (51-100) | Unhealthy (101-200) | Good (0-50) | Moderate (51-100) | Unhealthy (101-200) |
| 2007 | 365 | 348 | 17 | 0 | 95% | 5% | 0% |
| 2006 | 365 | 311 | 51 | 3 | 85% | 14% | 1% |

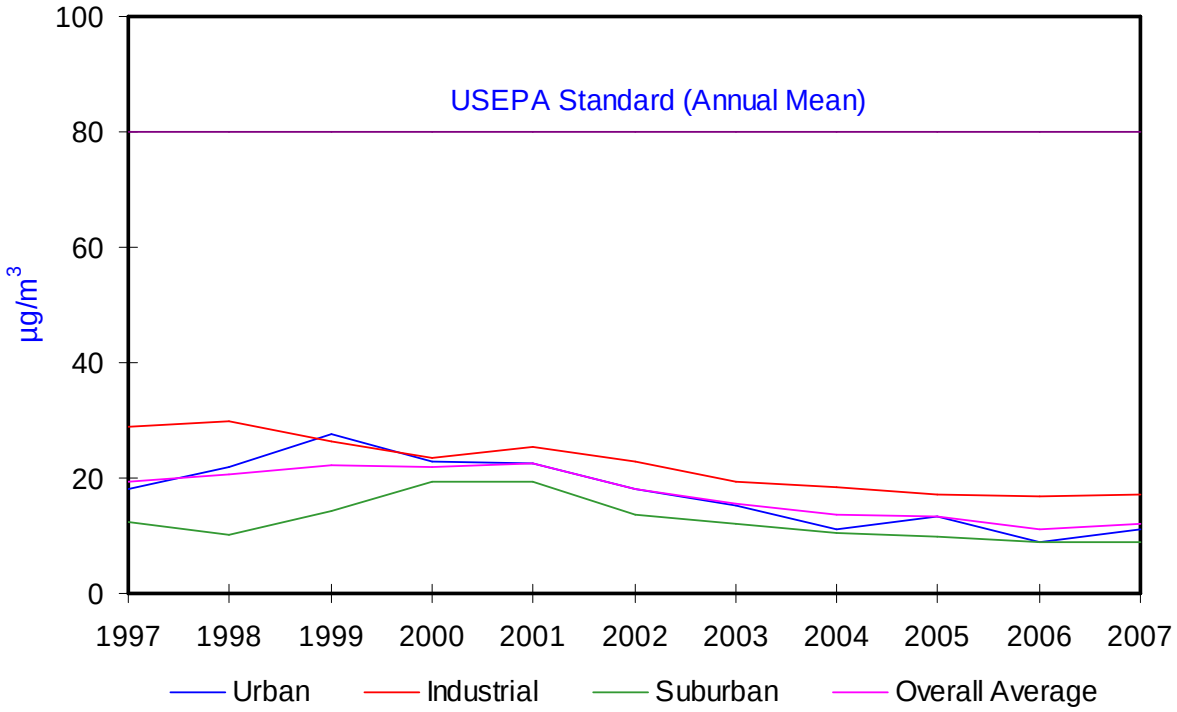
## Sulphur Dioxide

Sulphur dioxide is an undesirable by-product from the combustion of sulphur-containing fuels and to a lesser extent, from petroleum refining processes.

Prolonged exposure to high concentrations of sulphur dioxide increases the risk of contracting respiratory diseases.

The annual average levels of sulphur dioxide are shown in **Chart 2**. In 2007, the annual average level was 12 µg/m$^3$, which was within the USEPA standard of 80 µg/m$^3$.

**Chart 2**
**Annual Average Levels Of Sulphur Dioxide**




## Nitrogen Dioxide

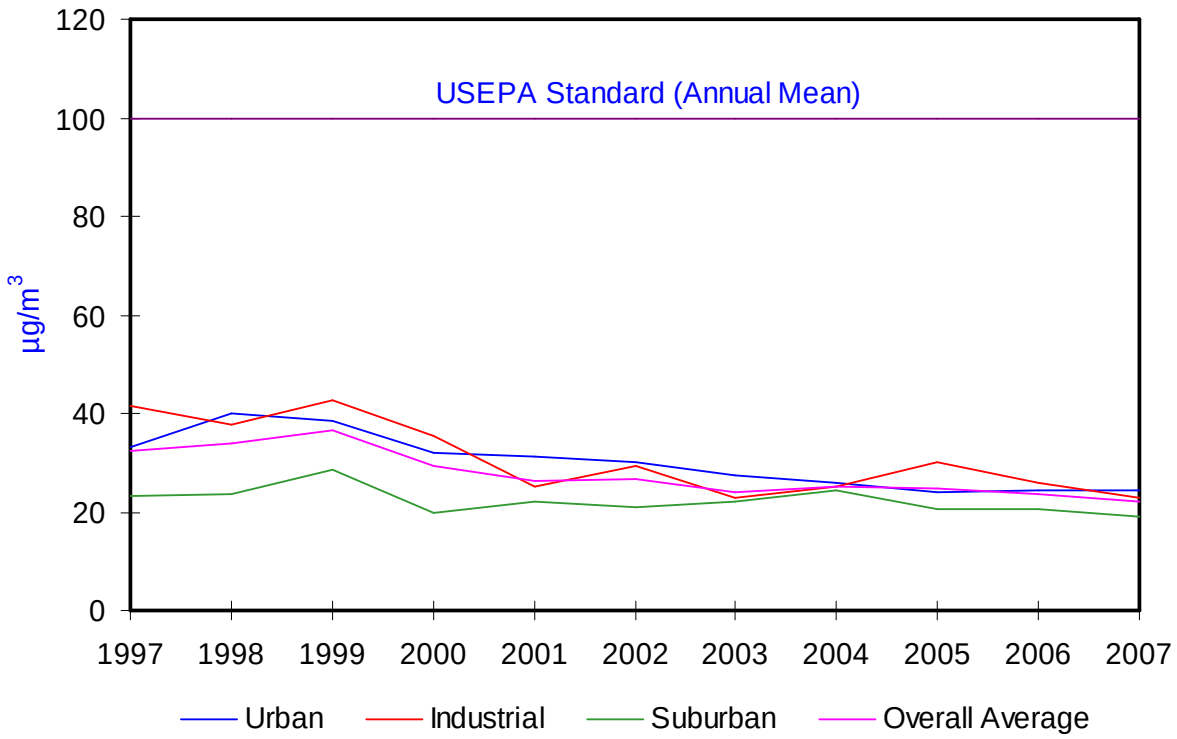
Nitric oxide accounts for most of the nitrogen oxides emitted by man-made sources. Nitric oxide is oxidised in the atmosphere to form nitrogen dioxide.

High levels of nitrogen dioxide increase the risk of respiratory infection and impair lung functions in asthmatics.

The annual average levels of nitrogen dioxide in the ambient air are shown in **Chart 3**.

In 2007, the annual average level of nitrogen dioxide was 22 µg/m$^3$, well within the USEPA standard of 100 µg/m$^3$.

**Chart 3**
**Annual Average Levels of Nitrogen Dioxide**



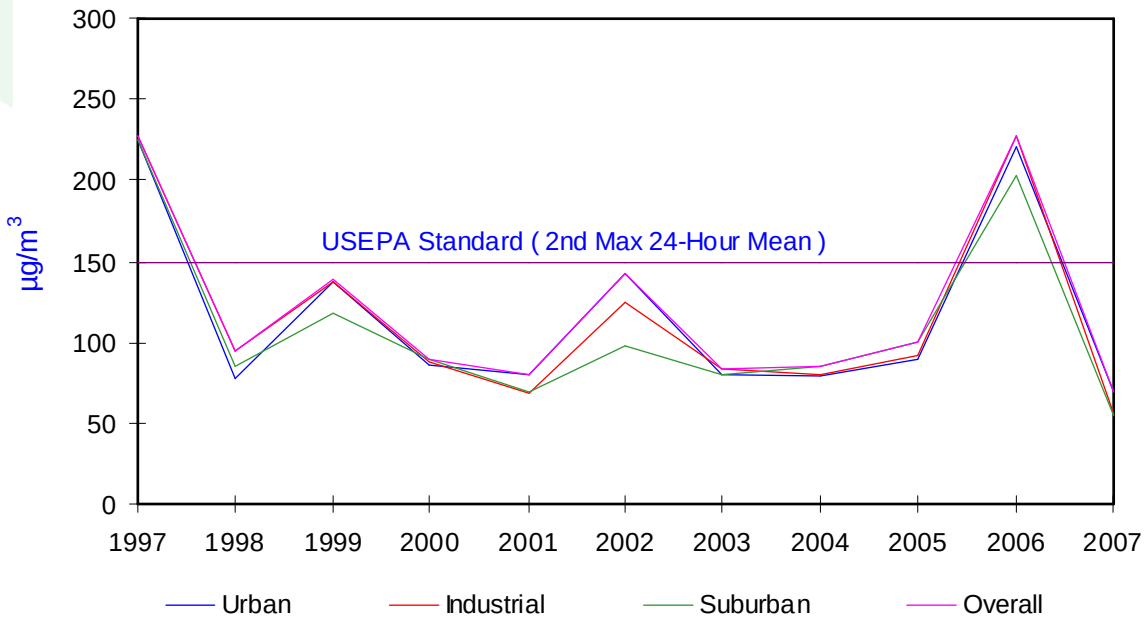

## Respirable Suspended Particles Particulate Matter (PM10 and PM2.5)

Respirable suspended particles (or PM10) refers to particulate matter of size 10 µm and below. PM2.5 refers to very fine particulate matter of 2.5 µm or less in size. These PM10 and PM2.5 particles have more serious health implications as they are able to penetrate into the deeper regions of the respiratory tract. When present in very high amounts, the particles cause breathing and respiratory problems, and aggravate existing respiratory and cardiovascular diseases.

In 2007, 24-hour mean PM10 level of 69 µg/m$^3$ was well within the USEPA standard of 150 µg/m$^3$. **Chart 4** shows the levels of PM10 in the ambient air.

The annual average level of PM2.5 in 2007 was 19 µg/m$^3$ and like many other major cities, the PM2.5 level did not meet the USEPA standard of 15 µg/m$^3$. **Chart 5** shows the annual average levels of PM2.5 in the ambient air. Motor vehicles and industries are major sources of PM2.5 in Singapore. A multi-pronged approach involving the introduction of stringent vehicular emission standards (Euro IV standards), introduction of better quality fuel (i.e. Ultra Low Sulphur Diesel), and more stringent enforcement action against smoke emissions from motor vehicles and industries have been implemented to bring down the ambient levels of PM2.5 over time. These measures will be further refined as better pollution control technologies become available.

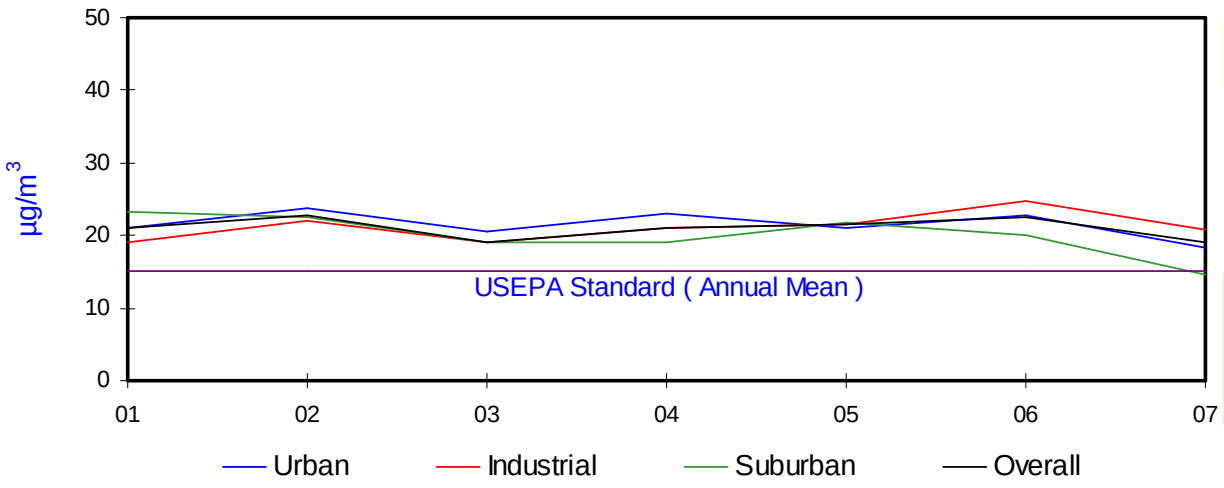
## Chart 4
**Levels of Respirable Suspended Particles Particulate Matter (PM10)**




(Note: 1) 1997 and 2006 PM10 levels were affected by transboundary smoke haze from plantation and forest fires in Indonesia

(Note: 2) Chart shows 2nd maximum 24-hr mean

## Chart 5
**Annual Average Levels of Particulate Matter (PM2.5)**




(Note: 1) PM2.5 level in 2006 was affected by transboundary smoke haze from plantation and forest fires in Indonesia.

## Low-Level Ozone

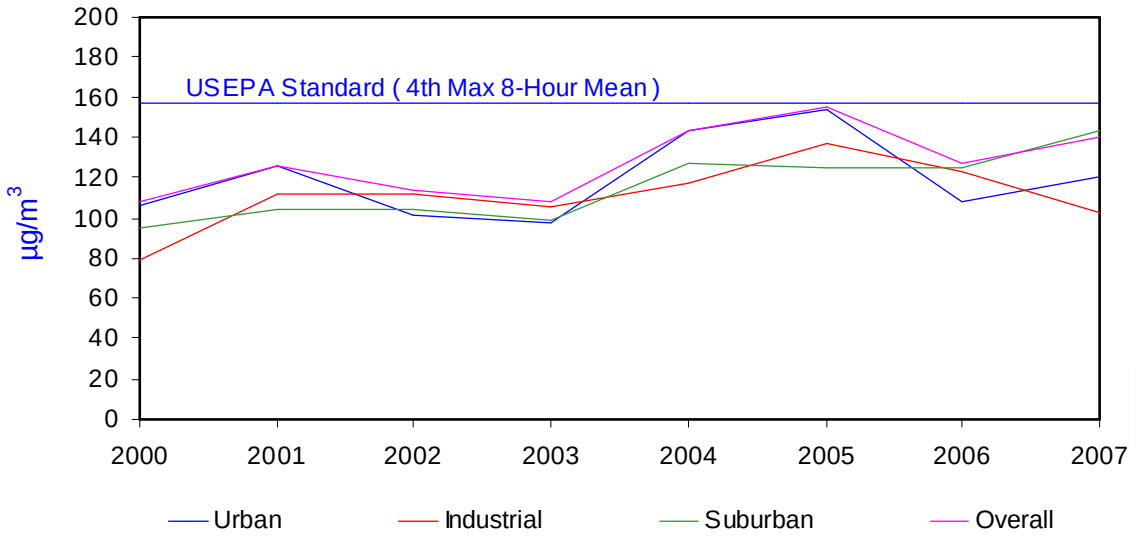
Ozone in the stratosphere is desirable as it protects life on earth by absorbing much of the harmful ultraviolet radiation from the sun.

However, ozone occurring in the lower atmosphere is a health hazard. Ozone can severely irritate eyes, mucous membranes and the respiratory system in humans as well as cause damage to plants.

Low-level ozone may be produced by the complex reactions of nitrogen oxides and volatile organic compounds catalysed by actinic radiation, or may result from the intrusion of stratospheric ozone into the troposphere.

In 2007, the 8-hour mean ozone level was 140 µg/m$^3$, within the USEPA standard of 157 µg/m$^3$. The trends of the ozone levels are shown in **Chart 6**.

**Chart 6**
**Average Ozone Levels**




(Note: Chart shows 4th maximum 8-hr mean)

## Carbon Monoxide

Carbon monoxide is a colourless and odourless gas with a higher affinity than oxygen for the haemoglobin in the blood. Hence, when it is inhaled, it can deprive body tissues of oxygen.

Exposure to moderate levels of carbon monoxide may cause nausea and impair vigilance. In excessive doses, it can cause death through asphyxiation.

The sources of carbon monoxide range from vehicular emissions, cigarette smoke to incomplete combustion of fuels. Vehicular emission usually accounts for most of the carbon monoxide in the air.

Carbon monoxide is measured at both ambient and roadside air monitoring stations. The 2007 ambient 8-hour mean carbon monoxide level was 0.4 mg/m$^3$ and the 2$^{nd}$ maximum 8-hour mean level was 1.7 mg/m$^3$. This level was well within the USEPA standard of 10 mg/m$^3$ for the 2$^{nd}$ maximum 8-hour mean. The roadside 8-hour mean levels of carbon monoxide are shown in **Table 12**.

### Table 12

**Roadside 8-Hour Mean Carbon Monoxide Levels (mg/m$^3$) in 2007**

| Monitoring Station | Time Interval (Hours) | | | | | |
|---|---|---|---|---|---|---|
| | 0000 - 0800 | | 0800 - 1600 | | 1600 – 2400 | |
| | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 |
| Chin Swee | 0.7 | 0.8 | 0.8 | 0.8 | 0.9 | 0.9 |
| Ngee Ann Polytechnic | 1.2 | 1.2 | 1.0 | 1.0 | 1.1 | 1.2 |

## Pollution From Vehicles

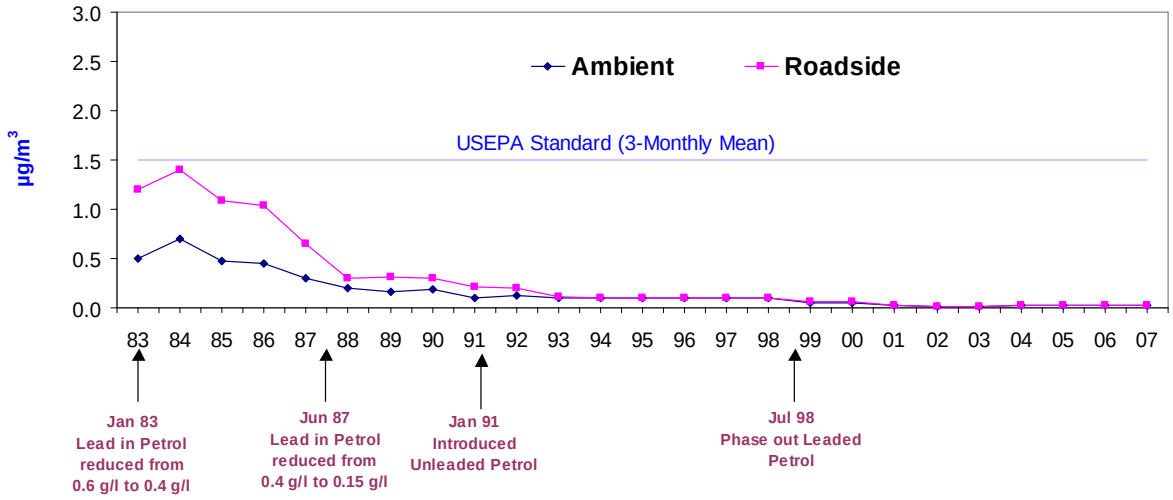
Lead compounds, such as tetra-ethyl lead and tetra-methyl lead, have for many years been added to petrol as anti-knock agents. The combustion of leaded petrol results in the emission of lead particulates into the air. If imbibed in large quantities, lead can cause irreversible damage to the brain and other organs.

Foetuses and children are particularly sensitive to the deleterious effects of lead as their nervous systems are still developing.

Lead levels in petrol had progressively been reduced since the 1980s and, in January 1991, unleaded petrol was introduced in Singapore. On 1 July 1998, leaded petrol was phased out.

The efficacy of these measures in reducing lead concentrations in the air is evident from **Chart 7**. From roadside levels of as high as 1.4 µg/m$^3$ in 1984, the lead levels have stabilised at around 0.1 µg/m$^3$ since 1992. The lead levels remained at **<** 0.1 µg/m$^3$ in 2007. The USEPA standard for three-monthly average lead level is 1.5 µg/m$^3$.

## Chart 7
**Lead Levels (1983 to 2007)**



# ENVIRONMENTAL MONITORING

## Water Monitoring

### Overview

PCD regularly monitors the water quality of various inland water bodies and coastal areas. The monitoring points are shown in **Charts 8** and **9**.

Water Quality in Water Catchment Areas

The water quality of 34 streams and 14 ponds in the water catchment areas is monitored quarterly.

Water quality of the 14 reservoirs within the water catchment areas is jointly monitored by PCD and PUB.

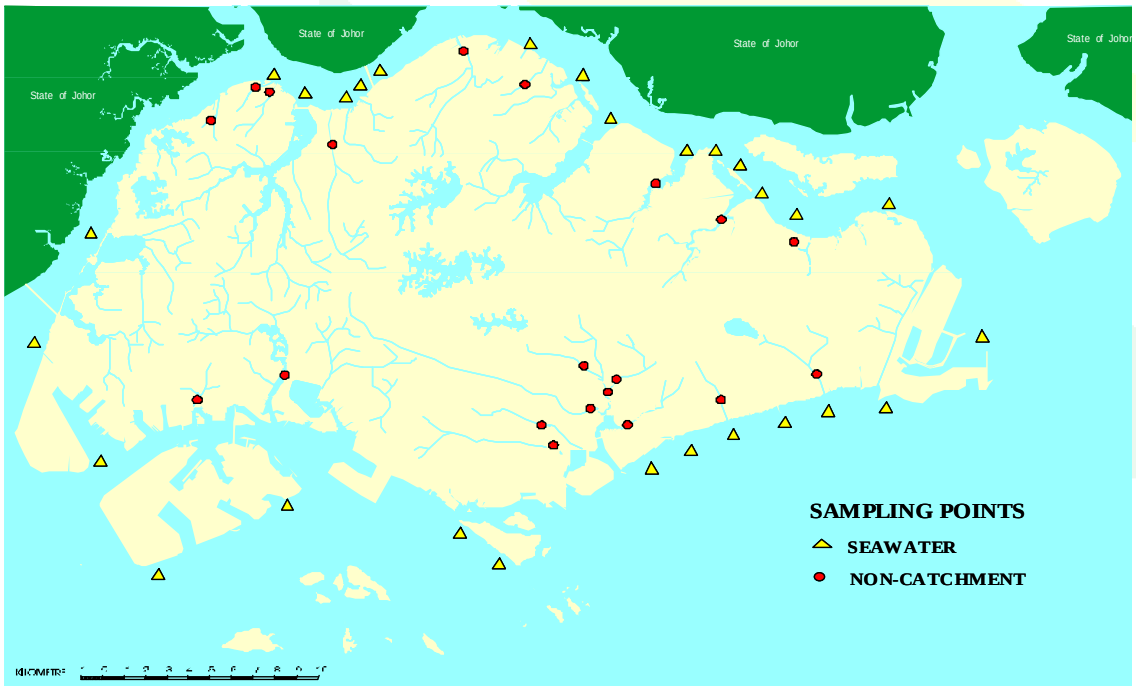
The water quality, based on the measured levels of dissolved oxygen (DO), biochemical oxygen demand (BOD) and total suspended solids (TSS) remained good in 2007. The monitoring data are shown in **Table 13**.

### Water Quality in Non-Water Catchment Areas

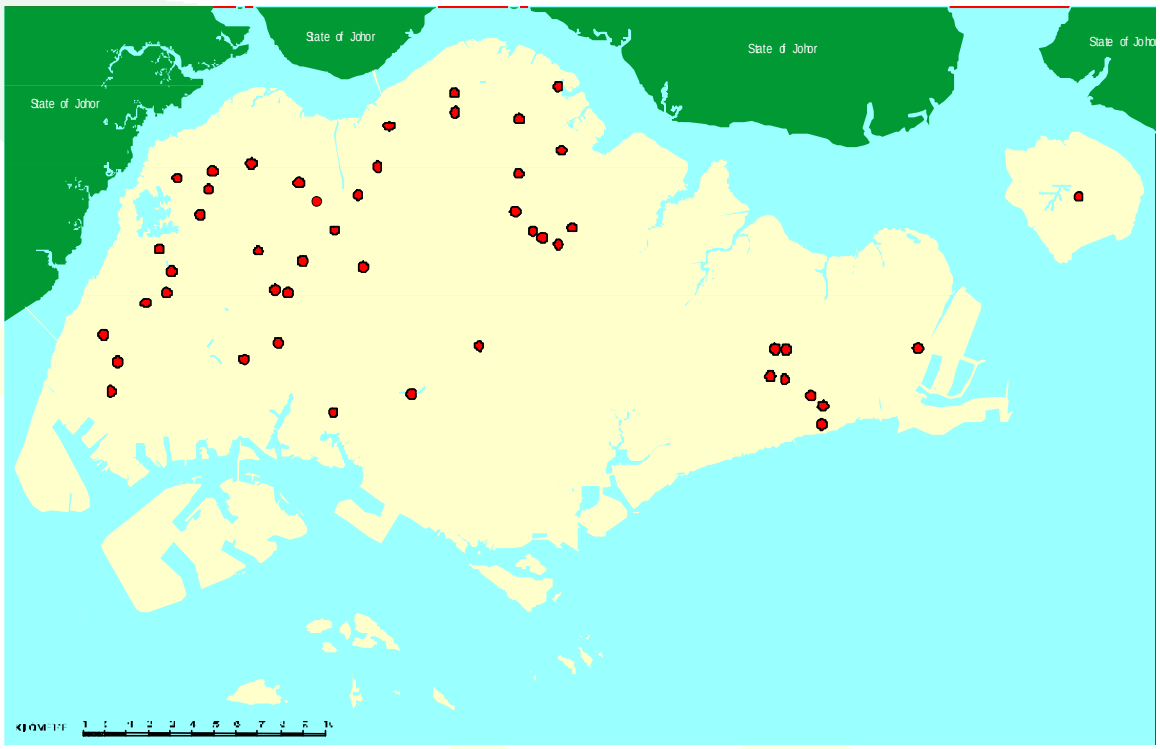
Water quality of the 20 rivers and streams in non-water catchment areas is monitored quarterly. Physical, chemical and microbiological parameters are analysed to assess the water quality. Results of the monitoring, as given in Table 13, revealed that the water quality of the rivers and streams was good.

**Chart 8**

**Locations of Non-Catchment and Seawater Sampling Points**



## Chart 9
### Locations of Catchment Sampling Points




## Table 13
### Monitoring Results of Inland Waters

| Parameter Monitored | | Water Catchment Streams (Percentage Of Time) | Non-Water Catchment Rivers/Streams (Percentage Of Time) |
|---|---|---|---|
| Dissolved Oxygen (> 2 mg/l) | 2007 | 100 % | 96 % |
| | 2006 | 100 % | 94 % |
| Biochemical Oxygen Demand (< 10 mg/l) | 2007 | 99% | 94 % |
| | 2006 | 100 % | 89 % |
| Total Suspended Solids (< 200 mg/l) | 2007 | 99 % | 100 % |
| | 2006 | 99 % | 100 % |

## Monitoring Of Coastal Waters

Water samples are collected monthly from 16 sampling points along the Straits of Johor and 12 sampling points along the Straits of Singapore. These samples are subjected to physical, chemical and microbiological examinations.

**Table 14** gives the monitoring results for the coastal waters.

### Table 14
**Monitoring Results of Coastal Waters**

| Parameter | | Straits of Johor East (Percentage of Time) | Straits of Johor West (Percentage of Time) | Straits of Singapore (Percentage of Time) |
|---|---|---|---|---|
| Faecal Coliform Count (<1,000 per 100 ml) | 2007 | 86 % | 74 % | 96 % |
| | 2006 | 92 % | 70 % | 93 % |

# 4

# Resource Conservation

## RESOURCE CONSERVATION

### Strategies

Singapore is a small island state with limited natural resources. We thus have to import most of the resources that we need.

One such key resource is energy, which fuels the growth of Singapore's economy. Energy, in one form or another, is consumed in every aspect of modern life in Singapore. As Singapore lacks the natural endowments to utilize renewable energies in a cost-effective manner, we are dependent on imported fossil fuels to meet our energy needs. The burning of these fossil fuels emits air pollutants, which have to be treated as they can negatively impact our air quality. The combustion of fossil fuels also emits carbon dioxide, which is a greenhouse gas that contributes to global warming and climate change.

In order to mitigate the impact of energy use, Singapore is promoting energy efficiency throughout all sectors of the economy. Energy efficiency not only helps to mitigate climate change by reducing the emission of carbon dioxide, it can also help to enhance air quality by reducing the emission of air pollutants like sulphur dioxide and particulate matter. Energy efficiency can also improve Singapore's economic competitiveness, since it results in overall cost savings due to lower energy bills, and can also moderate Singapore's dependence on imported fossil fuels.

Since 1970, while Singapore had enjoyed continued economic and population growth, the amount of solid waste generated has increased by about six times. We have put in place an integrated solid waste management system that ensures that waste is collected and disposed of safely in our incineration plants or the offshore Semakau Landfill. It is however not sustainable to rely solely on the provision of waste disposal facilities to meet Singapore's waste managemenet needs. We need to reduce waste going to the incinerators and the Semakau Landfill.

a) Waste minimization to reduce waste generated;

b) Recycling of waste generated to reduce the amount of waste that needs to be disposed of;

c) Volume reduction of all incinerable waste through waste-to-energy incineration; and

d) Landfilling of only non-incinerable waste that is not recycled

## RESOURCE CONSERVATION

### Climate Change

Climate change refers to the observed changes in the world's climatic conditions. There is a general consensus amongst scientists and governments that the climate is changing at an unprecedented rate, and that the observed climatic changes are very likely due to the increased emissions of greenhouse gases due to human activity. Climate change is a global phenomenon and, as an island state, Singapore will not be spared from the impacts of climate change.

There are ongoing international efforts to address the challenge of climate change. Nearly all countries in the world have ratified the United Nations Framework Convention on Climate Change (UNFCCC), as well as the Kyoto Protocol (KP). As a signatory to the UNFCCC and the KP, Singapore is committed to playing its part in addressing climate change. Given Singapore's circumstances, energy efficiency has been identified as an important strategy to reduce Singapore's greenhouse gas emissions. At the same time, Singapore is also promoting the development of clean energy by supporting research and development of clean energy.

Singapore has set a target to reduce carbon intensity (tones carbon dioxide per $GDP) by 25% between 1990-2012. Our carbon intensity in 2006 was about 31% lower than the 1990 level.

### National Climate Change Committee

The National Climate Change Committee (N3C) is an inter-agency committee with 3P (People, Private and Public sector) representation. It seeks to promote energy efficiency and the use of clean energy sources.

The N3C aims to address climate change by:

a) Promoting greater energy efficiency and less carbon-intensive energy in key sectors;

b) Raising awareness amongst the people, private and public sectors on the impacts and opportunities arising from climate change, and the actions they can take;

c) Building competency in Singapore to better respond to climate change such as through promoting research and development of low-carbon technologies; and

e) Understanding Singapore's vulnerability to climate change and facilitating the adaptation actions needed.

RCD coordinates and facilitates the N3C's programmes and provides secretariat support to the N3C and its Sub-committees and Workgroups.

## RESOURCE CONSERVATION

### Climate Change Initiatives

**a) Clean Development Mechanism (CDM)**

The CDM under KP is a mechanism that allows greenhouse gas emission reductions from projects implemented in non-Annex I[1] countries to be used to offset emissions of Annex I countries. Such projects, if implemented in Singapore, would generate carbon credits known as Certified Emission Reductions or CERs, which are tradable. Hence, any company in Singapore that is able to reduce its greenhouse gas emissions may be able to earn CERs and thereby benefit from the CDM.

NEA has been appointed as Singapore's Designated National Authority (DNA) for CDM projects under the KP. NEA's role is to ensure that CDM projects to be implemented locally meet national sustainable development criteria.

More information about Singapore's DNA can be found at
**http://www.nccc.gov.sg/cdm/cdm.shtm**

In August 2007, the Singapore DNA for CDM issued the first host country letter of approval for a proposed CDM project in Singapore to eco Pte Ltd. The ecoWise project involves recovering the waste heat from its existing biomass boiler to dry spent grain and for heating ISO tanks. The project is projected to avoid the use of up to 6.1 million litres of diesel fuel oil annually, resulting in $CO_2$ reductions of about 15,205 tons every year.

Singapore also played host to Carbon Forum Asia, a carbon market trade fair and conference whose inaugural event was held from 6-7 November 2007 in Singapore. Organized by the International Emissions Trading Association and Koelnmesse, Carbon Forum Asia was hosted by the Sustainable Energy Association of Singapore and was supported by various government agencies including MEWR, EDB, IE Singapore and NEA. Over 1000 participants from 46 countries gathered in Singapore to explore the business opportunities in emission reductions, as well as to engage with key market players in the Asian carbon market. RCD also conducted a side event at Carbon Forum Asia, introducing participants to Singapore's ongoing efforts to promote CDM.

[1] Under the KP, there are 2 categories of Parties – Annex I and non-Annex I. Annex I Parties.

**b) Study of Singapore's Vulnerability to Climate Change**

As a small island, Singapore is vulnerable to the effects of climate change. Given our national circumstances, the potential impacts of climate change on Singapore include:

a) Increased flooding;
b) Coastal land loss;
c) Water resources scarcity;
d) Public health impact from resurgence of diseases;
e) Heat stress;
f) Increased energy demand; and
g) Impacts on biodiversity

While these impacts are not due solely to climate change, they can be aggravated by adverse global climate changes brought about by increased emissions of greenhouse gases.

Singapore is aware of its vulnerabilities to climate change, and measures have been taken to help address the potential climate change impacts. There is a need to continue to improve our understanding of the detailed effects and resulting impacts of climate change on Singapore. NEA, in consultation with other government agencies, has commissioned a study team to study Singapore's vulnerability to climate change in March 2007. The study team is led by the Tropical Marine Science Institute of the National University of Singapore, and comprises both local and foreign experts. The results of the study are expected in 2 years, and will facilitate the identification of new adaptation measures as well as the review of existing adaptation measures.

## Energy Efficiency

Energy efficiency is Singapore's key strategy to address climate change. It is a cost-effective means of mitigating greenhouse gas emissions, and can also help maintain good air quality, improve economic competitiveness, and enhance energy security. While improving energy efficiency makes financial sense, there are market barriers such as the lack of information and capability that limit the implementation of energy efficiency measures.

In order to drive energy efficiency improvement in Singapore, the Energy Efficiency Programme Office ($E^2PO$) has been set up on 23 May 2007. The $E^2PO$ is an inter-agency committee chaired by NEA, and comprises the Ministry of Trade and Industry, the Economic Development Board, the Building and Construction Authority, the Housing Development Board, the Energy Market Authority, the Land Transport Authority, and the Agency for Science, Technology and Research as members. An inter-agency approach is crucial, as there is no one-size-fits-all solution for energy efficiency. Different sectors and companies face different circumstances with regards to energy efficiency, which are best addressed by sector-specific initiatives.

## RESOURCE CONSERVATION

The $E^2$PO is charged with developing a holistic energy efficiency strategy and masterplan for Singapore. The masterplan, also known as $E^2$ Singapore (Energy Efficient Singapore), was announced on 30 October 2007. $E^2$ Singapore has identified the following key thrusts to improving energy efficiency in Singapore:

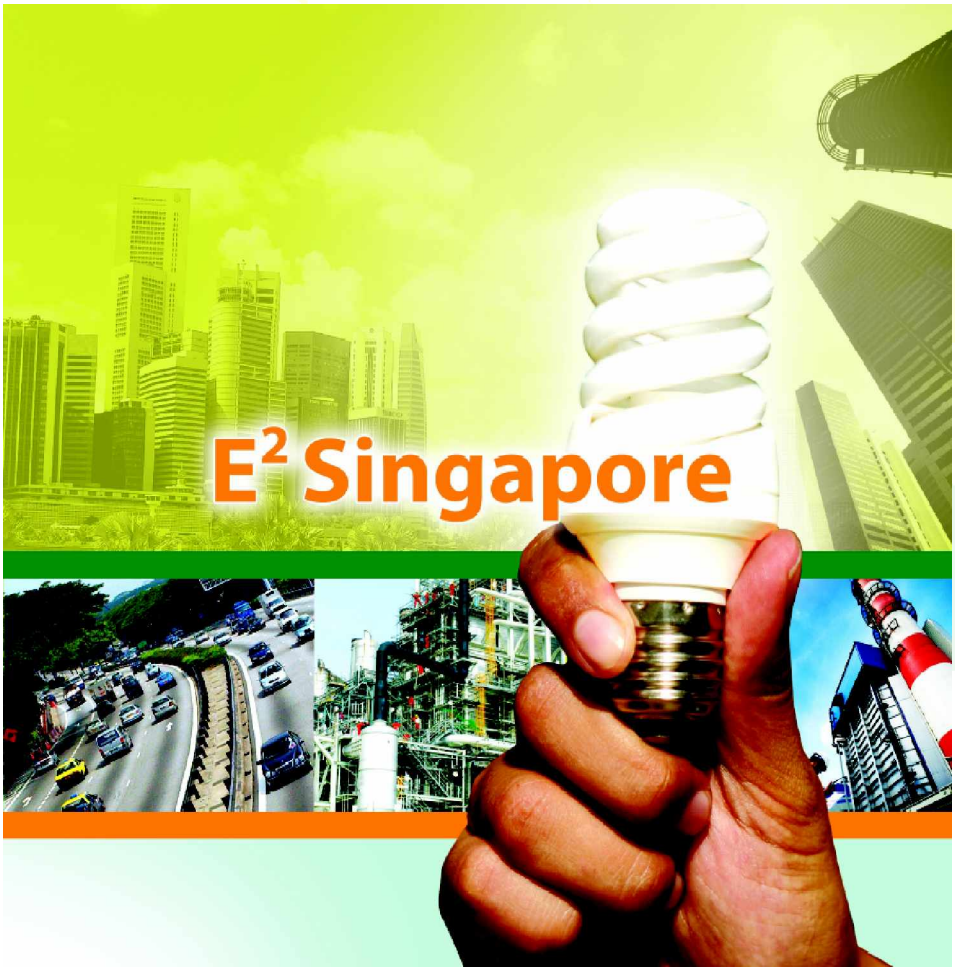
a) Promote the adoption of energy efficient technologies and measures by addressing the market barriers to energy efficiency;

b) Build capability to drive and sustain energy efficiency efforts and to develop the local knowledge base and expertise in energy management;

c) Raise awareness to reach out to the public and businesses so as to stimulate energy efficient behaviour and practices; and

d) Support research and development to enhance Singapore's capability in energy efficient technologies.

A publication, entitled $E^2$ Singapore, outlines the current energy efficiency measures undertaken in Singapore, and some of the future plans for improving energy efficiency in the various sectors of Singapore's economy.




The $E^2$ Singapore Publication

RCD serves as the secretariat to the $E^2PO$ and coordinates and facilitates its activities.

Looking forward, $E^2PO$ is looking to launch a series of initiatives in 2008 to further encourage the uptake of energy efficiency improvements in Singapore.

## Energy Efficiency Initiatives

### (a) Energy Efficiency Improvement Assistance Scheme

The S$10 million Energy Efficiency Improvement Assistance Scheme (EASe) is a co-funding scheme administered by NEA to incentivise companies in the manufacturing and building sectors to carry out detailed studies on their energy consumption and identify potential areas for energy efficiency improvement.

Under EASe, funding of up to 50% of the cost for such appraisals, subject to a cap of S$200,000, can be made available to any Singapore registered company with a building or manufacturing facilities in Singapore.

Since its launch in April 2005, 82 applications approved as at end 2007. The approved applications came from 25 manufacturing plants and 57 buildings. The improvements in energy efficiency arising from the studies will benefit the companies in terms of energy savings and help to reduce $CO_2$ emission. A total of S$2.24 million has been approved for the 82 energy studies which are estimated to generate total energy savings of 283,825 GWh or S$21.93 million per year when the energy efficiency measures are implemented. The total potential reduction in $CO_2$ emissions from these projects is estimated to be about 143.71 kilo-tonnes of $CO_2$ per year.

### (b) Energy Labelling Scheme

With the gazette of the Environment Protection and Management Act as well as associated subsidiary legislation in June 2007, mandatory energy labeling of household air-conditioners and refrigerators was introduced in Singapore. From 1 Jan 2008, all household air-conditioners and refrigerators[2] are required to be registered with NEA and be affixed with Energy Labels at the point of sale. The provision of such energy consumption information to consumers would help them to factor in energy efficiency into their purchasing decisions.

[2] All air-conditioners and refrigerators meeting the definition of registrable goods under the Environment Protection and Management (Registrable Goods) Order are subject to mandatory energy labelling

Energy Labels

### (c) Fuel Economy Labelling Scheme

The fuel economy labelling scheme started off as a voluntary scheme jointly administered by the Singapore Environment Council (SEC) and NEA to promote fuel-efficient cars. As of December 2007, 84 car models were issued with the Fuel Economy Label, representing 17% of the car models in the market. Mandatory fuel economy labelling for vehicles will be introduced by 1 April 2009.

### (d) Energy Smart Buildings Scheme

Jointly developed by NEA and the Energy Sustainability Unit of the National University of Singapore, the Energy Smart Buildings Scheme gives recognition to buildings in the top 25 per cent of their category for achieving exemplary energy efficiency without compromising indoor environmental quality.

The objectives of the Scheme are as follows:

a) To accord recognition to buildings with exemplary energy performance, without compromising indoor environment quality;

b) To encourage building owners and professionals to give due consideration for building energy efficiency during the design, development and management stages; and

c) To provide a quantitative and objective measure by which building owners can set energy performance targets and track their progress in improving their energy efficiency.

For a start, the Scheme targeted office buildings. The first recipients of the award were the Environment Building, Revenue House, SIA Computer Centre, JTC Summit, Alexandra Point, Fuji Xerox Tower, City House and Republic Plaza.

From 3 August 2007, the Energy Smart Scheme has been expanded to include hotels. Studies conducted in Singapore and other parts of the world have identified hotels as one of the more energy-intensive type of building. With the expected increase in hotel rooms and hotel occupancy rates, energy consumption by hotels is expected to grow. By recognizing the best-performing hotels in terms

of energy efficiency, the scheme could help to motivate other hotels to make energy efficiency improvements as well as demonstrate to hotel owners that it is economically viable for them to implement cost effective energy efficiency measures. The inaugural list of hotels that have been given the Energy Smart Hotel label were The Regent Singapore, Shangri-La Hotel, Intercontinental Hotel, and Changi Village Hotel.

The Energy Smart Hotel and Energy Smart Office Labels

To disseminate information on the Energy Smart Hotel Scheme and to share best practices on energy conservation and energy audits, RCD had worked with the Energy Sustainability Unit of the National University of Singapore and the Singapore Hotel Association to organize a seminar entitled “Towards Performing Energy Smart Hotels” on 3 August 2007. The seminar updated participants on the trends of energy conservation efforts and energy usage in hotels in Singapore, and provided them with the findings of recent studies on energy performance, indicators, and benchmarks for hotels.

The scheme will be further extended to include shopping complexes and hospitals in due course.

### (e) Regional Capacity Building

The 18th German-Singapore Environmental Technology Agency (GSETA) Asia-Pacific Regional Seminar, entitled "Climate Change and Sustainable Tourism", was held in Singapore from 23-25 October 2007. The GSETA, which is a partnership between Singapore's Ministry of the Environment and Water Resources and Germany's Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety, serves as a vehicle for the transfer of environmental technology and know-how to the Asia-Pacific region. Experts from the Asia-Pacific region, Germany, and international organisations such as the UNEP, IUCN, and the UNFCCC shared insights on climate change and sustainable tourism at the seminar.

An exhibition was held in conjunction with the seminar to provide participants with information on the technologies available to help address climate change, as well as to promote technology transfer. Exhibitors demonstrated to participants a wide range of technologies, including:

a) Renewable energy,
b) Energy efficient lighting systems,
c) Recycling of wood waste and food waste,
d) Energy efficiency in buildings, and
e) Energy auditing

18th GSETA Regional Seminar - Exhibition

## Overview on Waste Minimisation and Recycling Programmes

### State of Waste Recycling

Since the early 1990s, Singapore has been actively promoting waste minimisation and recycling to reduce the waste disposed of at the incineration plants and landfill. In 2007, the overall rate of recycling increased to 54 % as compared to 51 % in 2006.

**Table 15** provides the details on the waste disposal and recycling rates for 2007.

**Table 15**
**Waste Statistics and Recycling Rates for 2007**

| Waste Type | Waste Disposed of (tonne) | Total Waste Recycled (tonne) | Total Waste Output (tonne) | Recycling Rate (%) |
|---|---|---|---|---|
| Food | 507,700 | 51,200 | 558,900 | 9 |
| Paper/Cardboard | 583,900 | 619,000 | 1,202,900. | 51 |
| Plastics | 584,800 | 75,000 | 659,800 | 11 |
| Construction Debris | 19,000 | 759,300 | 778,300 | 98 |
| Wood/Timber* | 118,400 | 127,800 | 246,200 | 52 |
| Horticultural* | 133,500 | 91,100 | 224,600 | 41 |
| Ferrous Metals | 68,500 | 668,000 | 736,500 | 91 |
| Non-ferrous Metals | 16,700 | 75,600 | 92,300 | 82 |
| Used Slag | 7,200 | 520,000 | 527,200 | 99 |
| Sludge | 124,600 | 0 | 124,600 | 0 |
| Glass | 59,500 | 5,800 | 65,300 | 9 |
| Textile/Leather | 104,100 | 6,000 | 110,100 | 5 |
| Scrap Tyres | 3,500 | 22,000 | 25,500 | 86 |
| Others (stones, ceramics & rubber) | 234,600 | 14,000 | 248,600 | 6 |
| **Total:** | **2,566,000** | **3,034,800** | **5,600,800** | **54** |

* Includes 70,000 tonnes used as fuel in cogen plant

## RESOURCE CONSERVATION

### Waste Management and Recycling Industry

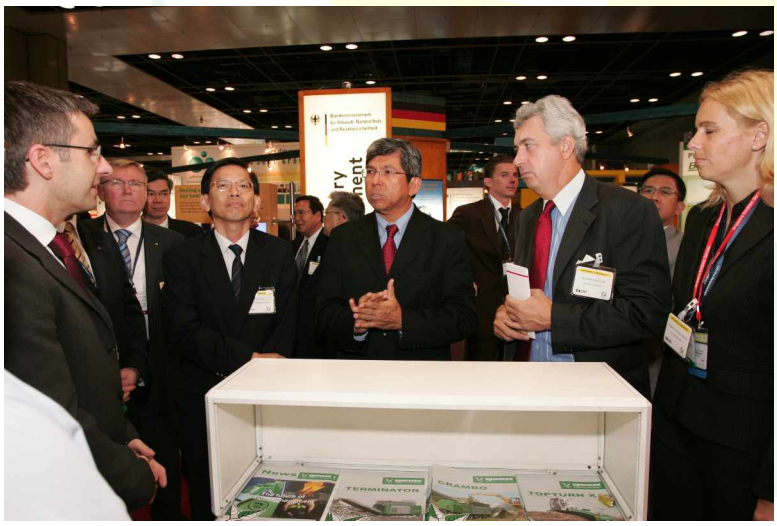
There are about 450 companies in the waste management and recycling industry in Singapore. They range from small operators to multi-national companies. Most of the companies are in the waste collection business with the rest involved in the waste sorting and recycling business.

The Waste Management and Recycling Association of Singapore (WMRAS), was established on 8 August 2001. It has about 70 members. The association plays an important role in helping the local waste management and recycling industry to grow and develop.

EnviroAsia 2007 was held from 27 Nov to 30 Nov 07 at Suntec Singapore International Convention and Exhibition Centre. WMRAS, Singapore Water Association (SWA) and Singapore Association For Environmental Companies (SAFEco) were the association partners whilst NEA, MEWR and PUB hosted the event. The event had more than 100 exhibitors and attracted over 5,000 visitors from 51 countries.

WMRAS would also be organising the International Solid Waste Association (ISWA) Congress 2008 in Singapore. ISWA is headquartered in Copenhagen, Denmark. This would be the second time an ISWA Congress is held in Asia. WMRAS also participated in various programmes such as NEA's Clean & Green Singapore 2007, and Recycling Day 2007.

WMRAS was also a signatory of the Singapore Packaging Agreement that was signed on 5 June 2007.



EnviroAsia 2007 Promoting Innovation in the Recycling Industry

To encourage and assist industries to undertake innovative environmental projects that could help in achieving the goal of environmental sustainability, a S$20 million Innovation for Environmental Sustainability (IES) Fund was set up in 2001. So far, more than 13 companies have been granted IES funding support to test-bed new techniques or innovative methods to turn recyclables into marketable materials.

## RESOURCE CONSERVATION

In 2007, two asphalt-manufacturing companies – Ley Choon Constructions and Engineering Pte Ltd and Samwoh Asphalt Premix Pte Ltd, were granted IES funding to set up facilities for the recycling of milled waste for asphalt production for road construction use.

### National Recycling Programme

In April 2001, the NEA launched the National Recycling Programme (NRP) for households in Housing & Development Board (HDB) and private residential estates. Under this programme, public waste collectors (PWCs) licensed by NEA provide fortnightly door-to-door collection of recyclables. Each household is provided with either a recycling bag or bin to store their recyclables such as waste paper, metal drink cans, glass bottles, old clothing, drink cartons and plastic bottles. Residents put out their recycling bags or bins outside their doors for collection on scheduled collection days.

The programme has achieved a participation rate of 63% in 2007, up from 59% in 2006.

To complement the NRP and in response to feedback from residents, NEA had worked with PWCs and Town Councils to introduce at least one set of centralised recycling depositories for every five blocks of HDB flats. In August 2007, all 1600 sets of recycling depositories had been deployed.

Centralised Recycling depositories in HDB estates

### Recycling Day 2007

NEA organises a Recycling Day every year as part of a community outreach programme to re-iterate the importance of 3R (Reduce, Reuse, Recycle) to the community. Recycling Day helps to create awareness and support for Singapore's recycling efforts and involves various 3P partners from the Public, Private as well as the People sectors.

Recycling Day 2007 was successfully held on 24 Nov 2007. The main event site was at the Central Stage @ Ang Mo Kio Town Centre and the other 3 satellite locations were Bukit Batok Central, Pasir Ris Street 11 and Punggol Community Club.

Stage Performances at Recycling Day 2007

Other than learning about how they could do their bit for the environment, participants are also treated to games, exhibitions, contests, quizzes, stage performances and magic shows.

Minister at Recycling Day 2007

Minister graced the event and as one of the main highlights, launched the 3R Programme for Preschools together with Mayor Central Singapore District, CEO (NEA) and representatives from PAP Community Foundation (PCF) and Presbyterian Community Services (PCS) at the main site in Ang Mo Kio.

Another of the key events was the Champion Recycler, which rewarded the recycler who brought in the most amounts of recyclables in terms of weight. An overwhelming response was received and the top recycler brought in more than 3,100 kg of recyclables at the Bukit Batok site and therefore bagged the top prize of $300 NTUC vouchers sponsored by Tetra Pak Jurong Pte Ltd.

Collection of Recyclables

## Recycling Programme in Condominiums

Condominiums, where Management Corporations decide whether to have recycling programmes, were still lagging behind in providing recycling facilities.

In response to rising calls from condominium residents for a recycling programme to serve their estates, NEA has been working with partners such as Singapore Institute of Surveyors and Valuers, Association of Property and Facility Managers, Neighbourhood Committees, Management Corporations, etc. to get more condominiums and private apartment developments to roll out recycling programme within their premises voluntarily.

Despite these efforts, as of December 2007, the percentage of condominiums with recycling programmes was only slightly up at 50%, from 43% in 2006. They included 8 “clusters of condominiums” which were served by shared public recycling depositories located within 1 km from their estates. To address this, NEA would mandate the provision of recycling facilities in condominiums and private apartment developments by 2009, starting with the larger condominium estates.

## RESOURCE CONSERVATION

### Recycling Programme at Schools

Recognising the need to start the young on recycling early, a structured waste recycling programme for schools was launched by NEA in collaboration with recycling companies and the SEC on 12 September 2002. The recycling programme involves the setting up of recycling areas in schools where recycling bins for paper, cans, and plastic are placed at designated areas called Recycling Corners. Educational materials are also made available at the Recycling Corners to raise awareness on waste minimisation and recycling among students. Talks, activities, and surveys organised by NEA and SEC were conducted to sustain the recycling programme. The percentage of schools with the recycling programme has increased from 84% in 2006 to 95% in 2007. This includes the 5% of schools that have set up their own recycling programmes.

Recycling Corner

The PWCs launched various recognition and incentive schemes to encourage schools to recycle waste. For example, reward points were given for recyclables collected, and these points can be exchanged for items such as printers and stationery. In September 2004, a PWC, Altvater-Jakob, launched their recognition and incentive scheme called SMART (Students Must Always Recycle Trash) programme. The SMART programme gives recognition to the best performing schools. In 2006, another PWC, SembWaste, launched a programme called RECESS (Recycling is Championed and Encouraged by Students in Schools) to encourage and recognise the recycling efforts of students and teachers.

## RESOURCE CONSERVATION

### Recycling Bins at Public Places

Recyclable waste such as flyers, newspapers, drink cans and plastic bottles are also generated in large quantities at public places. To supplement the National Recycling Programme, NEA has been working with various partners to provide recycling bins at public places with high human traffic such as shopping malls, hawker centres and markets, food courts, institutions, HDB estates, community centres and outside MRT stations. The presence of recycling bins serves also to remind the public of recycling. By end 2007, there were approximately 3,800 recycling bins set up in public places.

Public Recycling Bins

### Recycling at Industrial Estates

Recycling programmes for flatted factories in JTC Corporation's industrial estates was launched on 28 November 2003. The programme provided a practical way for small and medium size factories occupying high-rise factory buildings to recycle waste. In this programme, recycling bins were placed at convenient locations such as the lift lobbies of each block at the estate for factories to deposit recyclable wastes. In addition, designated areas have been set up at bin centres within the estate for wooden pallets for reuse or recycling. To date, all 21 JTC flatted industrial estates and all 9 terraced-workshop industrial estates have joined the scheme.

A guidebook on waste minimisation for industries was developed to help companies reduce waste through more efficient and effective use of resources, reusing and recycling.

## Singapore Packaging Agreement

NEA signed the Singapore Packaging Agreement with 5 industry associations representing more than 500 companies, 19 individual companies, 2 non-governmental organizations, the Waste Management & Recycling Association of Singapore and the 4 public waste collectors in a ceremony held at the Ulu Pandan Community Club, on 5 June 2007.

The Agreement represents a collaborative effort between the government, industry and NGOs to work towards reducing waste in Singapore. The Agreement will last for a period of 5 years, with effect from 1 July 2007. The Agreement is voluntary, to provide greater flexibility for the industry to adopt cost-effective solutions to reduce packaging waste. For a start, the programme will focus on food and beverage (F&B) packaging, as this is one of the most commonly seen type of packaging waste in our households today.