

AIR QUALITY



Photo 1: Urban Air Pollution from Mobile Sources

(DOE Photo Library)

Malaysia experienced short periods of slight to moderate haze in the months of June, August and September brought about mainly by trans-

AIR QUALITY MONITORING

The Department of Environment (DOE) monitors the country's ambient air quality through a network of 51 stations (Map 1a and 1b). These monitoring stations are strategically located in both residential and industrial areas to detect any significant change in the air quality which may be harmful to human health and the environment.

The National Air Quality Monitoring network is also supplemented by manual air quality monitoring stations (High Volume Sampler) located at 25 different sites. At these sites, total suspended particulates, particulate matter (PM_{10}) and several heavy metals such as lead are measured once in every six days.

AIR QUALITY STATUS

The air quality status for Malaysia is determined according to the Air Pollutant Index (API) as shown in Table 1. The overall air quality for Malaysia throughout 2004 deteriorated slightly compared to the previous year. Several unhealthy air quality days were recorded at various locations in Wilayah Persekutuan Kuala Lumpur, Selangor, Penang, Perak, Negeri Sembilan and Melaka. The unhealthy days recorded in the Klang Valley (Wilayah Persekutuan Kuala Lumpur and Selangor) and Negeri Sembilan were mainly caused by high concentrations of ground level ozone.

On the other hand, the unhealthy air quality recorded in other parts of the country was mainly due to high levels of PM_{10} . In 2004,

API	Air Quality Status
0-50	Good
51-100	Moderate
101-200	Unhealthy
201-300	Very unhealthy
>300	Hazardous

influence of south westerly winds contributed to the deterioration of air quality in the west coast of Peninsular Malaysia. The fires in Kalimantan also contributed to the slight haze in the southern part of Sarawak. Apart from these haze episodes, there was no other serious incidences air pollution in 2004. Particulate Matter (PM_{10}) and ground level ozone remained the prevailing pollutants in the country.

In 2004, the air quality in the Klang Valley was in the moderate category 70 percent of the time and the predominant pollutant was ozone formed by the reaction of volatile organic compounds (VOCs) and NO_x in the presence of strong solar radiation. However, PM_{10} was the predominant pollutant for unhealthy conditions in the dry season during the south westerly monsoon. The highest number of unhealthy days recorded at one location in 2004 was 88 days, compared to 56 days in 2003 (Figure 1). The overall air quality status in Klang Valley is shown in Figure 2.

Northern Region

In the northern region of the West Coast of Peninsular Malaysia, comprising the States of Perlis, Kedah including Langkawi, Pulau Pinang and Perak, the overall air quality was between good and moderate most of the time. Good air quality was recorded in Langkawi, Pulau Pinang (USM), Taiping and Alor Setar more than 55 percent of the time. Kangar experienced good air quality for 24 percent of the time and moderate air quality for the rest of the remaining time. Sungai Petani experienced 40 percent of good air quality time, 58 percent moderate and remaining 2 percent unhealthy quality mainly due to high levels of ozone concentration.

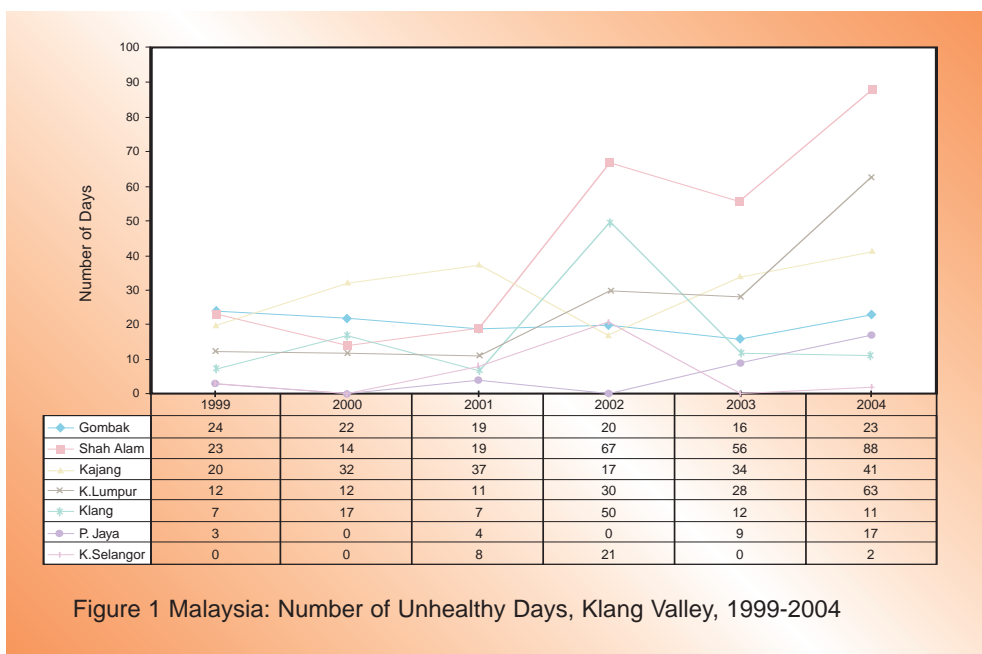


Figure 1 Malaysia: Number of Unhealthy Days, Klang Valley, 1999-2004

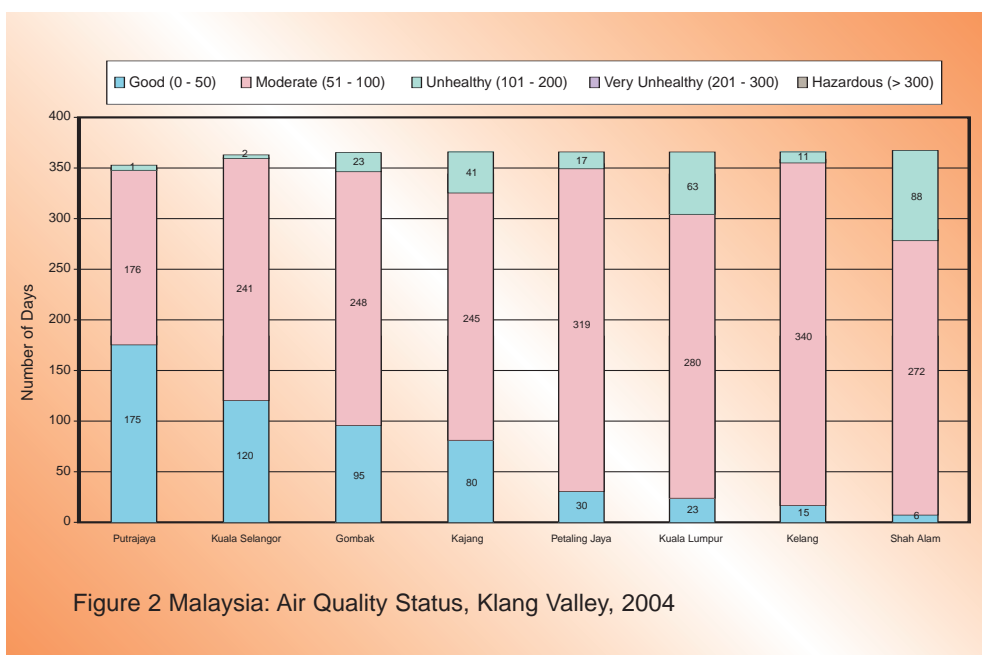
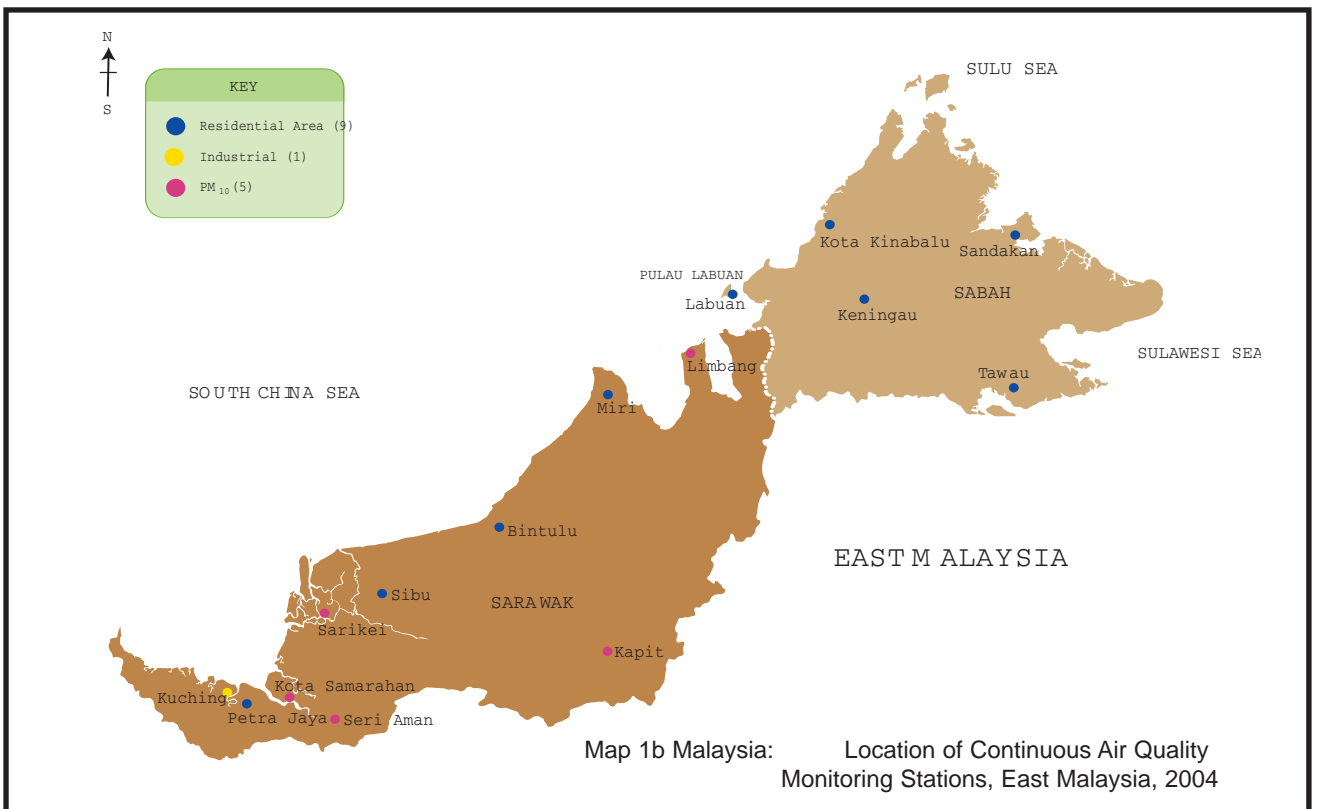
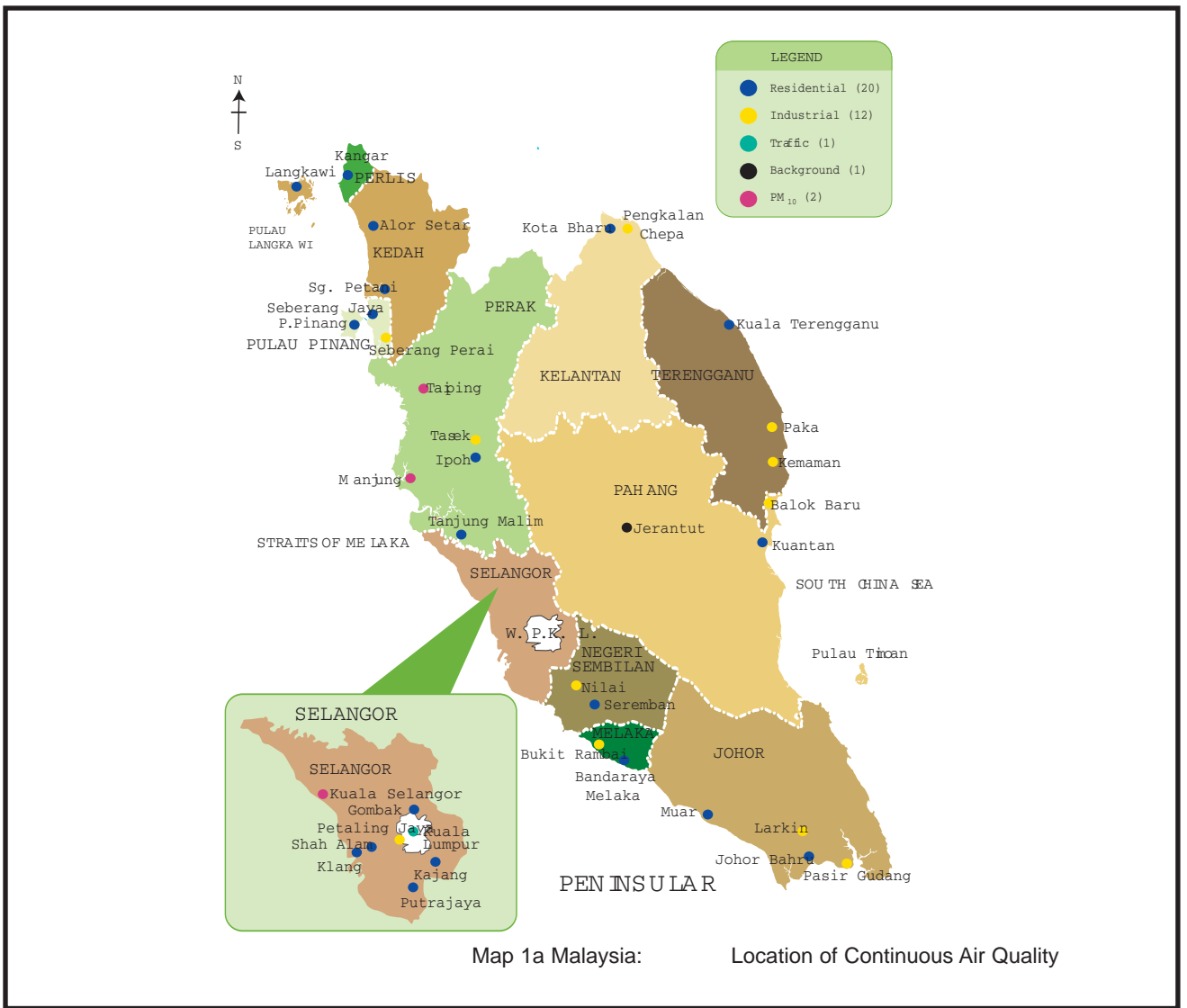


Figure 2 Malaysia: Air Quality Status, Klang Valley, 2004

Air quality stations in Seberang Prai recorded moderate air quality 97 percent of the time and unhealthy air quality for the remaining three percent. PM_{10} was the main pollutant detected in the area. Main sources of PM_{10} identified were industrial activities, motor vehicle emissions and trans-boundary pollution which occurred during the south westerly monsoon. Notably, the high levels of sulphur dioxide (SO_2) observed in previous years were significantly reduced. This could be attributed to the measures taken to promote the use of cleaner fuel such as natural gas in the industrial combustion process.



Southern Region

Similarly, the status of air quality observed in the southern region of the West Coast of Peninsular Malaysia, which incorporates the States of Negeri Sembilan, Melaka and Johor, was between good to moderate most of the time, with the exception of a few unhealthy days. In Negeri Sembilan, the air quality station in Seremban recorded 66 percent moderate air quality days, 33 percent good air quality days and one percent (3 days) unhealthy air quality days in 2004. In Nilai, it was observed that more moderate air quality days (81%) were recorded as compared to good days (16%). Throughout the year, seven unhealthy days were recorded in this

area. Nilai is located south of the Klang Valley and is bounded by a mountain range on the eastern side which reduces dispersion of industrial emission in the area. This topography also contributes to the accumulation of PM₁₀ and ground level ozone generated by industrial activities and motor vehicle emissions.

In Bandaraya Melaka, the air quality was good for more than 60 percent of the time, while in Bukit Rambai the air quality was moderate 97 percent of the time. Both areas recorded several unhealthy air quality days mainly due to trans-boundary pollution during the south westerly monsoon. Bukit Rambai has an air quality station located in a wood-based industrial zone. All four

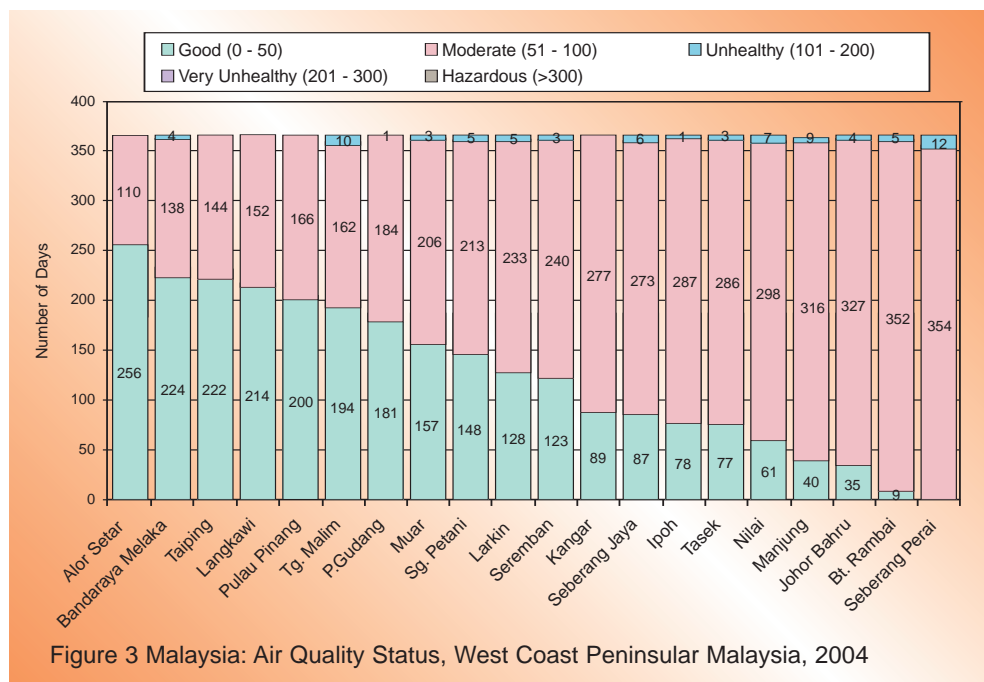


Figure 3 Malaysia: Air Quality Status, West Coast Peninsular Malaysia, 2004

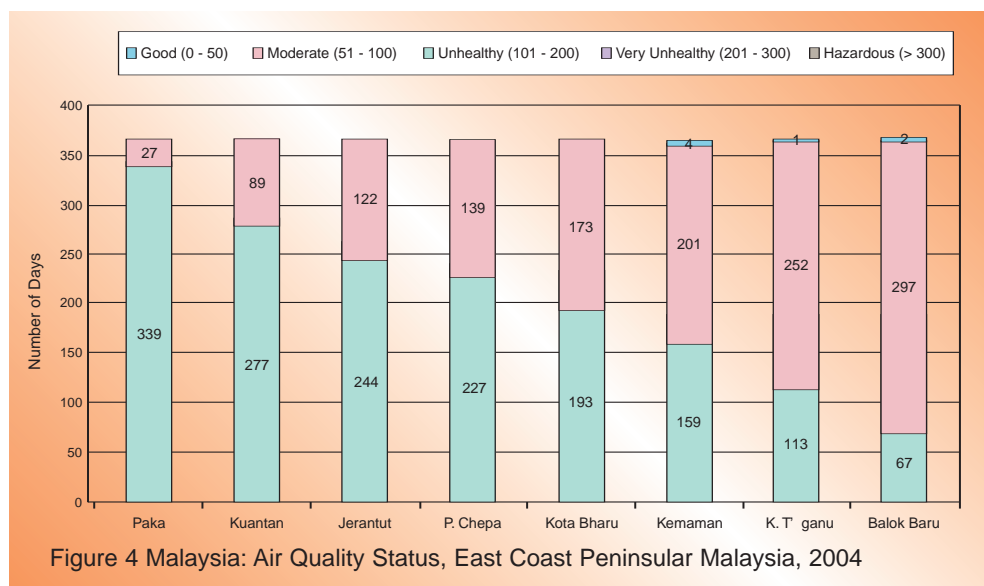


Figure 4 Malaysia: Air Quality Status, East Coast Peninsular Malaysia, 2004

stations in Johor recorded less than 50 percent good air quality days and several unhealthy air quality days in 2004. Ozone was the predominant pollutant causing unhealthy days in these areas. Figure 3 describes the overall air quality status for the West Coast of Peninsular Malaysia.

Air Quality Status in the East Coast

The air quality in the East Coast of Peninsular Malaysia remained good most of the time. Areas such as Kuantan, Jerantut, Paka and Pengkalan Chepa experienced good air quality for more than 60 percent of the time, while Kemaman, Kuala Terengganu, Kota Bharu and Balok Baru experi-

Air Quality Status in Sabah, Wilayah Persekutuan Labuan and Sarawak

The air quality in Sandakan, Kota Kinabalu and Keningau in Sabah was good for more than 85 percent of the time, while Tawau recorded more moderate air quality than good air quality days. No unhealthy days were recorded at all the locations in Sabah. In Labuan, the air quality was good 83 percent of the time and moderate for the remaining 17 percent.

Most stations in Sarawak experienced more than 85 percent good air quality days in 2004 (Figure 5). Stations in Sri Aman, Petra Jaya and Samarahan recorded between two and 17 unhealthy air quality days. The unhealthy air quality days were caused by high concentrations of particulate level due to trans-boundary pollution.

AIR QUALITY TRENDS

Six criteria pollutants, namely Carbon Monoxide (CO), Nitrogen Dioxide (NO₂), Ozone (O₃), Sulphur Dioxide (SO₂) and Particulate Matter (PM₁₀) were monitored continuously at 51 locations, while Lead (Pb) concentration was measured once in every six days at three locations. The air quality trend for the period 1996 to 2004 was computed by averaging direct measurements from the monitoring sites on a yearly basis and cross-referene to the Malaysian Ambient Air Quality Guidelines shown in Table 2.

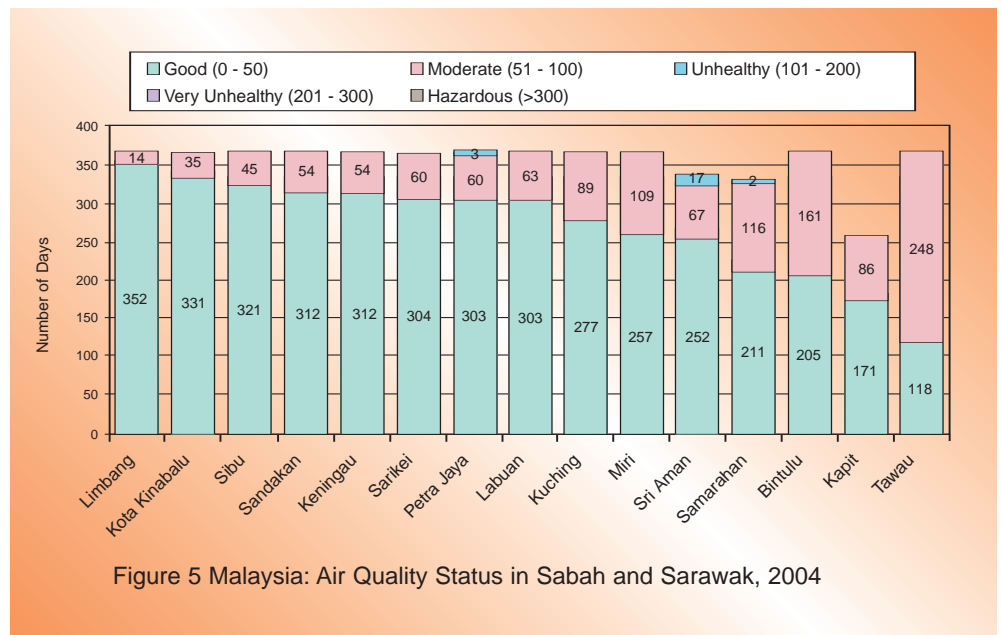


Figure 5 Malaysia: Air Quality Status in Sabah and Sarawak, 2004

Table 2 Malaysia: Ambient Air Quality Guidelines

Pollutant	Averaging Time	Malaysia Guideline	
		ppm	(ug/m ³)
Ozone	1 Hour	0.10	200
	8 Hours	0.06	120
Carbon Monoxide	1 Hour	30	35
	8 Hours	9	10
Nitrogen Dioxide	1 Hour	0.17	320
	24 Hours	0.04	
Sulphur Dioxide	1 Hour	0.13	350
	24 Hours	0.04	105
Particulate Matter (PM ₁₀)	24 Hours		150
	1 Year		50
Total Suspended Particulate (TSP)	24 Hours		260
	1 Year		90
Lead	3 Months		1.5

Particulate Matter (PM₁₀)

Particulate Matter is the general term used to describe respirable particles of less than 10 microns in size. They may be from motor vehicle exhaust,

This pollutant can cause eye and throat irritation, and the accumulation of particulate matter in the respiratory system is associated with numerous respiratory problems such as decreased lung function. High levels of particulate matter can also pose health risk to sensitive groups such as children, the elderly and individuals with asthma or cardiopulmonary diseases.

Particulate matter (PM₁₀) can also cause undesirable impact on the environment. The presence of high levels of PM₁₀ in the atmosphere is a major cause of reduced visibility, resulting in hazy conditions especially during the dry season. Other environmental impacts can occur when particulate matter is deposited onto soil, plants, water or other materials.

Depending on the chemical composition of these substances, when particulate matter is deposited in sufficient quantities, it may change the nutrient balance and acidity in soil, interfere with plant metabolism and change the composition of the materials.

PM₁₀ continues to be the prevalent pollutant in many areas in Malaysia. The annual average lev-

els of PM₁₀ concentration in the ambient air between 1996 and 2004 were just slightly below the Malaysian Ambient Air Quality Guideline for PM₁₀ except in 1997, when the country experienced severe haze episodes, and in 2002, when the annual average concentration of PM₁₀ was equivalent to the Malaysian Ambient Air Quality Guidelines.

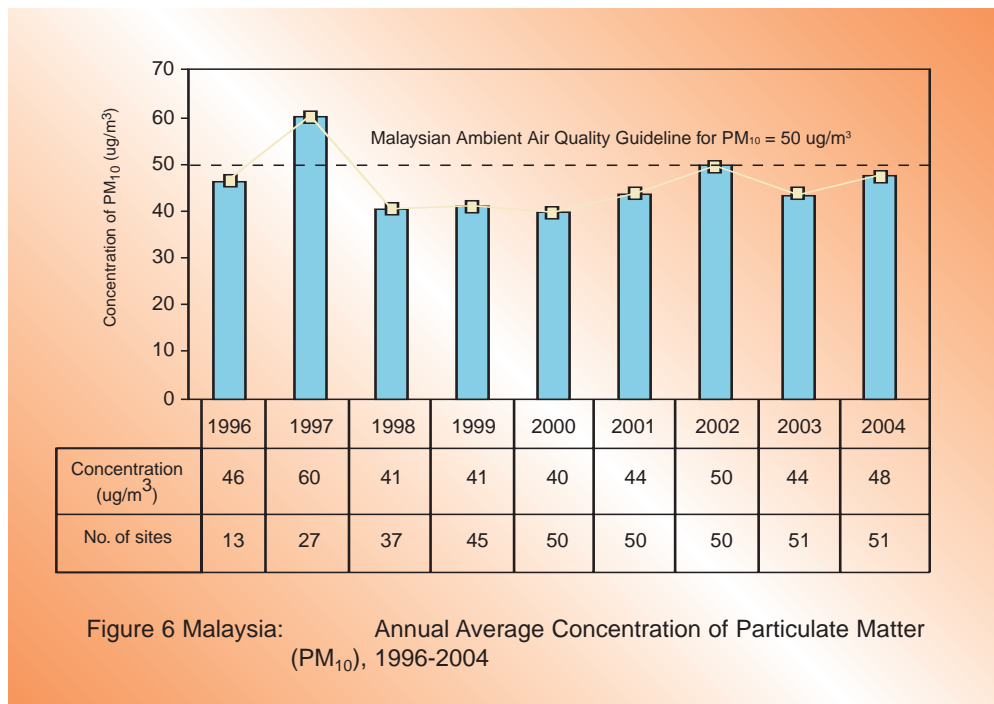


Figure 6 Malaysia: Annual Average Concentration of Particulate Matter (PM₁₀), 1996-2004

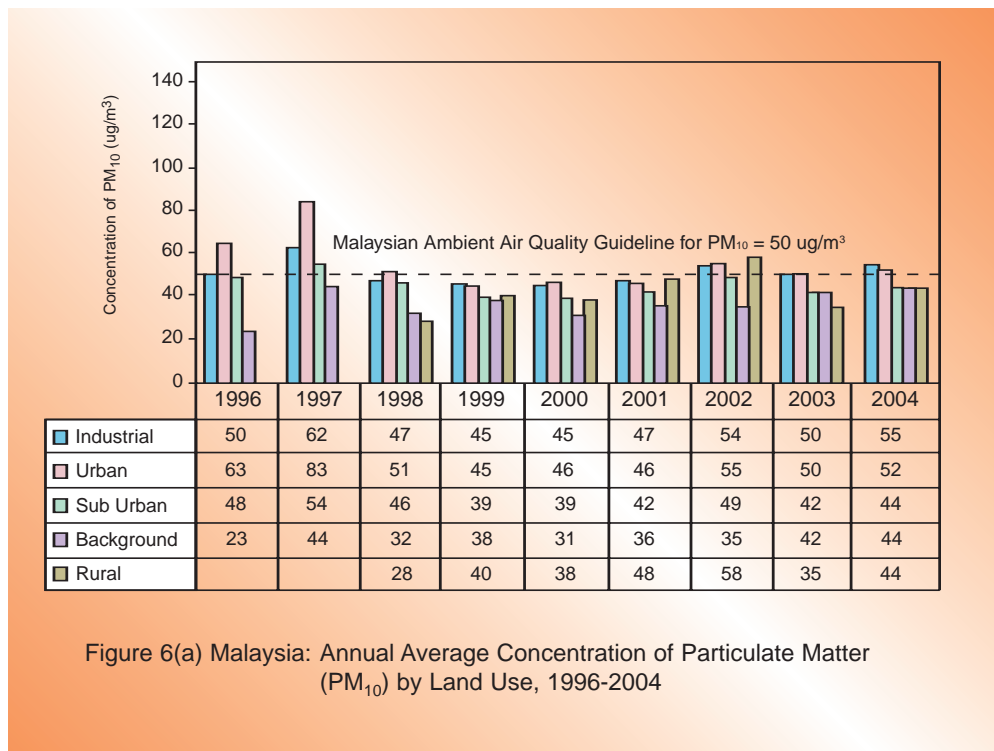


Figure 6(a) Malaysia: Annual Average Concentration of Particulate Matter (PM₁₀) by Land Use, 1996-2004



Photo 2: Aerial Photo of Open Burning at Agricultural Site (DOE Photo Library)

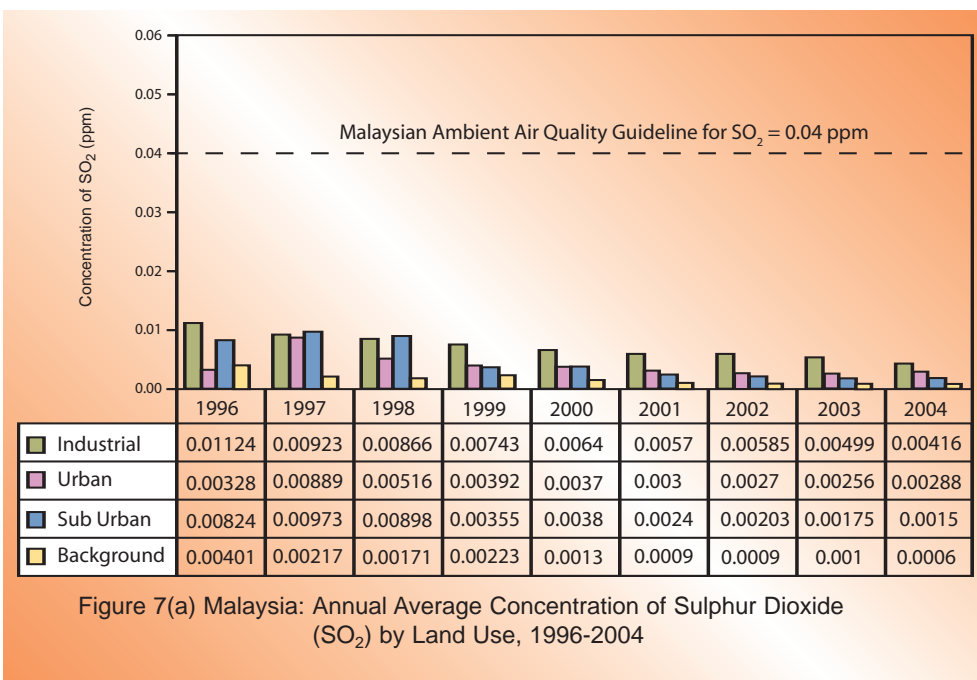
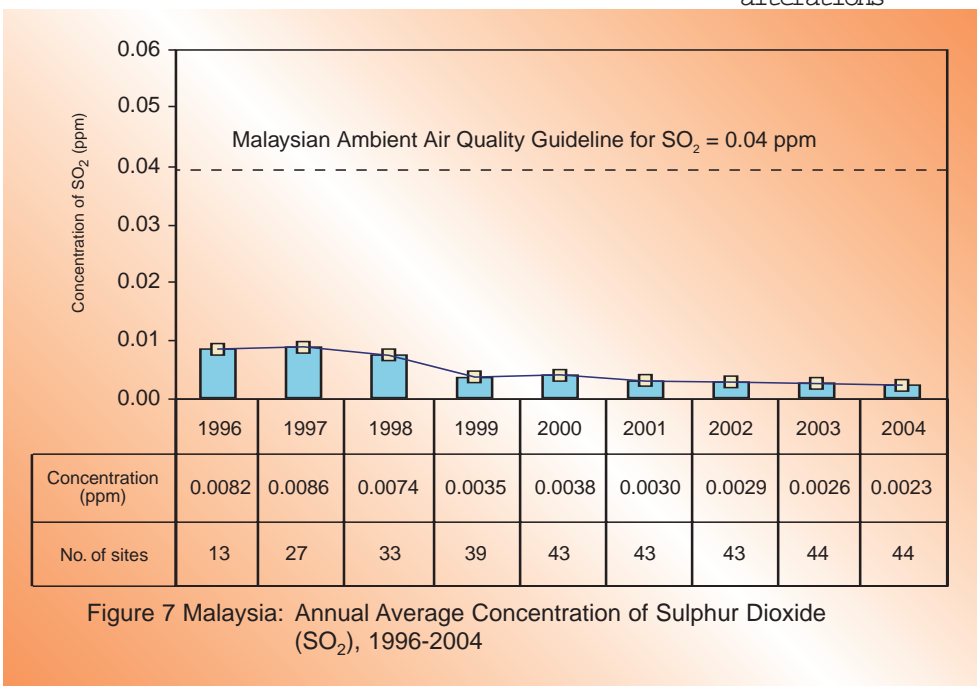
Sulphur Dioxide (SO₂)

Sulphur Dioxide is a colourless, pungent, irritating, water-soluble reactive gas. This gas is formed during the combustion process of fuel containing sulphur (e.g. oil and coal) mainly in industrial activities. High concentrations of SO₂ in the atmosphere increase the risk of adverse symptoms in asthmatic patients and irritate the respiratory system. Other effects associated with long-term exposure to high concentrations of SO₂ coupled with high levels of particulate matter include respiratory illnesses, alterations

in lung function and aggravation of existing cardiovascular diseases.

There are also environmental concerns associated with high concentrations of SO₂. Sulphur dioxide along with NO_x is a major precursor to acidic deposition, which contributes to the acidification of soils, lakes and streams and can cause adverse impact on the ecosystem. Sulphur dioxide can also be harmful to plant life and accelerates the corrosion of buildings and monuments.

The annual average levels of SO₂ in the ambient air between 1996 and 2004 (Figure 7) were well below the Malaysian Ambient Air Quality Guideline. Figure 7(a) shows the annual average concentra-



Nitrogen Dioxide (NO₂)

Nitrogen dioxide (NO₂) is a reddish brown, highly reactive gas that is formed in the ambient air through the oxidation of nitrogen monoxide. Nitrogen oxides (NO_x) is the term used to describe the sum of NO, NO₂ and other oxides of nitrogen. The major sources of man-made NO_x emissions are high-temperature combustion processes, such as those occurring in automobiles and power plants. Most of the NO_x (95 percent) from combustion processes are emitted as NO and the rest as NO₂. Nitrogen monoxide (NO) is readily converted to NO₂ in the environment.

Short-term exposure to NO₂ may lead to changes in airway responsiveness and lung function in individuals with pre-existing respiratory illnesses and increases respiratory illness in children. Long-term exposure may increase susceptibility to respiratory infection and cause alteration in lung function. Nitrogen oxides also react in the air to form ground-level ozone and fine

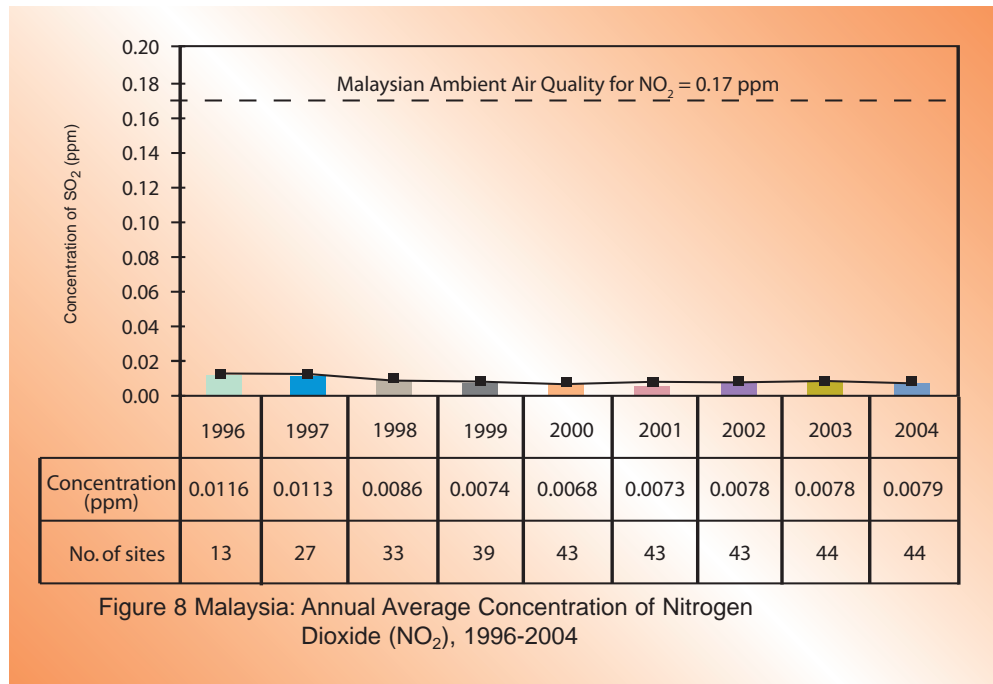


Figure 8 Malaysia: Annual Average Concentration of Nitrogen Dioxide (NO₂), 1996-2004

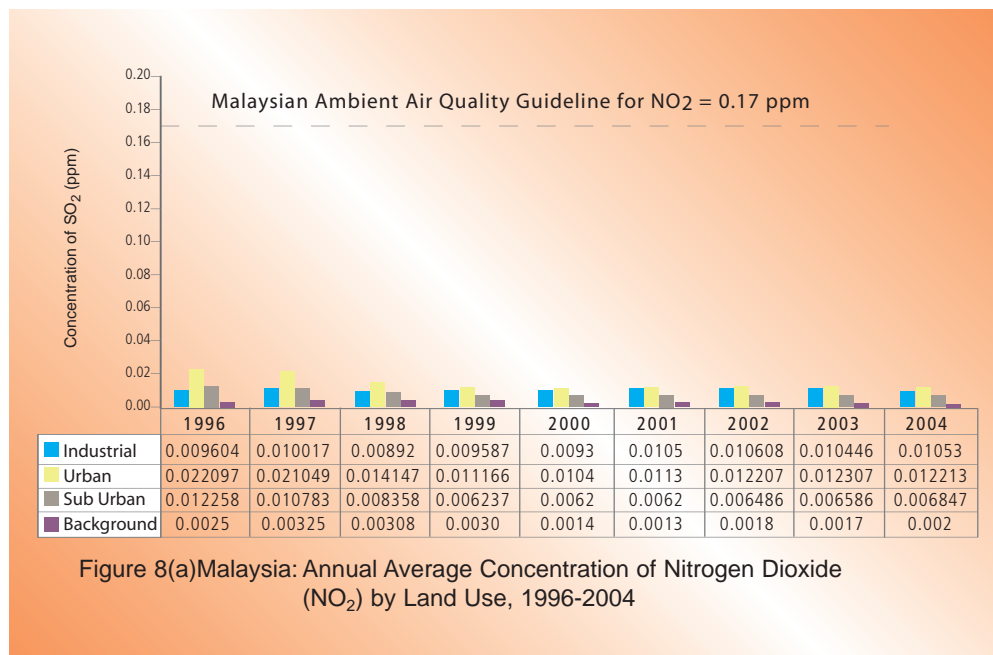


Figure 8(a)Malaysia: Annual Average Concentration of Nitrogen Dioxide (NO₂) by Land Use, 1996-2004



Photo 3: Continuous Air Quality Monitoring Station (DOE Photo Library)

particle pollution, both of which are associated with adverse health impacts.

Nitrogen oxides contribute to a wide range of environmental effects, including the formation of acid rain and potential changes in the composition and competition of some species of vegetation in wetland and terrestrial systems, visibility impairment, acidification of freshwater bodies, eutrophication of estuarine and coastal waters and increase in levels of toxins harmful to aquatic life.

Ground Level Ozone (O₃)

Ozone is not emitted directly into the air but is formed by the reaction of Volatile Organic Compounds (VOCs) and NO_x in the presence of heat and sunlight. Ground-level ozone forms readily in the atmosphere, usually in the warm sunny urban atmosphere. VOCs are emitted from various sources, including motor vehicles, chemical plants, refineries, factories, consumer and commercial products, and other industrial sources. Nitrogen oxides are emitted from motor vehicles, power plants, and sources of combustion. Changes in weather patterns contribute to yearly differences in ozone concentrations. Ozone and the precursor pollutants that form ozone can also be transported hundreds of kilometres away depending on wind directions.



Photo 4: Industrial Air Pollution (DOE Photo Library)

Exposure to high concentrations of ground-level ozone has been linked to numerous health effects. Repeated exposure to ozone can make people more susceptible to respiratory infections resulting in lung inflammation and aggravate pre-existing respiratory diseases such as asthma.

Ozone also affects vegetation and ecosystems, leading to reduction in agricultural and commercial forest yields, reduced growth and survivability of tree seedlings, and increased plant susceptibility to diseases, pests, and other environmental stresses. In long-lived species, these effects may become evident only after several years or even decades. Thus ozone has the potential for long-term effect on forest ecosystems.

Figure 9 shows the annual average daily maximum one-hour ozone concentrations in ambient

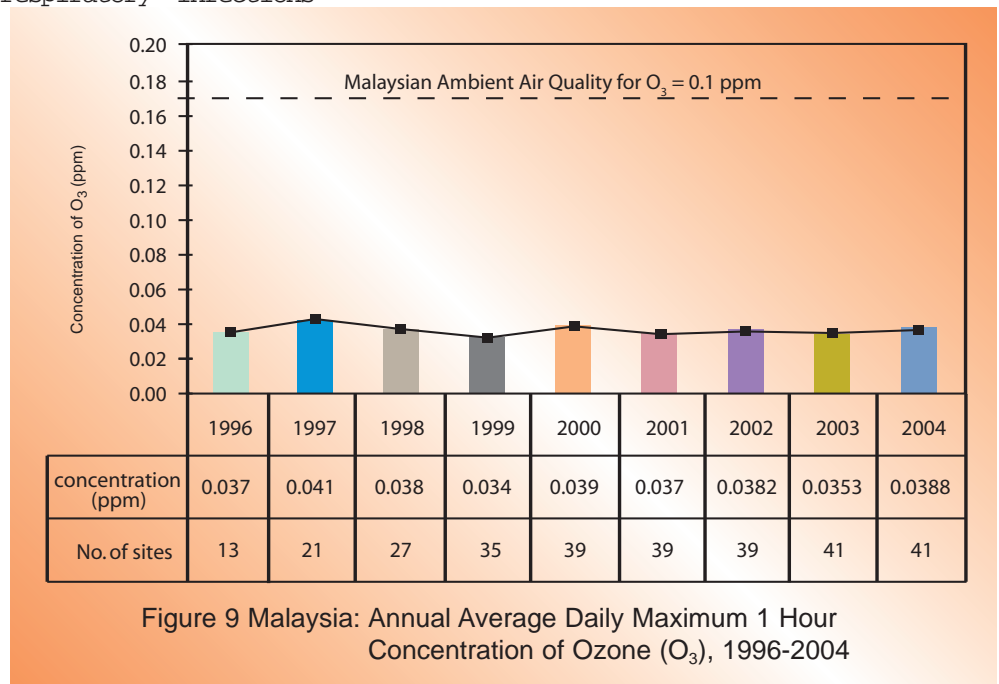


Figure 9 Malaysia: Annual Average Daily Maximum 1 Hour Concentration of Ozone (O₃), 1996-2004

air for the years 1996 to 2004. There were fluctuations in the trend observed throughout this period. The highest level was recorded in 1997. This pattern can be explained by the meteorological conditions during that year when the whole region experienced prolonged dry and hot weather as a result of the El Nino phenomenon. In 2004, the annual average daily maxi-

Carbon Monoxide (CO)

Carbon monoxide is a colourless, odourless and at high concentration, a poisonous gas. Carbon monoxide is formed when the carbon present in fuel is not burnt completely. CO is emitted mainly through motor vehicle exhaust. Other sources of CO emission include industrial processes and open burning activities. Carbon

monoxide enters the bloodstream through the lungs and reduces oxygen delivery to organs and tissues. The health threat from exposure to CO is most serious to those who suffer from cardiovascular diseases. At high levels of exposure, CO can be poisonous even for healthy people. Visual impairment, reduced work capacity and poor learning ability are among the health effects associated with exposure to elevated CO levels.

The annual eight-hourly average concentrations of carbon monoxide throughout the country measured from 1996 to 2004 were well below the Malaysian Ambient Air Quality Guideline (Figure 10). The concentration of CO was

consistently higher in urban areas where the main sources of emission were motor vehicles. Figure 10(a) shows CO concentrations for various categories of land use.

Lead Concentration (Pb)

Excessive exposure to lead may cause neurological impairment such as mental retar-

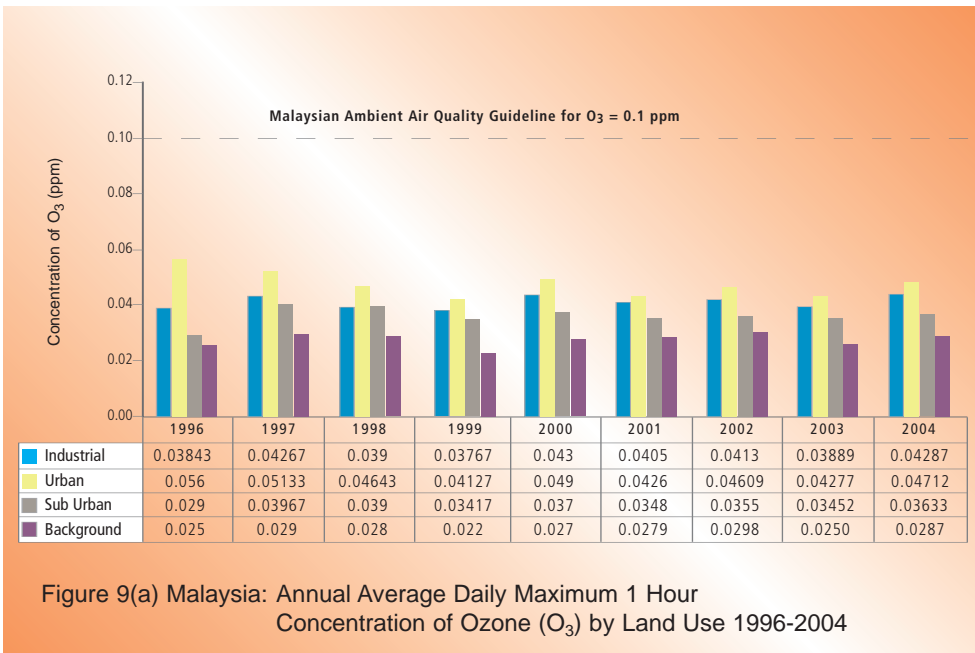


Figure 9(a) Malaysia: Annual Average Daily Maximum 1 Hour Concentration of Ozone (O₃) by Land Use 1996-2004



Photo 5: Open Burning at Construction Site (DOE Photo Library)

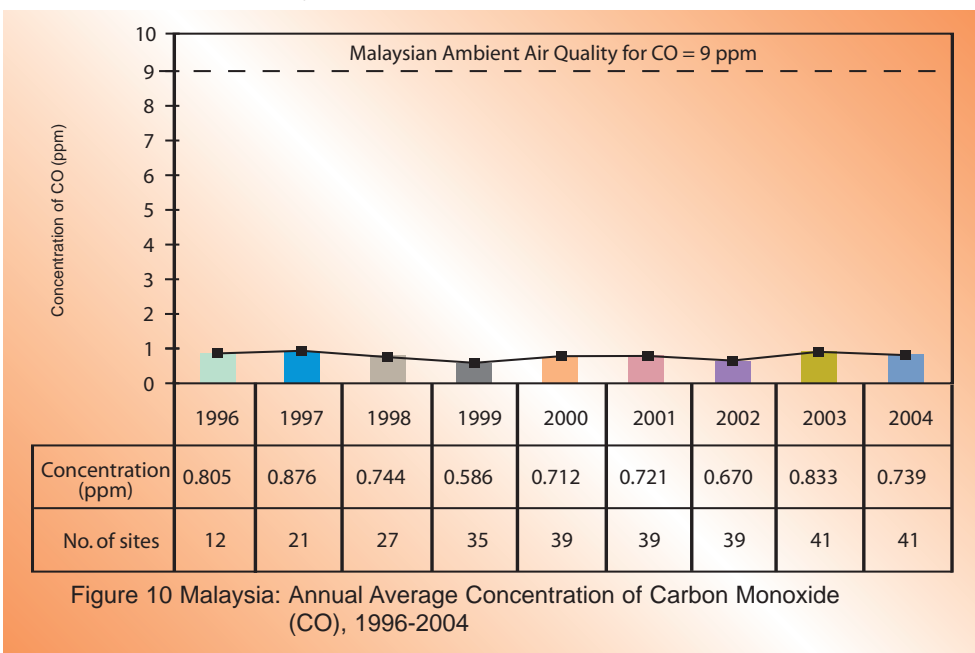


Figure 10 Malaysia: Annual Average Concentration of Carbon Monoxide (CO), 1996-2004



Photo 6: Open Burning at Illegal Solid Waste Dumping Site (DOE Photo Library)

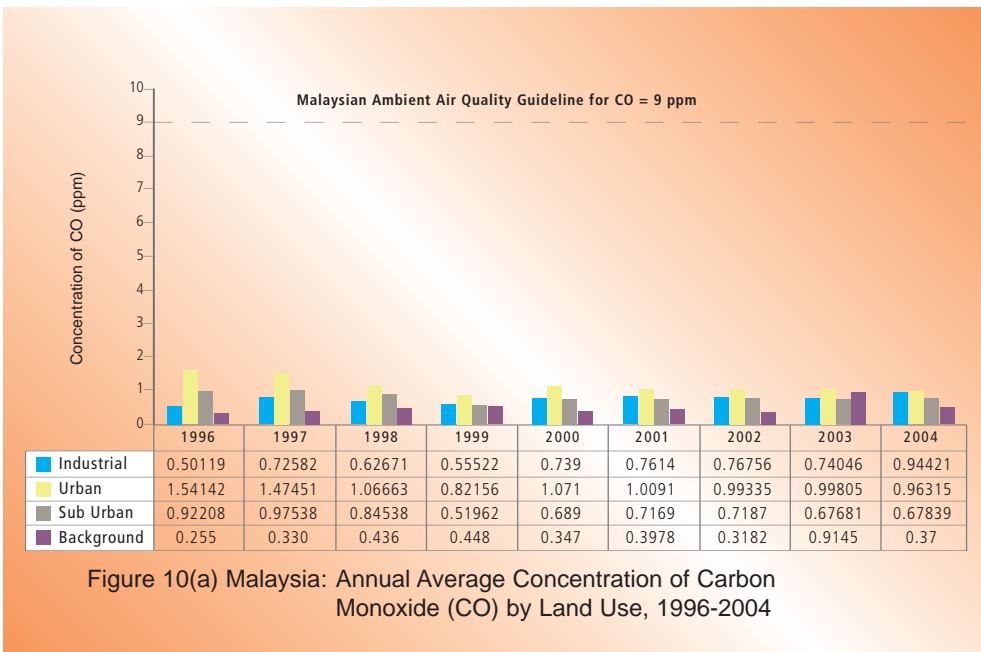


Figure 10(a) Malaysia: Annual Average Concentration of Carbon Monoxide (CO) by Land Use, 1996-2004

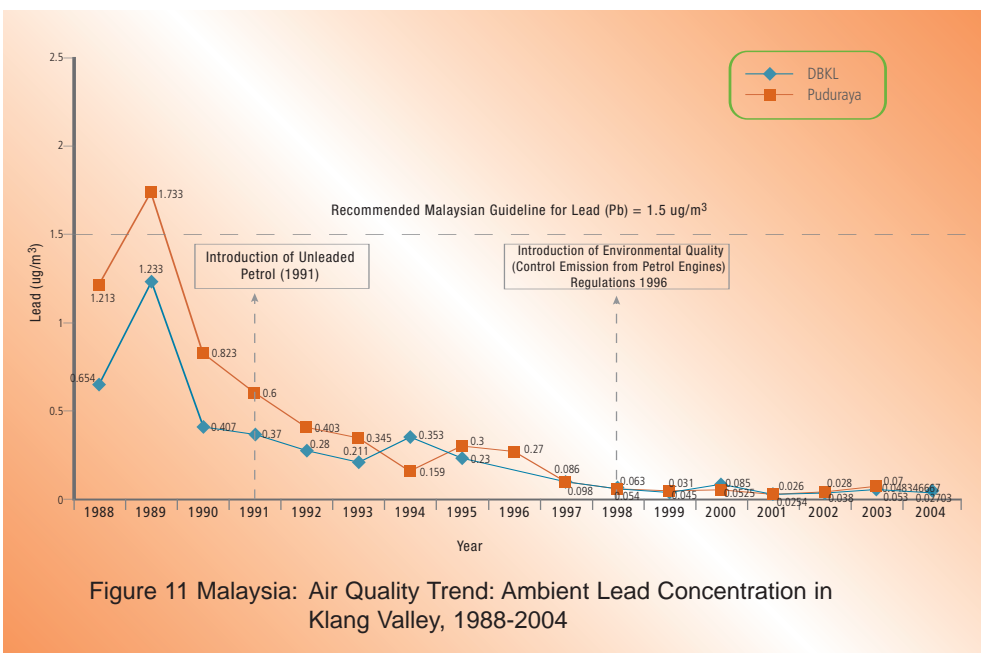


Figure 11 Malaysia: Air Quality Trend: Ambient Lead Concentration in Klang Valley, 1988-2004

In the past, motor vehicles were the main sources of Lead (Pb) emissions into the atmosphere. The lead levels monitored in the atmosphere were high in the eighties. However, as a result of Government efforts to promote the use of unleaded petrol in 1991 and the total phase-out of leaded petrol in 1998, the lead level in the atmosphere had declined significantly. In 2004, the average level of atmospheric lead monitored in the Klang Valley remained low as in previous years (Figure 11).



Air Quality

