AIR QUALITY MONITORING AND STRATEGY IN INDONESIA

by

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ABSTRACT

BAPEDAL, The Environment Impact Management Agency is responsible for the air pollution control. In addressing the air pollution BAPEDAL launched the "Blue Sky Program". This program consists of two components, air pollution from the mobile sources and the air pollution from stationary sources.

For mobile sources the Blue Sky Program aims at curbing air pollution in urban areas. The first target areas are four major cities in Indonesia namely Jakarta, Bandung, Semarang and Surabaya which try to cut the smoke emission. Also in this program plan is made to expand the use of CNG for city public transportation, the application of catalytic converter, encourage the application of cleaner fuel such as unleaded gasoline.

For the stationary sources the program will focus on four main activities i.e. pulp and paper, coal fired power plants, cement and steel industries. Under this program emission standards and monitoring guidance will be developed.

I. INTRODUCTION

Indonesia is one of the developing countries that has sustained high economic growth. It is estimated that for the next twenty five years the Indonesian's GDP annual growth rate is expected to average about 6%. This growth is supported by manufacturing sector which is expected to grow at 9 to 11% annually. This economic expansion and the population increase will lead to the rapid growth in the energy consumption and production in transport, industry, power and household sectors.

It is obvious that such scale of development will be associated with and increasing environmental impact. Additionally, the utilization of more coal in electricity generation in the coming years will considerably increase the intensity of the precursor emission to the atmosphere.

Air pollution is the most important environmental issue associated directly with the energy consumption. As stated before the increase of the energy consumption mainly related to development in industrial, transportation, and power sectors. Air pollution has been recognized as one of the important environmental problems from the development of the energy sector in Indonesia.

II. POPULATION

With a population of about 180 million, Indonesia is now the fourth largest country in the world, following China, India and the USA. Demographic change appears to be following a pattern similar to that of the developed countries. These changes, including a significant decline in fertility rates and the rapid growth of the urban population.

From 1970 to 1988, while the mortality rate was being cut nearly in half (from 17.3 deaths per thousand to 9.1), the fertility rate declined even faster (from 41.4 births per thousand to 28.0). As a result, the overall population growth rate fell from 2.4% per

annum in the late 1960's to 1.8% in the late 1980's, to an estimated 1.6% today.

Indonesia's population is not evenly distributed. Java alone, which has only about 7% of the land area, accounts for nearly 60 percent of the total population. This results in a population density of about 815 people per square kilometer. By the end of the decade, population density is likely to exceed 900 and, by the year 2020, the number of people per square kilometer may be over 1,100. However, in the outer islands it is distinctly lower 77 in Sumatra, 65 in Sulawesi, 17 in Kalimantan, and only 4 in Irian Jaya.

III. ENERGY

The increase of population and the change of way of life due to urbanization and the rising standard of living of the population will increase the demand of energy. For example, the demand for electricity is expected to increase by a factor of 13 over the next 25 years. Especially in Java, although its area only 7% of the total Indonesian land area but 60% of the total Indonesian population live and most of the indutrial activities located, the environment will experience a heavy pressure as the result of the increase of energy consumption.

The domestic demand for energy has grown very rapidly over the past 25 years, averaging nearly 7% per annum in the 1980's, although at the present level the energy intensity is still relatively low. The combination of economic growth, the changing stucture of the economy and the backlog of demand from both industry and households means that energy demand will grow even faster over the next several decades-

Tabel 1. Total population (in thousands)

	1970	1980	1990	2000	210	2020
Java	76.086	91.271	106.919	120.902	134.045	145.741
Sumatra	20.809	26.017	36.232	43.981	51.087	57.833
Kalimantan	5.155	6.723	9.059	11.402	13.606	15.757
Sulawesi	8.527	10.409	12.447	14.151	15.863	17.304
Others	8.632	11.073	13.576	16.077	18.418	20.424
Indonesia	119.209	147.062	178.233	206.513	233.019	257.059

Source : World Bank

Tabel 2. Urban population (in thousands)

	1980 Urban	(%) of Total	1990 Urban	(%)of Total	2000 Urban	(%)of Total	2010 Urban	(%)of Total	2020 Urban	(%)of Total
Java	22.926	25.2	37.514	35.1	52.711	43.6	68.573	51.2	84.727	58.1
Sumatra	5.480	19.6	9.579	26.4	13.893	31.6	18.388	36.00	23.042	39.8
Kalimantan	1.441	21.4	2.513	27.7	3.643	32.0	4.823	35.4	6.045	38.4
Sulawesi	1.654	15.9	2.909	23.4	4.228	29.9	5.598	35.3	7.015	40.5
Others	1.465	13.3	2.606	19.2	3.817	23.7	5.075	27.6	6.378	31.2
Indonesia	32.996	22.4	55.121	30.9	78.292	37.9	102.457	44.0	127.207	49.5

Source : World Bank

increasing nearly 3-fold in the 1990's, and is estimated 14 fold by the year 2020.

The expected rapid growth consumption and production of energy has important implications for the environment. The use of petroleum fuels, mostly by transport and industry, is concentrated in urban areas and constitutes a major factor in deterioting ambient air quality of Indonesia's major cities. In addition to this, a shift from oil to coal such as the use of coal for power generation adds the pressure to the environment.

IV. TRANSPORTATION

Air pollution is the most important environmental issue associated directly with the energy consumption. As stated before the increase of the energy consumption mainly related to development in industrial , transportation and power sectors. The number of vehicles increase rapidly in Indonesia. Fuel use for road transport is projected to increase by a factor of 2.1 times the 1990 level by 1998, 4.6 times by 2008, and 9.0 times by 2018 for Indonesia as a whole. Studies showed in major cities such as Jakarta, Semarang the transport sector is the dominant contributor to air pollution.

V. AIR QUALITY MONITORING

On a national basis, the Meteorological and Geophysical Agency (BMG) operates a network of 18 air monitoring stations located as shown in Figure 2. The BMG network is co-located with meteorological stations has been operating since 1976 but the majority have been operational since the early 1980's. Also, with the exception of the BMG Headquarters station in Jakarta, which measures TSP SO_2 and NO_2, all the other stations only measure TSP.

The most extensive and longest operating ambient air monitoring networks are located in Jakarta, where along with the Ministry of Health (MOH) and Center for Urban, Environmental Research and Development-Jakarta (DKI-KPPL) and BAPEDAL (PUSARPEDAL) operate a total of 23 stations as shown in Table 6.

In addition, several short term air quality monitoring studies have been done in Indonesia related to a specific sector, such as transportation, or as an indicator of potential air quality problems in selected cities.

The measurement methods by various agencies are based on the WHO methods as listed in Table 6.

VI. THE JAKARTA MONITORING NETWORK

The first BMG site was set up in 1976 and has been operating ever since. The pollutans measured are SO_2, NOx and TSP. Once for 24 hours measurement is made every sixth day measurement of O_3 started at

Tabel 3 . Projected fuel consumption in Indonesia

	Unit	1990	1998	2008	2018	1990-98	1998-08	2008-18
Gassoline	million kl	6.2	13.0	28.5	55.2	9.8%	8.1%	6.8%
ADO+IDO+FO	million kl	17.6	32.4	80.0	164.4	7.9%	9.5%	7.5%
Kerosene+LPG	million kl	7.5	10.3	15.2	22.5	4.0%	4.0%	4.0%
Natural gas	BCF	303.7	1035.1	1330.7	1706.3	16.6%	2.5%	2.5%
Coal	million tons	6.4	19.4	64.3	168.2	14.8%	12.7%	10.1%
Wood	million tons	3.6	8.5	20.1	35.6	11.3%	9.0%	5.9%
Bagasse	Million tons	0.7	1.4	2.7	3.6	9.7%	6.9%	2.9%

Source : World Bank

this site in October 1992 providing 15 minutes averages on paper output from the analyser. These are processed and recorded manually as hourly averages. The method used is chemilumescence and calibration by standard gas provided by the manufacturers, Environment SA.

The remaining six BMG sites started operating in 1980/81. They were closed down between 1988 and 1990, started operating again in 1991 and are continuing at the present time. At this six sites only TSP is measured, the sampling points are about 1.5 m above the ground and once for 24 hours measurement is made every six days.

Two of the four MOH sites are operated by Ecological Health Research Center (PPEK) and contribute to the United Nations Global Environment Monitoring System (GEMS). The pollutants usually measured at these sites are SO_2, NOx and TSP. Measurement averaged over 24 hours are generally made every six days. These sites have been operating since 1979.

KPPL has operated air quality monitoring sites in Jakarta over a long period. Over the years the sites have changed and it was only from the early 1980's that a consistent set of data was available. The pollutants measured are SO_2, NO, NO_2 and TSP. At three of the sites instruments are permanently installed and 24 hour measurement is made every eight days. The other eight sites work on a regular cycle. Measurement is made at four sites on one day and the next day the instruments are moved to the remaining four sites where a further set of 24 hour measurement is made. The sequence is repeated every eight days. Depending on the availability of funds, measurement is made for only eight to ten months each year, usually starts in June. Calibration for SO_2, NO and NO_2 is by standard solution and is carried out every three months.

BAPEDAL air quality monitoring was set up in mid 1993. This station equiped with Automatic Continous Monitoring and measures severall parameters such as NOx, SOx, CO, HC, TSP and pH.

VII. REGULATION

There are two basic laws that currently used to control air pollution in Indonesia. The first one is the Indonesia enacted Law No. 4, 1982, which is The Basic Provisions for the Management of the Living Environment, which provides the umbrella for the government regulations and ministerial decrees regarding the management of the environment in the country. Under this law a ministerial decree on environmental standards had been issued in 1986 which established among others the national ambient air quality standards as well as the general emission standard for stationary sources.

Tabel 4
Projected air emissions of transport fuels (million tons)

	1990	1998	2008	2018
Hydrocarbons	97.96	205.40	450.30	872.16
Carbon monoxide	151.28	317.20	695.40	1,346.88
Nitrogen oxides	79.98	167.70	367.65	712.08
Sulfur oxides	19.84	41.60	91.20	176.64
Suspended particulate	12.40	26.00	57.00	110.40
Lead	2.48	5.20	11.40	22.08

Source : World Bank

Table 5. Measurement methods used in Indonesia

No.	Parameter	Analysis method
1.	Sulfur dioxide	Pararosaniline method collected in midget impringer
2.	Carbon monoxide	Detector tube method (i.e. Draeger tube)
3.	Nitrogen oxides as NO_2	Saltzman method collected in midget impringer
4.	Oxidant as O_3	NBKI method collected in midget impringer
5.	Suspended particulates	Gravimetric high volume sample

Table 6. Air quality monitoring network in Jakarta

Station No.	Period of operation	TSP	SO_2	NO_x	HC	CO	Metals
BMG1	1976-Present	*	*	*			
BMG2	1980-87, 1991-Present	*					
BMG3	1980-87, 1991-Present	*					
BMG4	1980-87, 1991-Present	*					
BMG5	1980-86, 1991-Present	*					
BMG6	1980-87, 1991-Present	*					
BMG7	1980-87, 1991-Present	*					
PPEK1	1979-Present	*	*	*			
PPEK2	1979-Present	*	*	*			
BKTL1	1990-Present	*	*	*			
BKTL2	1991-Present	*	*	*			
P2L1	1992-Present	*	*	*			*
P2L2	1992-Present	*	*	*			*
P2L3	1991-Present	*	*	*			*
P2L4	1983-Present	*	*	*			*
P2L5	1985-88, 1992	*	*	*			*
P2L6	1986-88, 1992	*	*	*			*
P2L7	1986-88, 1992	*	*	*			*
P2L8	1986-88, 1992	*	*	*			*
P2L9	1983-Present	*	*	*			*
P2L10	1983-Present	*	*	*			*
P2L11	1983-88	*	*	*			
P2L12	1983-Present	*	*	*			
P2L13	1983, 1984	*	*	*			
P2L14	1983, 1984	*	*	*			
P2L15	1983, 1984	*	*	*			
P2L16	1983-85	*	*	*			
P2L17	1983-85	*	*	*			
BAPEDAL	1993-Present	*	*	*	*	*	

Source: BMG, BTKL, KPPL, PPEK and BAPEDAL

Figure 1
Air quality stations - Jakarta

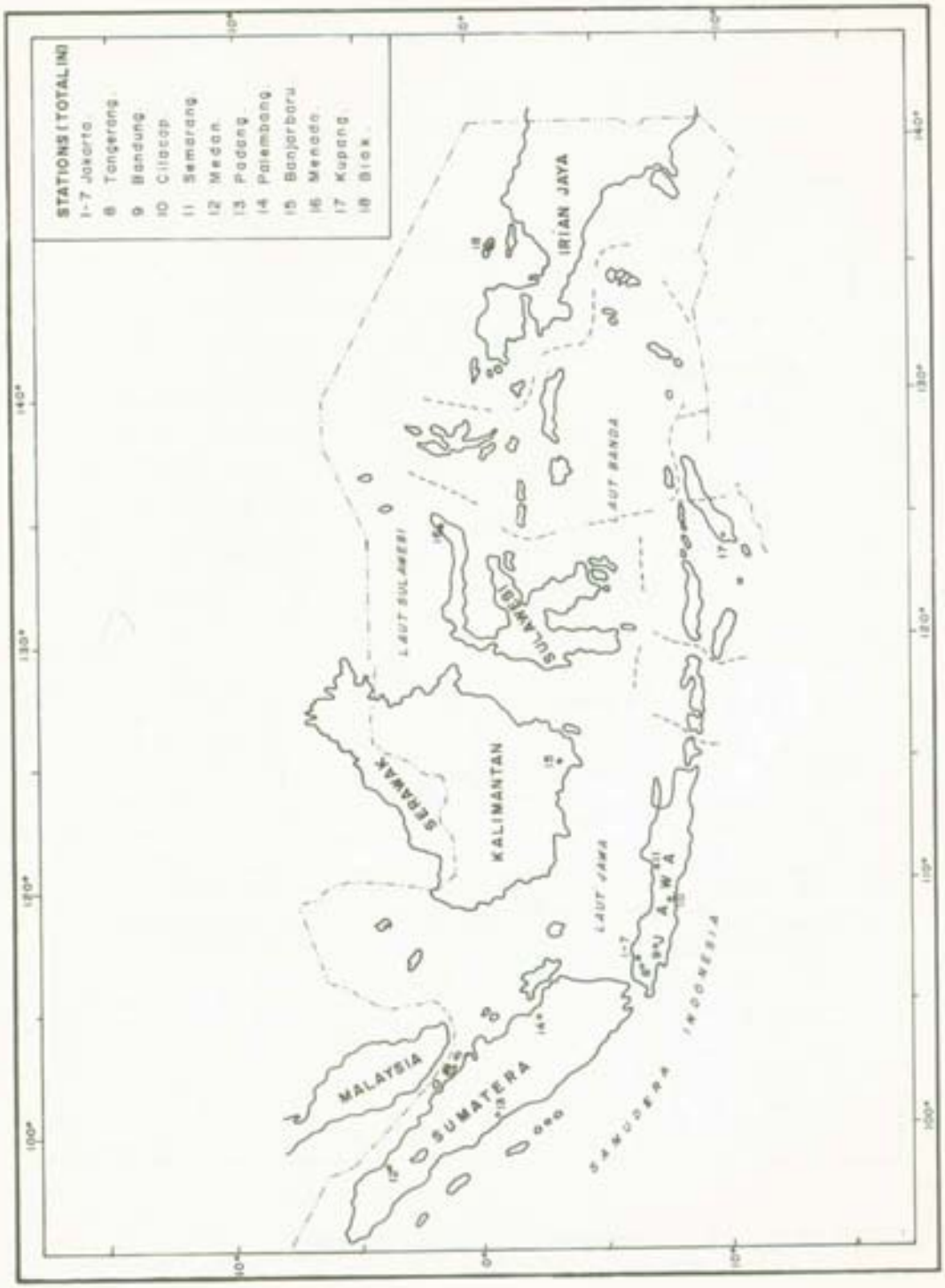

Figure 2
MBG air quality monitoring network in Indonesia 1991
(total suspended particulates)

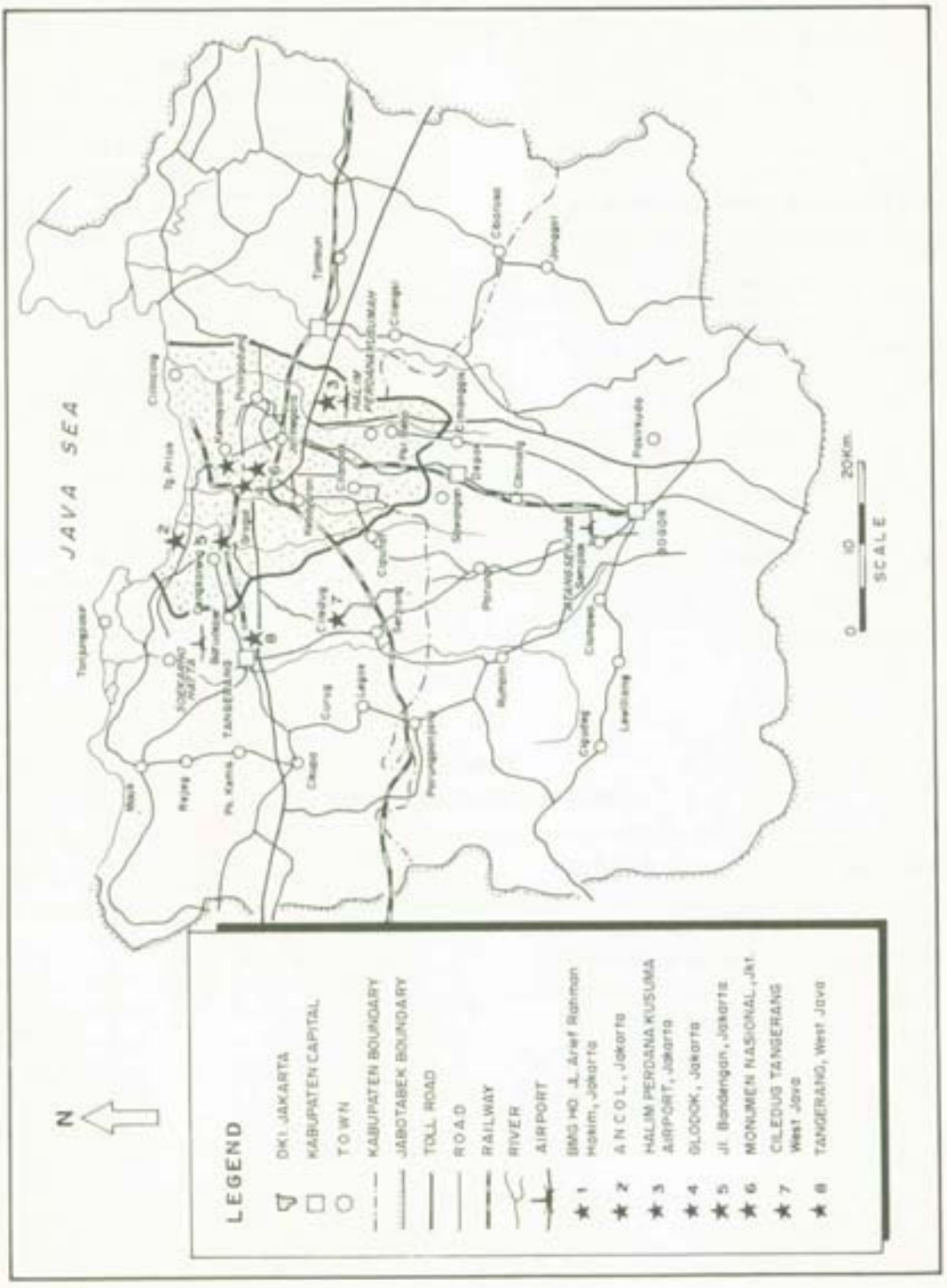

Figure 3
MBG air quality stations – JABOTABEK

The second is the Indonesian Law No. 14, 1993, which provides the umbrella for the traffic regulation. This traffic law contains provision for the control of exhaust emission from vehicles. Under this law emission standards for motor vehicles have been decreed by the State Minister for the Environment/Head of BAPEDAL.

Table 7
National ambient air quality standards

Parameter	Time of measurement	Standards (ug/m^3)
Sulfur dioxide	24 hours	260
Carbon monoxides	8 hours	2,260
Nitrogen oxides	24 hours	92.5
Ozone	1 hour	200
TSP	24 hours	0.26
Lead	24 hours	0.06
Hydrogen sulfide	30 minutes	24
Ammonia	24 hours	1,360
Hydrocarbon	3 hours	160

Source : The Decree of the State Minister for Population and the Environment No. 02/1988.

Tabel 8
Draft national ambient air quality standards

Parameter	Time of measurement	Standards (ug/m^3)
Sulfur dioxide	1 hour	900
	24 hours	300
	1 year	60
Carbon monoxides	1 hour	30,000
	8 hours	10,000
Nitrogen dioxides	1 hour	400
	24 hours	150
	1 year	100
O_3	1 hour	160
Suspended	24 hours	230
particulates	1 year	90
Lead	24 hours	2
Hydrocarbon	3 hours	160

Remarks: These value have been determined based on the following atmospheric condition, i.e. temperatur 25 °C, and 1 atmosphere

Tabel 9
Motor vehicle emission limit

Vehicle type	Fuel type	CO* (%)	HC* (ppm)	Smoke **
Motor bicycle 2-stroke	Gasoline (Octane>87)	4,5	3000	
Motor bicycle 4-stroke	Gasoline (Octane>87)	4,5	2400	
Vehicle	Gasoline (Octane>87)	4,5	1200	
Vehicle	Diesel (Cetane>45)			50% Bosch (diam 102 mm) or 25% opacity
Vehicle	Diesel (Cetane>45)			50% Bosch (diam 102 mm) or 25% opacity

(*) Measured at idling condition
(**) Measured at free acceleration

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