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ANNEX 9

DATA ANNEX: INDONESIA

FROM IDEAS TO ACTION: CLEAN ENERGY SOLUTIONS FOR ASIA TO ADDRESS CLIMATE CHANGE

June 2007
This report was produced for the United States Agency for International Development.
It was prepared by International Resources Group (IRG).

ANNEX 9

DATA ANNEX: INDONESIA

FROM IDEAS TO ACTION: CLEAN ENERGY SOLUTIONS
FOR ASIA TO ADDRESS CLIMATE CHANGE

Indonesia country profile – Quantitative data

NOTE: This compilation is mostly based on regional datasets and to a limited extent on country-level primary data. While regional datasets offer the advantage of data consistency (definitions and units) and higher data quality, they are often outdated relative to national country data sets. Further, the assumptions made by regional research institutes to model future trends may vary from those adopted by national government institutes. As such, the data presented here is best used to evaluate broad differences between countries and obtain an overview of future trends, rather than provide specific information at a particular point in time.

Section 1. Introduction

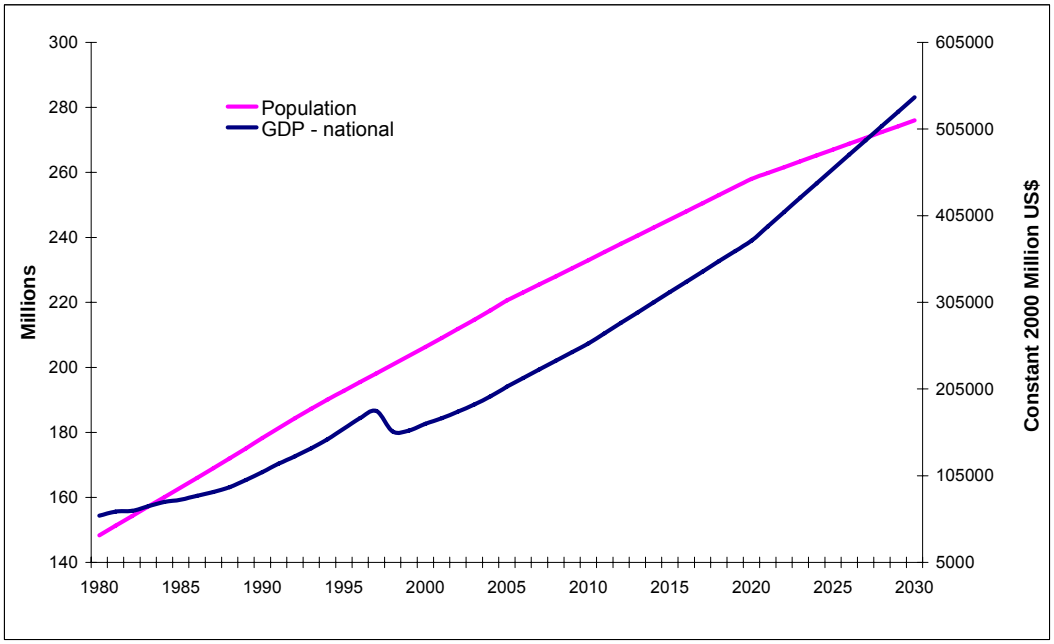
a) General data

Population (2005) [#]	241,973,879
Country area (km²) [#]	1,904,443
GDP - per capita (constant 2000 US$) [2005] [##]	942
Percentage of total population living in urban areas (%) [#]	44.5
Percentage of people connected to the grid (electricity) [%] [#]	52.5

* Urbanization level is expected to reach 68% by 2030 [*#]

Source: [#] RECIPES (2006), [##] WDI (2006), [*#] APERC (2006)

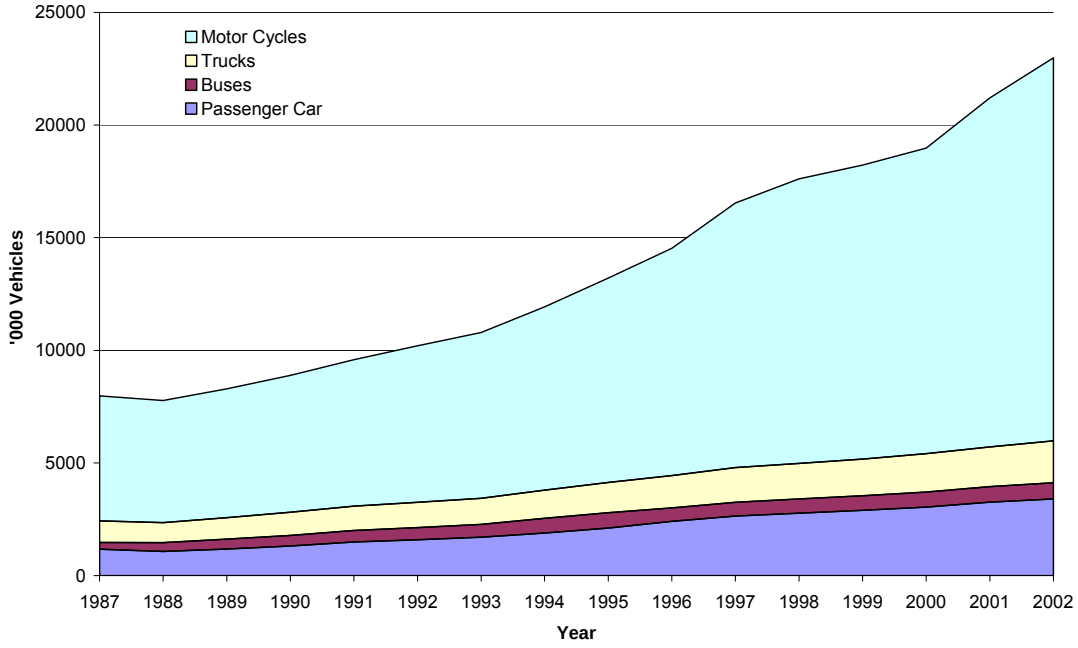
b) Growth in Population and GDP



Source: WDI (2006), APERC (2006)[1]

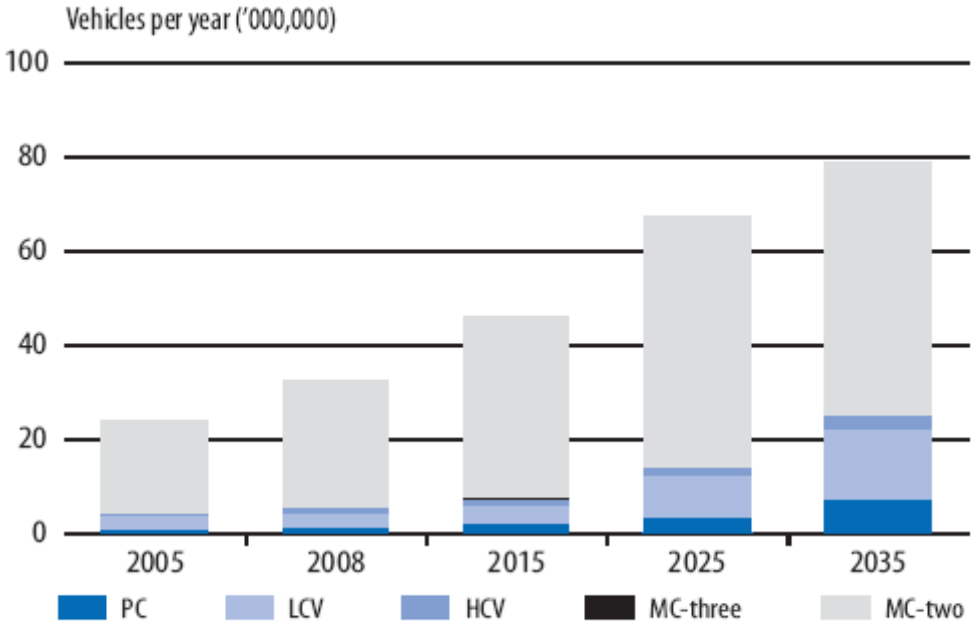
[1] Data projections

c) Number of vehicles in Indonesia



Source: SI (2006).

a. Forecasts for Growth in the Number of Motor Vehicles in Indonesia

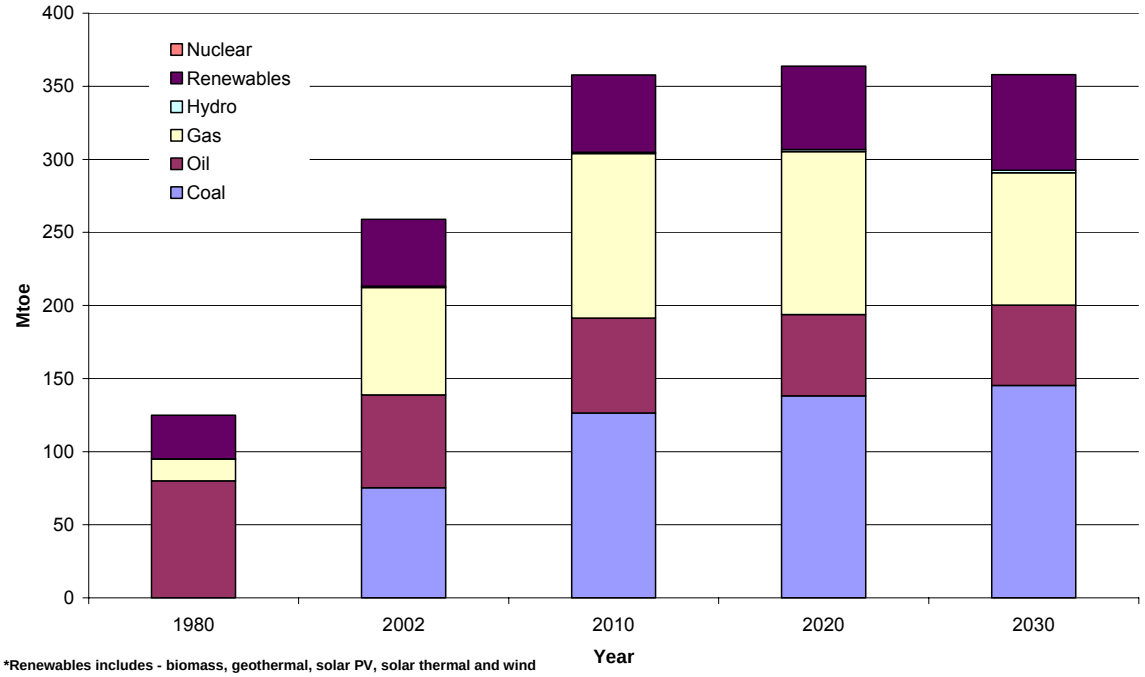


HCV = heavy commercial vehicle; LCV = light commercial vehicle; MC-three = three-wheeled vehicle with a motorcycle engine; MC-two = two-wheeled motorcycle; PC = private car

Source: ADB (2006).

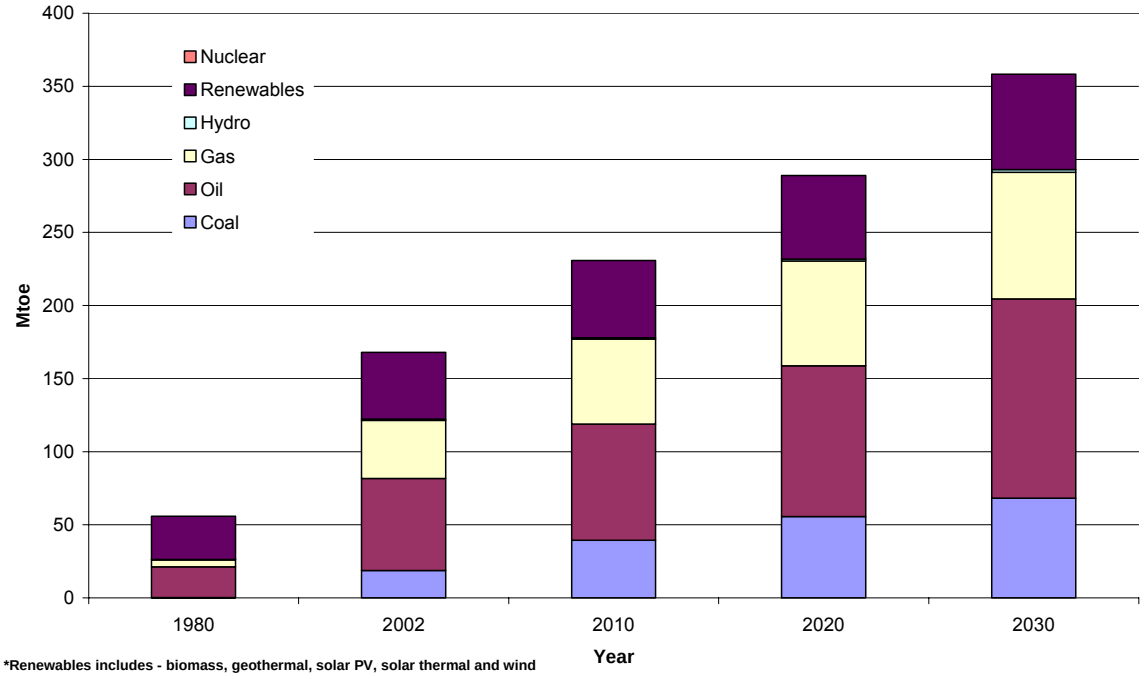
Section 2. Current status of energy supply and demand

d) Energy production by source



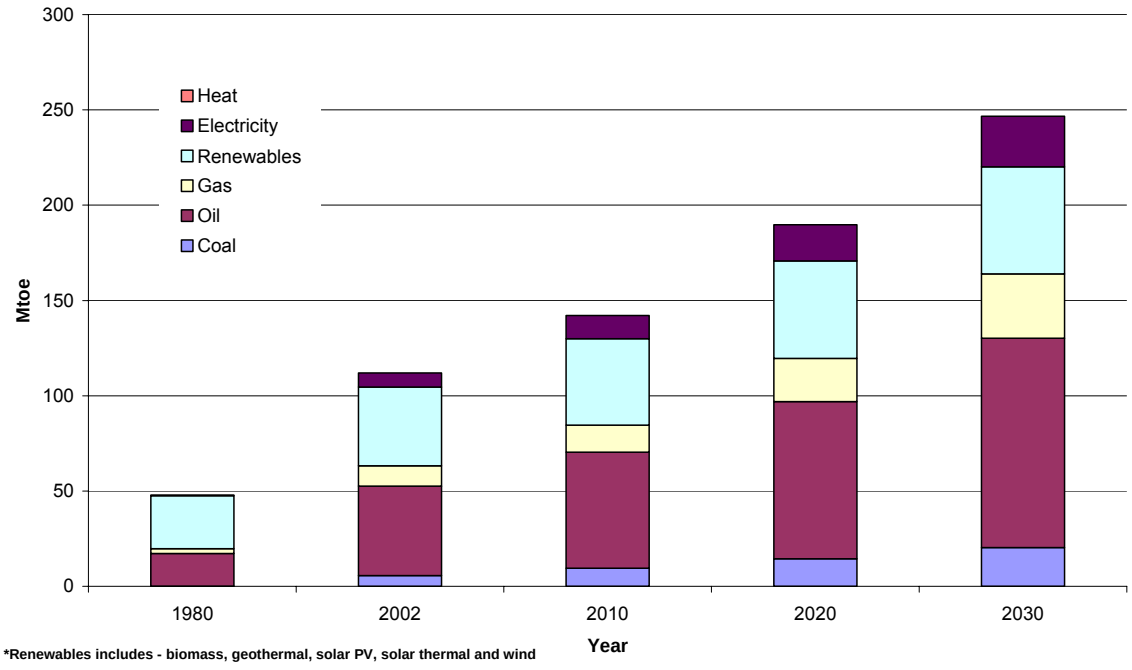
Source: APERC (2006).

e) Primary Energy demand



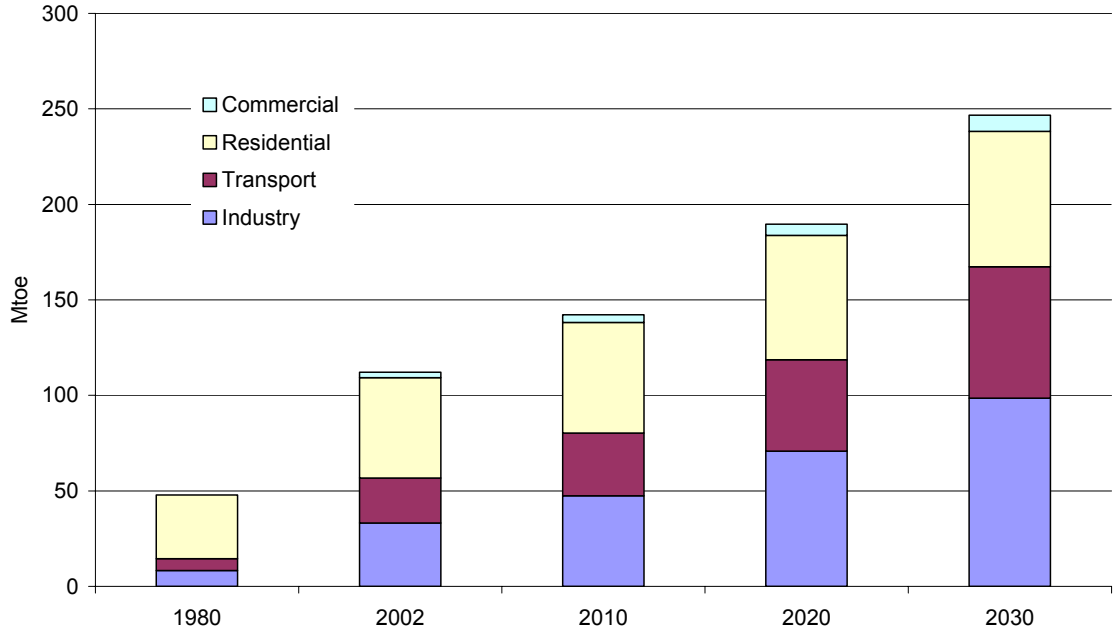
Source: APERC (2006).

f) Total final energy demand by source



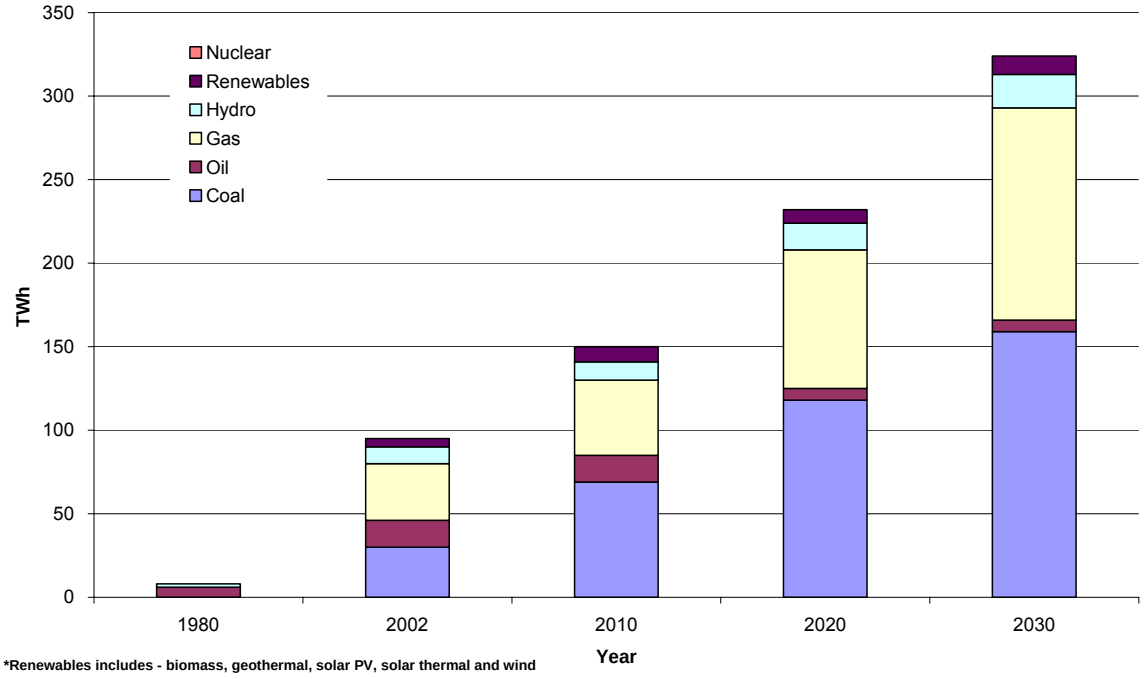
Source: APERC (2006).

g) Total final energy demand by sector



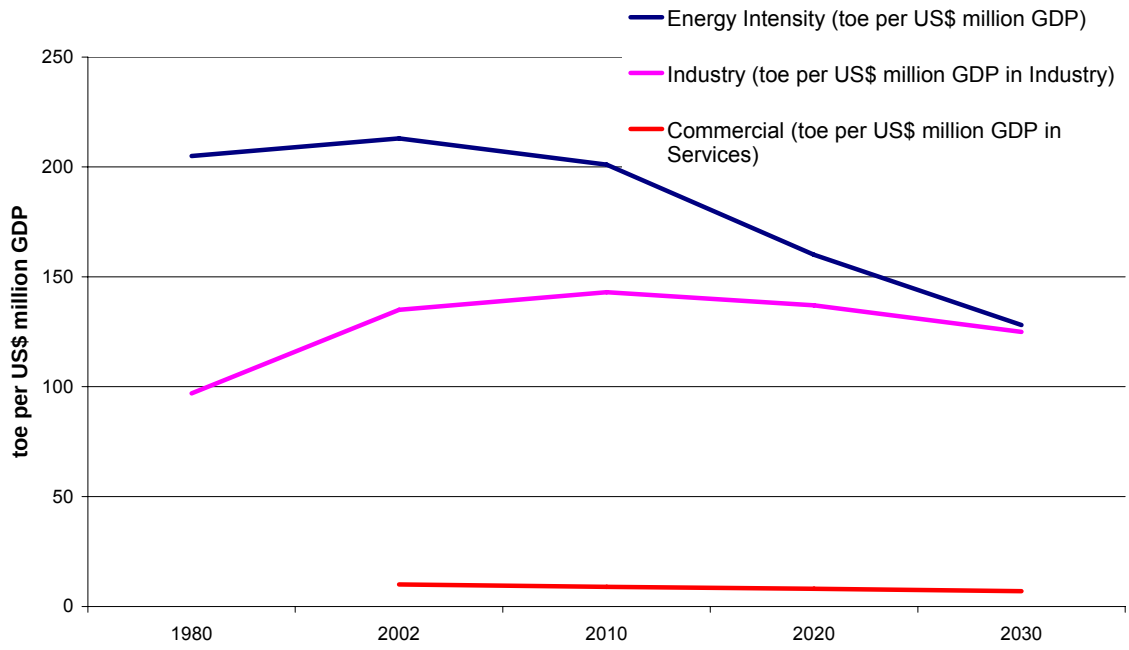
Source: APERC (2006).

h) Total electricity generation



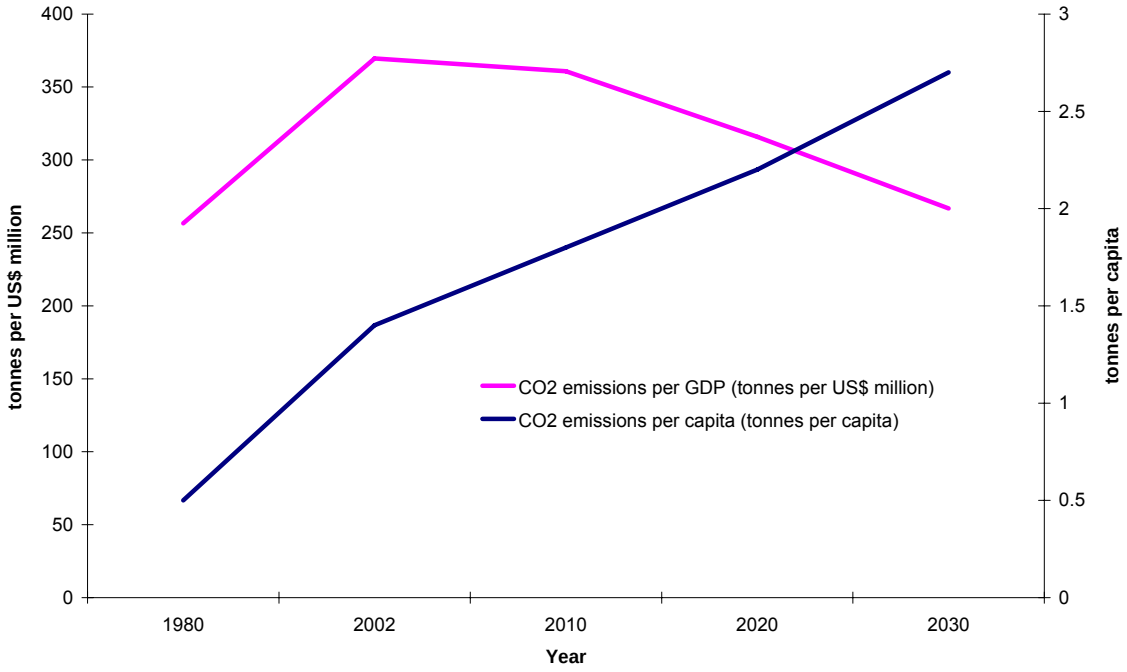
Source: APERC (2006).

i) Energy intensity



Source: APERC (2006).

j) CO_2 emissions intensity



Source: APERC (2006).

k) Retail price of various energy sources

Fuel type	***2003***
Gasoline (Cent US$/liter)	20
Diesel (Cent US$/liter)	21
Kerosine (Cent US$/liter)	9
Coal (Cent US$/kg)	2.6
LNG (Cent US$kg)	9
LPG (Cent US$/kg)	33
NG (Household) [US$/ MBTU]	0.36
NG (Fertilizer Industry) [US$/ MBTU]	1.7
Biomass ($/ton)	
Electricity (Household) (Cent US$/KWh)	6.07
Electricity (Industry) (Cent US$/KWh)	6.16
Electricity (Commercial) (Cent US$/KWh)	7.68

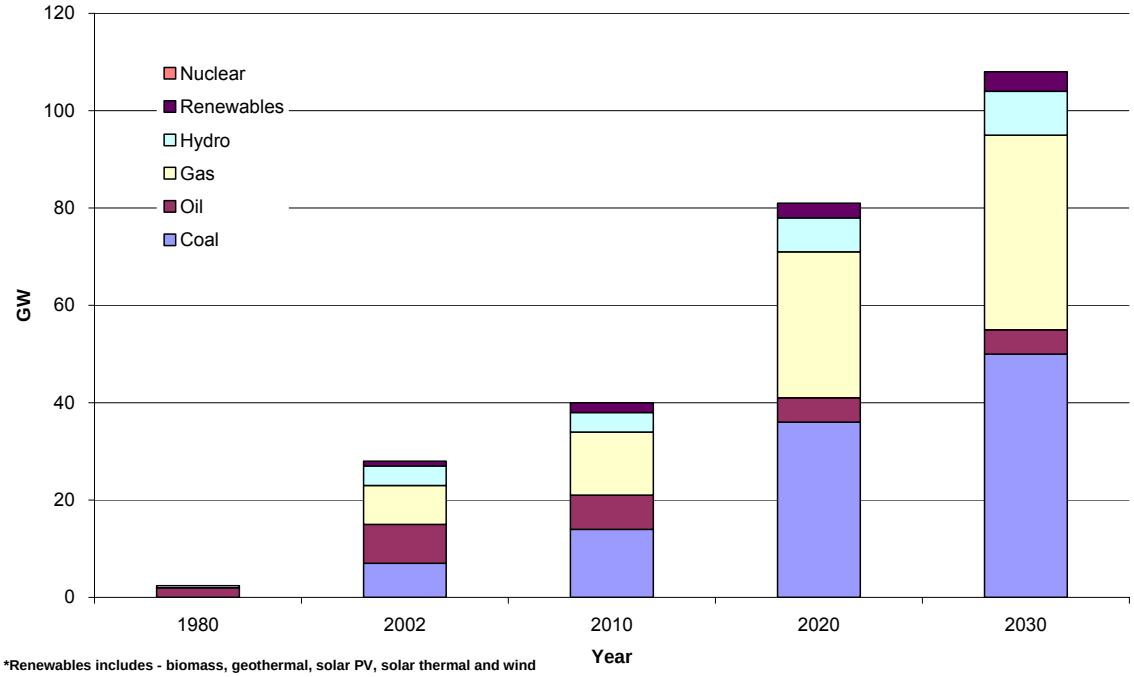
Source: Compiled by ECO-Asia from various sources.

l) Energy reserves status

Energy Reserves (2002)	**Total**	**Proven**	**Probable**	**Production**	**R/P ratio**
Coal (million ton)	38000	6500	31500	97	67
Oil (million barrel)	9692	4867	4825	460	11
NG (billion cubic meter)	4814	2690	2124	76	35

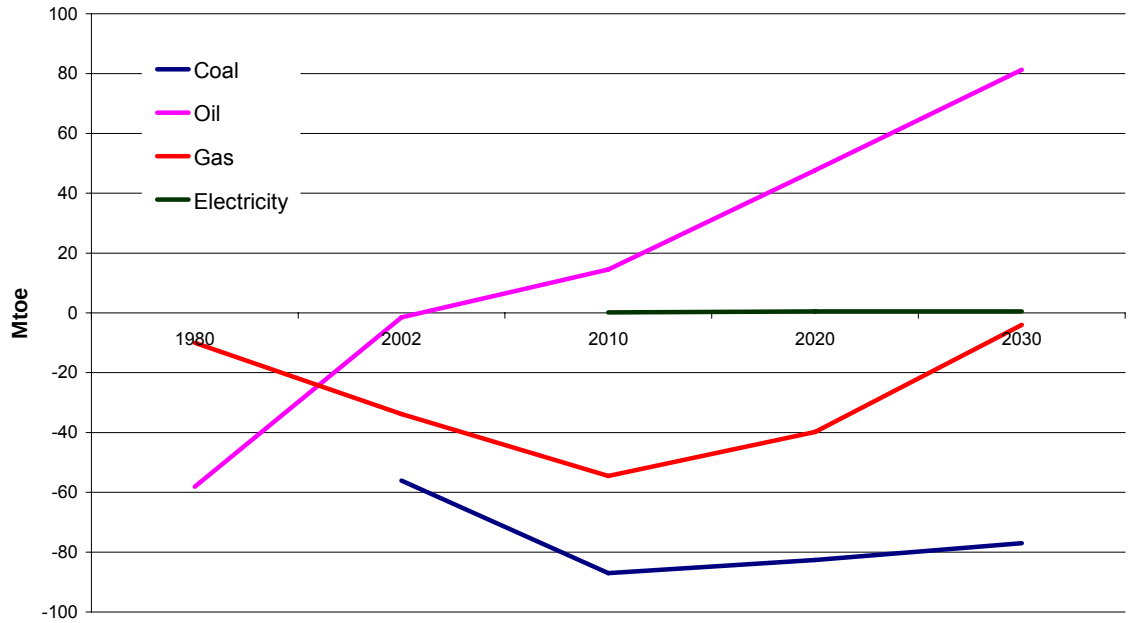
Source: REP (2006).

m) Electricity installed generation capacity



Source: APERC (2006).

n) Demand supply gap analysis

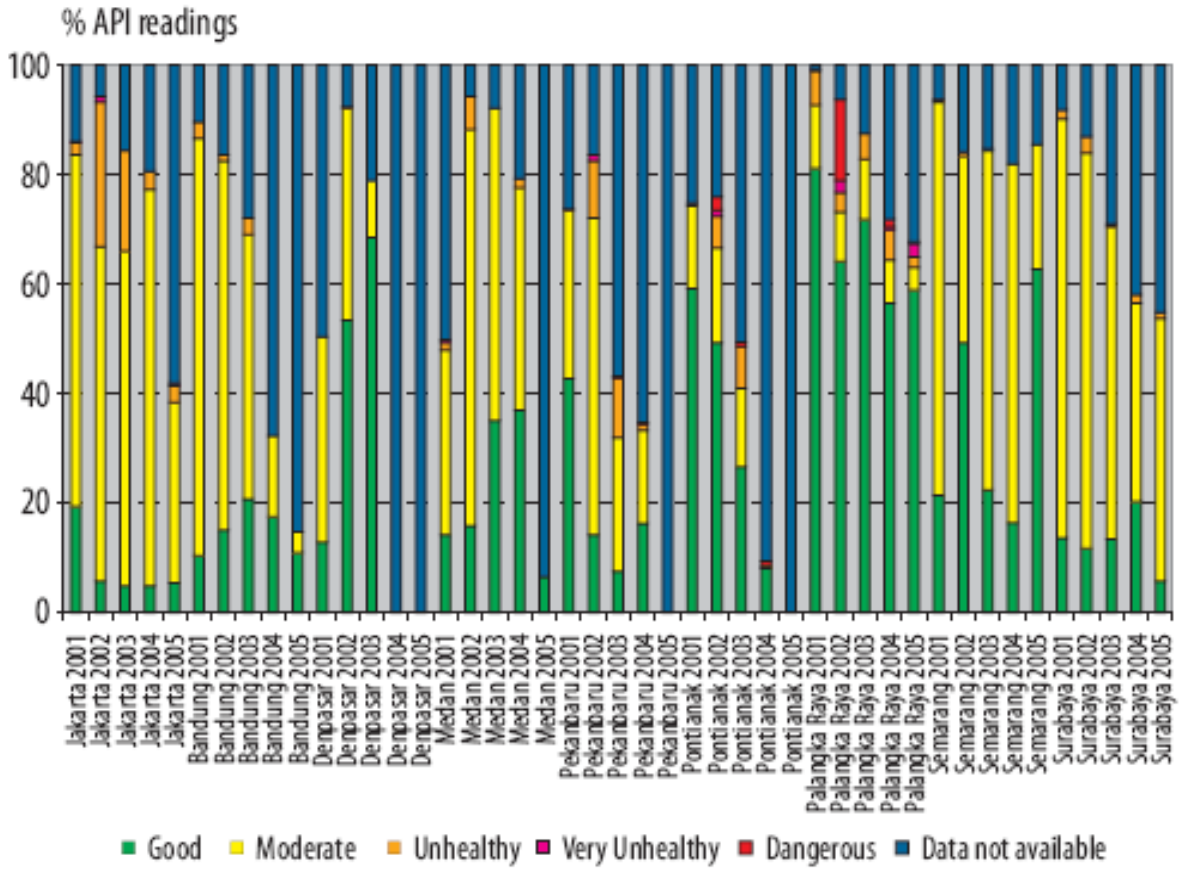


Source: APERC (2006).

Section 3. Environmental impacts related to energy use

o) Ambient levels

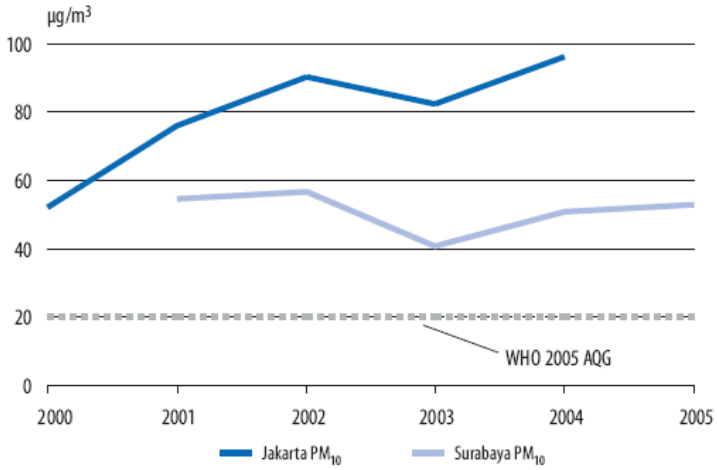
Percentage Compositions of Air Pollution Indexes for Nine Cities in Indonesia, 2001–2005



API = Air Pollution Index; % = percent

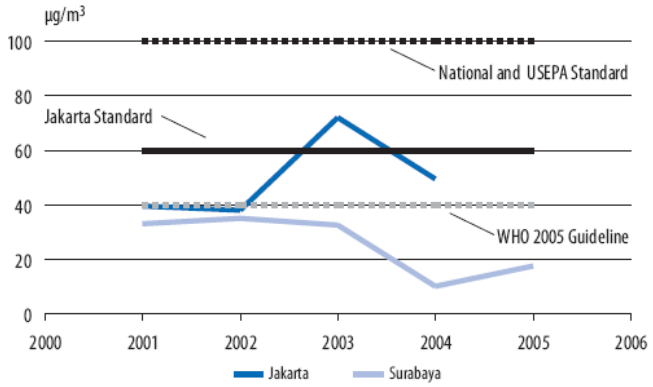
Source: Tamin, R., and A. Rachmatunisa. 2004. For 2001–2003 data. Ministry of Environment. *Status Lingkungan Hidup Indonesia (SLHI) 2004* or Status of Indonesia Environment 2004 for 2004 data; Ministry of Environment. 2005. Indonesia State of Environment Report 2005 (SLHI 2005). Indonesia.

Annual Averages of 24-hour Mean Concentrations of PM_{10} in Jakarta and Surabaya



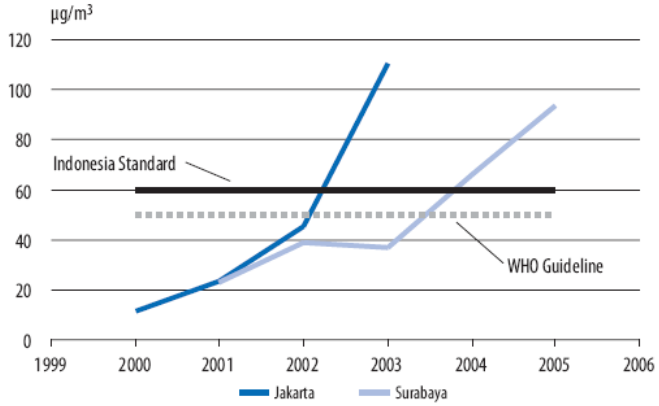
AQG = air quality guideline; PM_{10} = particulate matter with diameter less than or equal to 10 micrometers; WHO = World Health Organization; µg/m³ = micrograms per cubic meter
Source: Data from the Ministry of Environment. 2005. Indonesia State of Environment Report 2005 (SLHI 2005). Indonesia.

Annual Average NO_2 Concentrations in Jakarta and Surabaya



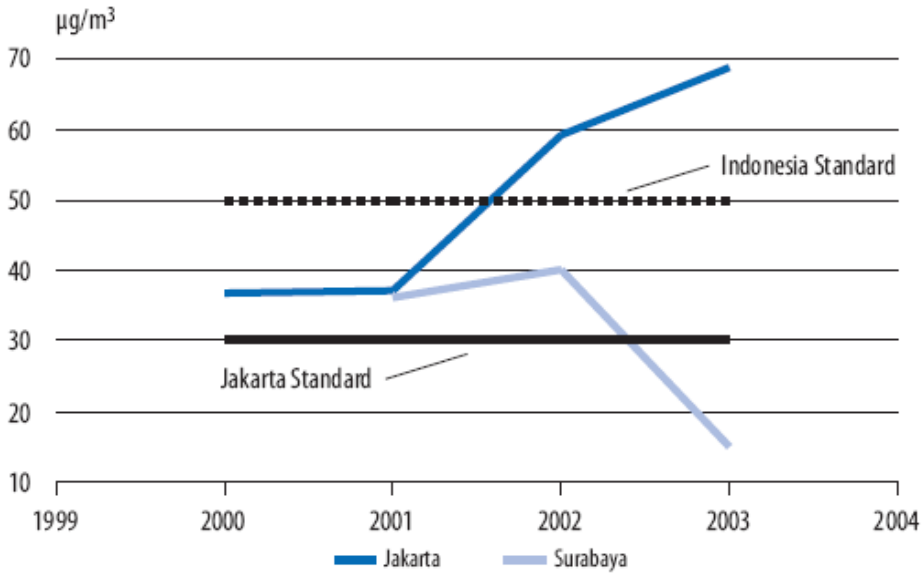
NO_2 = Nitrogen dioxide; US EPA = United States Environment Protection Act; WHO = World Health Organization; µg/m³ = micrograms per cubic meter
Sources: Jakarta data from Ministry of Environment. 2005. Indonesia State of Environment Report 2005 (SLHI 2005). Indonesia; Surabaya data from Air Laboratory of Surabaya, Environment Department of Surabaya, 2003.

Annual Average SO_2 Concentrations in Jakarta and Surabaya



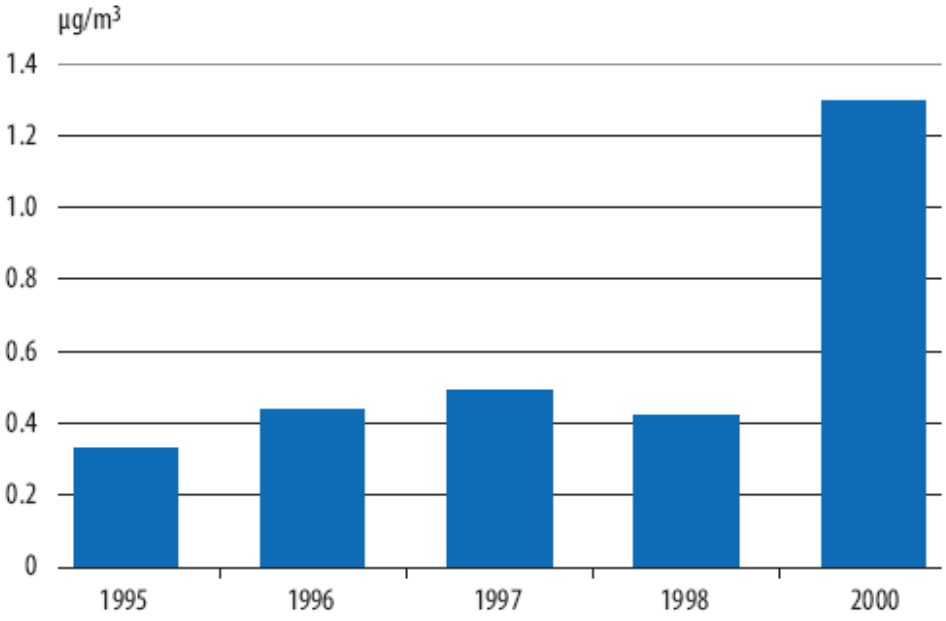
SO_2 = Sulfur dioxide; WHO = World Health Organization; µg/m³ = micrograms per cubic meter.
Sources: Jakarta data from the Ministry of Environment. 2005. Indonesia State of Environment Report 2005 (SLHI 2005). Indonesia; Surabaya data from Air Laboratory of Surabaya, Environment Department of Surabaya, 2003.

Annual Average O_3 Concentrations in Jakarta and Surabaya



O_3 = ozone; µg/m³ = micrograms per cubic meter
Sources: Jakarta data from the Ministry of Environment. 2005. Indonesia State of Environment Report 2005 (SLHI 2005). Indonesia; Surabaya data from Air Laboratory of Surabaya, Environment Department of Surabaya, 2003.

Concentrations of Pb in Jakarta, 1995–2000



Pb = Lead; µg/m³ = micrograms per cubic meter.
Note: Standard for lead is 1 µg/m³ as an annual mean.
Source: World Bank. 2003. World Bank Indonesia Environment Monitor 2003. Available at: http://siteresources.worldbank.org/INTINDONESIA/Resources/Publication/03-Publication/indo_monitor.pdf.

Indonesia and Jakarta's Air Quality Standards Compared to WHO Guidelines

Pollutant	Average Time	Jakarta	National	WHO 2005 Update
SPM	24-hour	230	230	–
	1-year	90	90	
PM_{10}	24-hour	150	150	50
	1-year	–	–	20
SO_2	1-hour	900	900	–
	24-hour	260	365	20
	1-year	60	60	–
NO_2	1-hour	400	400	200
	24-hour	92.5	150	–
	1-year	60	100	40
O_3	1-hour	200	235	–
	8-hour	–	–	100
	1-year	30	50	–
Pb	1-year	–	1	–
CO	1-hour	26,000	30,000	–
	8-hour	–	–	–
	24-hour	9,000	10,000	–

CO = Carbon monoxide; O_3 = ozone; NO_2 = Nitrogen dioxide; Pb = lead; PM_{10} = particulate matter with diameter less than or equal to 10 micrometers; SO_2 = Sulfur dioxide; SPM = suspended particulate matter; WHO = World Health Organization; $\mu g/m^3$ = micrograms per cubic meter
Note: Values are based on the atmospheric conditions at 25°C and pressure 1 atm.
Source: Asian Development Bank (ADB). 2002. Action Plan: Integrated Vehicle Emission Reduction Strategy for Greater Jakarta, Indonesia. Prepared by Indonesian Multi-Sectoral Action Plan Group on Vehicle Emissions Reduction. Prepared for Asian Development Bank Regional Technical Assistance 5937: Reducing Vehicle Emissions in Asia. July. Available at: www.adb.org/vehicle-emissions/actionindo.asp.
Syahril, S., B. Resosudarmo, and H.S. Tomo. 2002. Study on Air Quality, Future Trends, Health Impacts, Economic Value and Policy Options, Jakarta, Indonesia. Prepared for the Asian Development Bank. September 2002.
Available at: www.adb.org/Documents/Studies/Air_Quality_INO/air_quality.pdf.
World Health Organization. 2005. WHO Air Quality Guidelines Global Update 2005 Meeting Report. Bonn, Germany. 18–20 October. Available at: www.euro.who.int/Document/E87950.pdf.

Additional Notes:

NO_2 ambient concentrations for Jakarta and Surabaya show compliance to Indonesia and Jakarta's annual ambient concentration standards, except for 2003 in Jakarta. However, these annual averages would fail to meet the 2005 WHO AQG.

PM_{10} averages in Jakarta and Surabaya from 2000–2004 exceeded the 2005 update of the WHO air quality guideline (AQG) for PM10.

SO_2 annual average concentrations in Jakarta and Surabaya were found to have increased from 2000 onwards, reaching levels exceeding the ambient AQ standards. In Jakarta, the 2000 average ambient level was 11$\mu g/m^3$, which more than doubled in 2001 at 23 $\mu g/m^3$, increased to 45 $\mu g/m^3$ in 2002 and finally reached 111 $\mu g/m^3$ in 2003. According to MOE, these data for Jakarta were not accurate since one of the stations had problems that could lead to this being misinterpreted as an alarming increase in SO_2 levels (Rachmatunisa 2004). As for Surabaya, SO_2 levels in 2001–2003 complied with annual standards of 60 $\mu g/m^3$, but data from 2004 and 2005 showed non-compliance.

O_3 ambient concentrations in Jakarta have increased from 2001–2003. These concentrations exceeded the 30 $\mu g/m^3$ Jakarta limit for annual averages with

concentrations in 2003 exceeding the limit more than twofold. Measurements of O_3 in Surabaya for 2001–2003 show the annual levels are also within the standards for 1-year national standard (50µg/m^3). The 2001 ozone level is 36 µg/m^3 and the 2002 level is 40 µg/m^3. The observed annual mean for 2003 is of about 15 µg/m^3 seems very low compared to the 2001 and 2002 levels. This merits further clarification of the data.

Pb emissions from gasoline have been identified as one of the major threats to Indonesians, especially to children. Atmospheric lead pollution in Jakarta increased from 0.42 µg/m^3 in 1996 to 1.3 µg/m^3 in 2000. This is attributed to the increase in the number of vehicles as Indonesia's economy recovers. More recent data (Nugroho 2003) reveal a decrease in the average lead concentrations at various sampling locations in Jakarta city (Central, North, East, West, and South Jakarta) and at control sites (Bekasi, Bogor, and Tangerang). Since gasoline was the primary Pb contributor to ambient air, MOE and Komite Penghapusan Bensin Bertimbel (KPBB) in 2006 had conducted fuel quality monitoring in 20 cities from May to August 2006 (Figure 3.8). The fuel quality monitoring activity supplemented the ongoing air pollution control efforts. In terms of Pb levels, the quality of gasoline distributed in Indonesia has improved in 2006, especially with the recent move of Pertamina to remove Pb from all gasoline production starting in July 1 (Huizenga 2006). The 2006 survey showed that the average Pb content in gasoline was 0.038 grams per liter (g/L). Current average Pb levels in gasoline have gone down by 71.43% compared to the 2005 average level of 0.133 g/L. It expected that the Pb Concentration in ambient air will decrease further as old stocks of leaded gasoline are used and replaced by unleaded gasoline.

CO, during 2001–2003, the 24-hour levels of CO in Surabaya complied with the standards for 24-hour averaging (10,000µg/m^3). The annual average of 24-hour values for CO were 1,280, 1,180, and 1,090 µg/m^3. These, however, cannot be compared with 24-hour levels for 2001, 2002, and 2003 respectively.

Source: ADB (2006).

p) PM $_{10}$ Exceedance Days in DKI Jakarta, 2001-2003

Location	Year	Number of Exceedance Days/ Year	Number of Observation Days/Year	Data Capture/Year (%)	% Exceedance / Observation Days
JAF1	2001	5	362	99.20	1.38
JAF1	2002	15	329	90.10	4.56
JAF1	2003	5	277	75.90	1.81
JAF3	2001	0	29	7.90	0.00
JAF3	2002	2	331	90.70	0.60
JAF3	2003	0	124	34.00	0.00
JAF4	2001	1	111	30.40	0.90
JAF4	2002	6	232	63.60	2.59
JAF4	2003	1	326	89.30	0.31
JAF5	2001	0	155	42.50	0.00
JAF5	2002	3	340	93.20	0.88
JAF5	2003	0	266	72.90	0.00

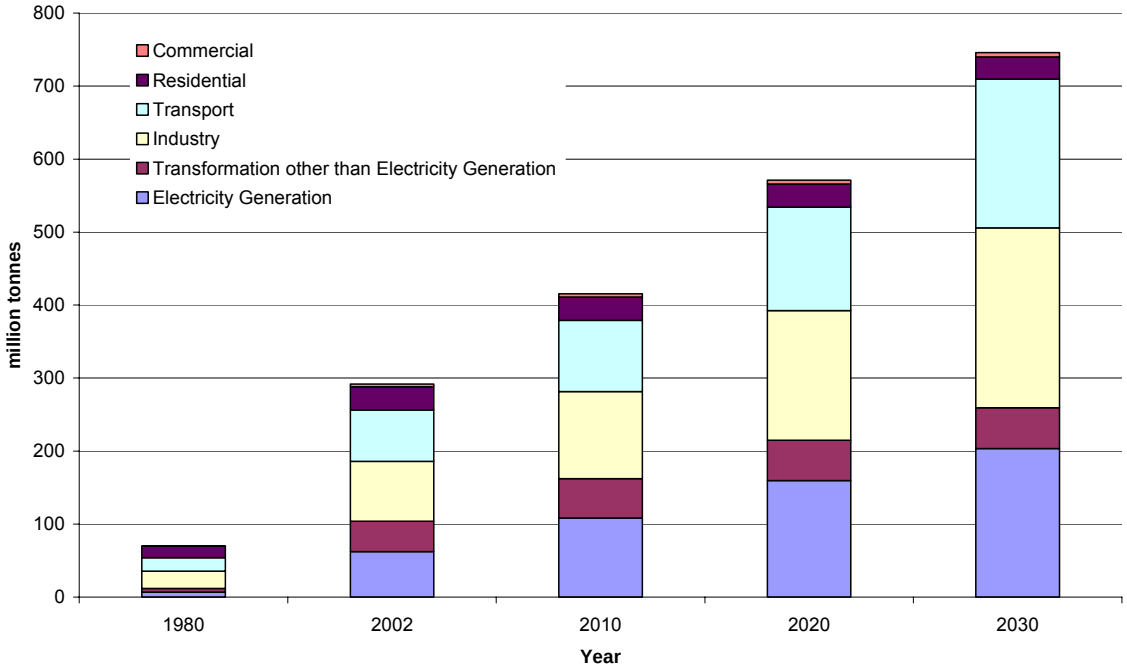
Source: ADB (2006).

q) Vehicular related emissions

Emission type	Unit	1991 in Surabaya in 1991	1998 in Jakarta
CO	tons	53052.00	
SO_2	tons	267.00	5773.70
NOx	tons	1897.00	56075.10
PM_{10}	tons		6156.40
TSP	tons	784.40	
HC	tons	2202.20	

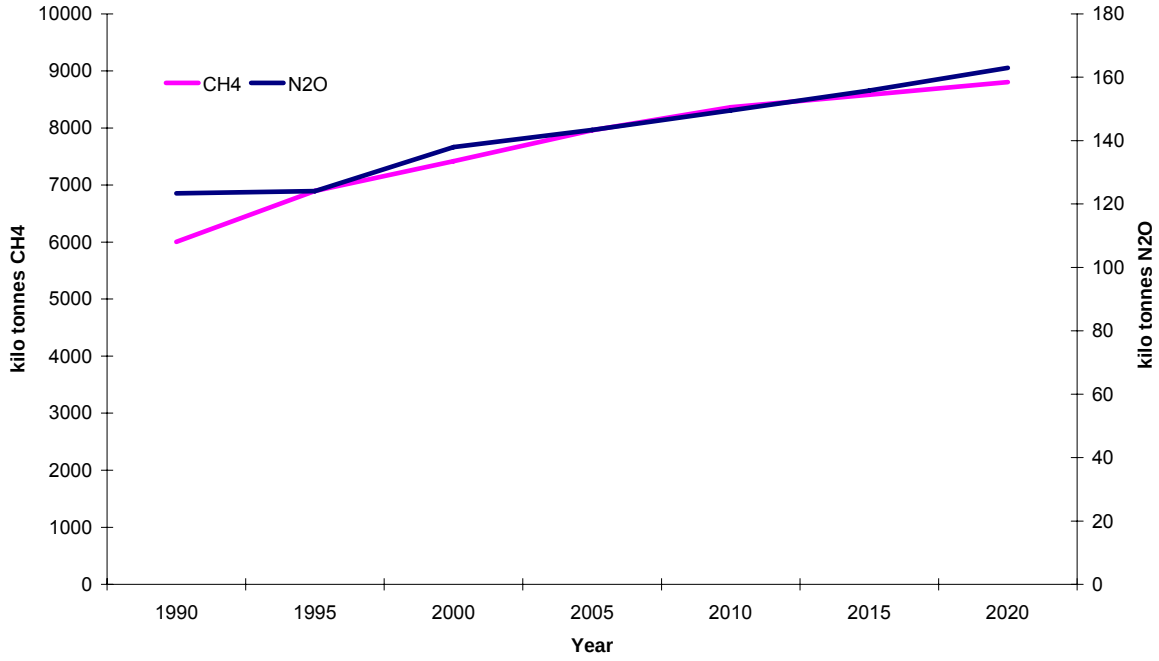
Source: ADB (2006).

r) CO_2 emissions sector wise



Source: APERC (2006).

s) Emission of other GHGs



Source: EPA (2006).

t) National aggregate emission of other gases

Type emission	Amount
SO_2 (kilo tons - 1995) #	684
CO (kilo tons - 1994) ##	11966
N_2O (kilo tons - 1994) ##	61
NO_X (kilo tons - 1994) ##	928

Source: # David G, S. et.al (2002), ## UNFCC national communications

Section 4. Health impacts

u) Health Impacts Due to Vehicles Emissions in Greater Jakarta

Parameter	1990	1995	2000	2005
Affected urban population (million persons)	10.9	13.60	16.50	19.90
TSP pollution level (µg/m^3)	200	200	200	200
TSP mortality	4,580	5,000	5,450	6,120
Work loss (million days)	15.82	19.74	23.95	28.88
Restricted activity (million days)	30.77	38.39	46.58	56.17
Hospital admissions ('000 cases)	67	84	101	122
Outpatient/clinic visits ('000 cases)	155	194	235	283
Asthma ('000 days)	318	396	312	358
Bronchitis in children ('000 cases)	247	270	312	358
Airborne lead pollution (µg/m^3)	1.3	1.3	1.3	1.3
Child IQ decrement (number)	765,000	835,000	965,000	1,106,000

Source: ADB (2002).; Note: TSP = total suspended particulate; μg/m^3 = micrograms per cubic meter

v) Corresponding Health Cost Estimates Due to Vehicles Emissions in Greater Jakarta (billion rupiah)

Parameter	1990	1995	2000	2005
TSP pollution level (μg/m^3)	200	200	200	200
TSP mortality	687.0	750.0	817.5	918.0
Work loss (million days)	98.1	122.4	148.5	179.1
Restricted activity (million days)	24.6	30.7	37.3	44.9
Hospital admissions ('000 cases)	34.8	43.7	52.5	63.4
Outpatient/clinic visits ('000 cases)	5.0	6.2	7.5	9.1
Asthma ('000 days)	1.6	2.0	2.4	2.9
Bronchitis in children ('000 cases)	2.8	3.0	3.5	4.0
Airborne lead pollution (μg/m^3)	176.0	192.1	222.0	254.4
Child IQ decrement (number)	1,029.90	1,150.10	1,291.20	1,475.80

TSP = total suspended particulate; μg/m^3 = micrograms per cubic meter

Source: ADB (2002).

w) Estimated Health Impacts and Costs of Air Pollution in Jakarta, 1998

Health Effects	Number of Cases	Cost ($US million)
PM_{10}		
Premature mortality	3,307	30.94
Restricted activity days	18,194,822	31.94
Hospital admissions	5,905	0.49
Emergency room visits	115,845	1.59
Asthma attacks	1,323,551	3.31
Lower respiratory illness (children)	296,909	0.36
Respiratory symptoms	90,057,542	108.8
Chronic bronchitis	30,118	0.18
NO_2		
Respiratory symptoms	3,506,535	4.24
Total		**181.4**

Source: Syahril and Torno (2002).

x) Prevalence Rates, Correlation Strengths, and Estimated Costs of Health Impacts

Symptoms	Prevalence (%)		Correlation with NO_2	Cost per Child and Episode (million rupiah)	Cost per Mother and Episode
	Students	Mothers			
Cough[§]	11.6-41.0	16.5-29.3	**	380-730	320-630
Phlegm[§]	6.0-36.6	6.0-16.4	*	310-600	290-570
Persistent cough	3.3-18.5	4.0-11.9	-	148-390	85-170
Wheezing[§]	3.0-17.4	-	***	190-372	-
Asthma	2.0-12.3	0.9-7.9	***	165-320	185-360

NO_2 = Nitrogen dioxide; % = percent
[§]without cold; * p<0.05; ** p< 0.01; *** p<0.005

Source: ADB (2006).

Section 5. Clean energy outlook

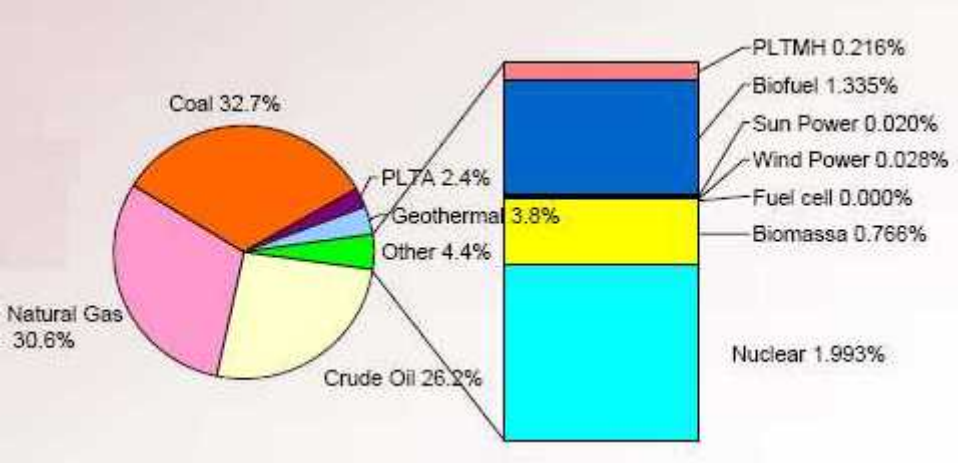
y) Renewable energy outlook table

	Potential (MW)	Installed (MW)		Generation Cost (Cent US$/KWh)	Target (MW)			
		2004	2005		Price in 2005 (cents US$/kWh)	2010	2020	2025
Wind	9450	0.5		4	9			
Biomass	50000	445		5.2				
Solar Thermal				6				
Solar PV (2004)	4.5 kW/m2/day	5		15				
Geothermal (2004)[2]	27189	807	812	3.28				
Small Hydro	712	54	214	0.4				
Biodiesel		0.17 billion liters per year	0.17 billion liters per year					
Biogas (2001)	685	0.06						

Source: Compiled by ECO-Asia from various sources.

z) National energy mix in 2025 (an optimizing scenario)

[2] The installed capacity in 1990 - 144.8 MW, 1995 - 309.8MW and in 2000 - 589.5MW



Source: DGOG (2006)

aa) Energy Efficiency outlook

Notes:

- The Indonesian Energy Plan for 2003-2020 targets, among others, a one percent per year reduction in energy intensity.
- Potential energy savings in industry is conservatively estimated at 20 pecent.

Source: ADB (2006b).

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