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ANNEX 11

DATA ANNEX: THAILAND

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

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Thailand 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datasets offer the advantage of data consistency (definitions and units) and higher data quality, they are often outdated relative to national country data sets.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.

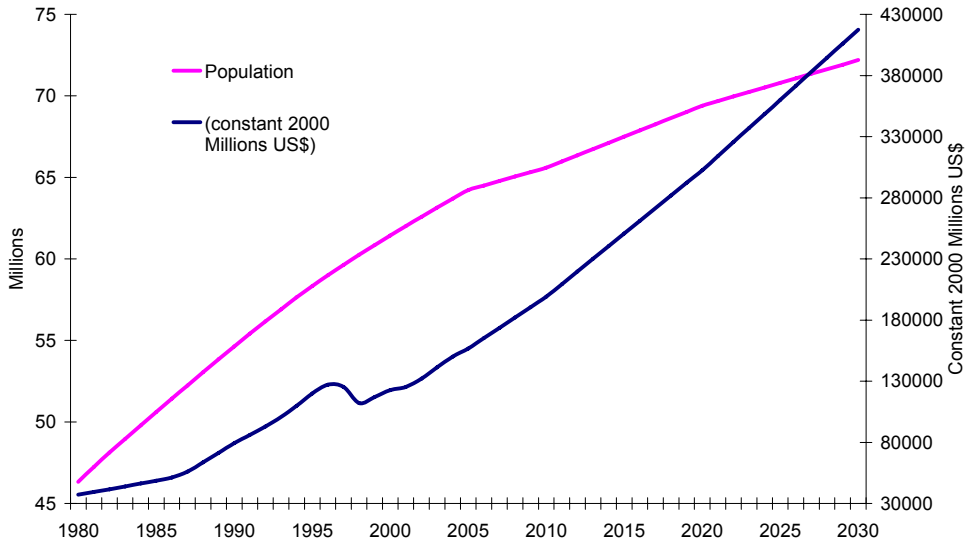
Section 1. Introduction

a) Country Overview

Population (2005) [#]	65,4443,71
Country area (km²) [#]	513,115
GDP - per capita (constant 2000 US$) [2005] [##]	2,440
Percentage of total population living in urban areas (%)[#]	31.6
Percentage of people connected to the grid (electricity) [%][#]	91.1
* Urbanization level is expected to reach 47% by 2030 [*#]	

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

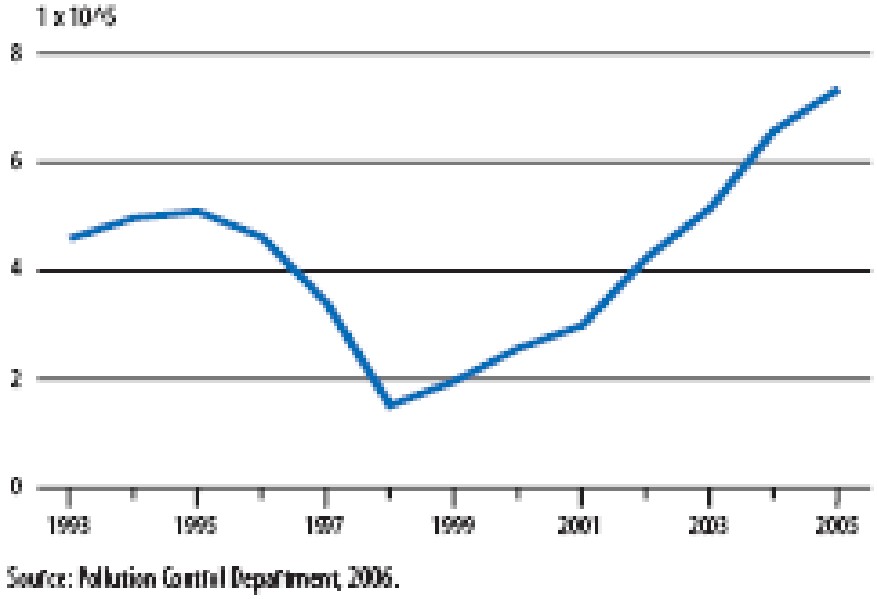
b) Growth in Population and GDP



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

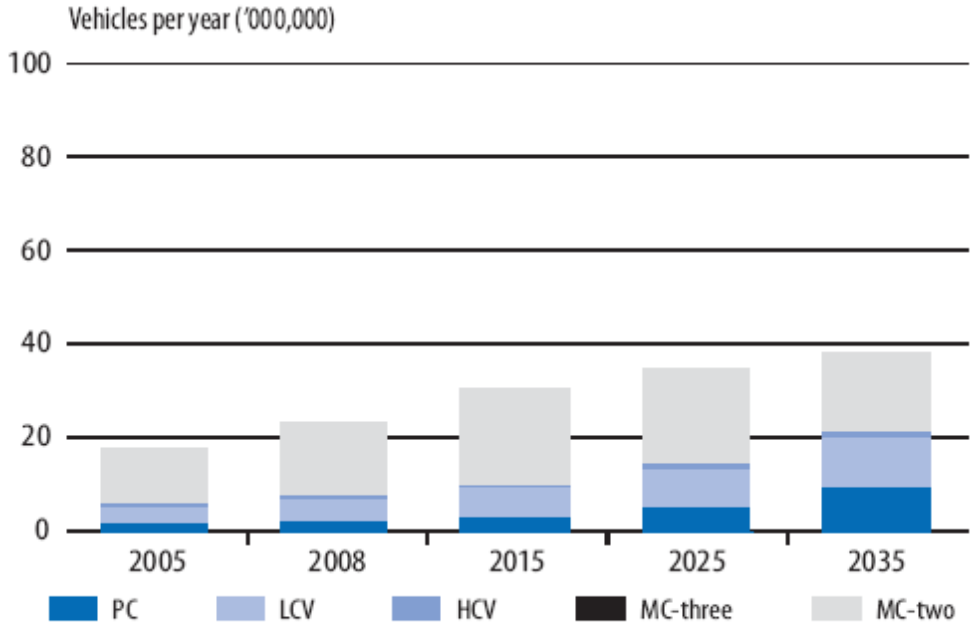
[1] Future projections

c) Number of New Vehicles Registered in Bangkok, 1993-2005



Source: ADB (2006b).

d) Forecasts for Growth in the Number of Motor Vehicles in Thailand

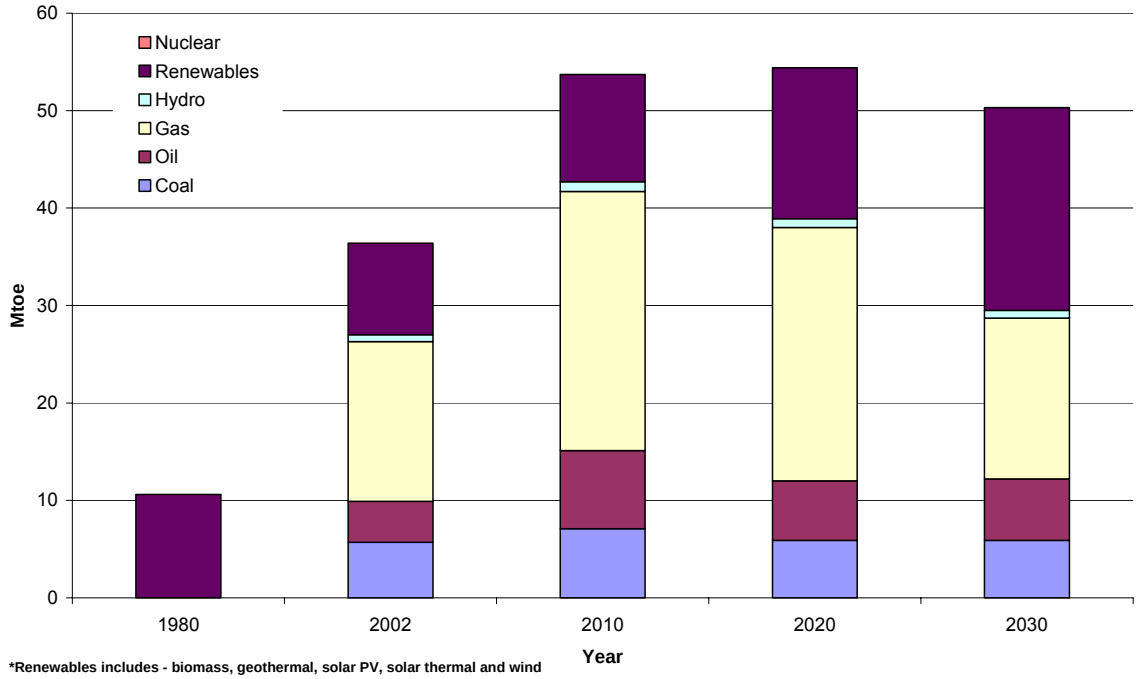


HCV = heavy commercial vehicle; LCV = light commercial vehicle; MC-three = three-wheeled vehicle with a motorcycle engine; MC-two = two-wheeled motorcycle; PC = private car.

Source: ADB (2006b).

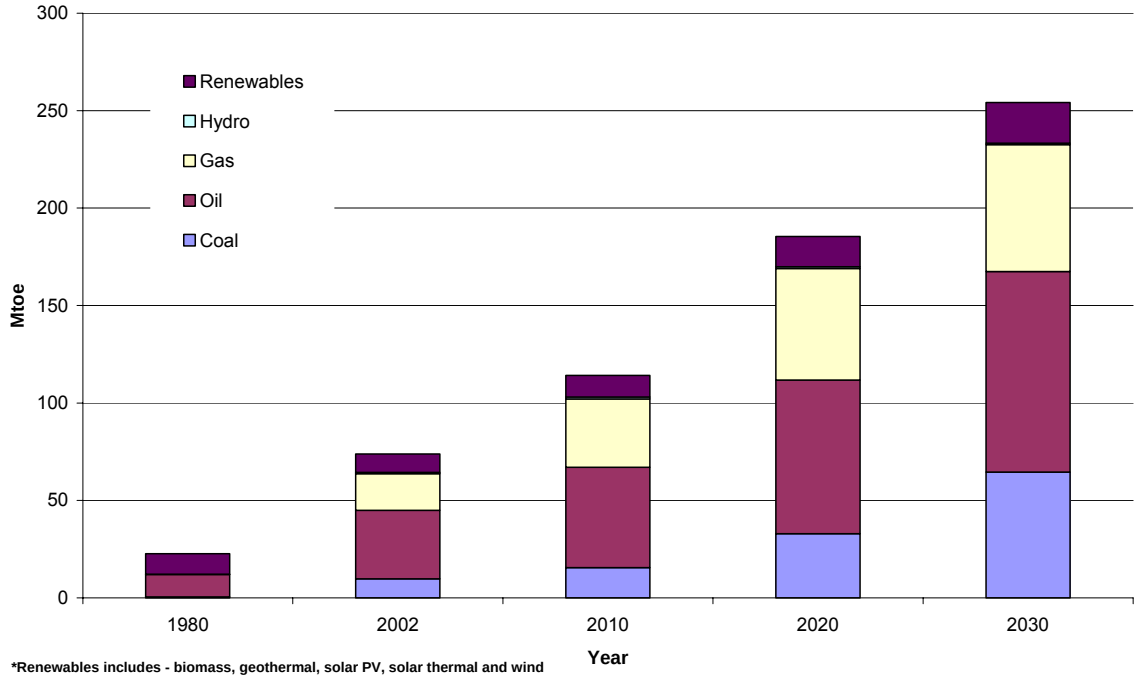
Section 2. Current status of energy supply and demand

e) Energy Production by Source



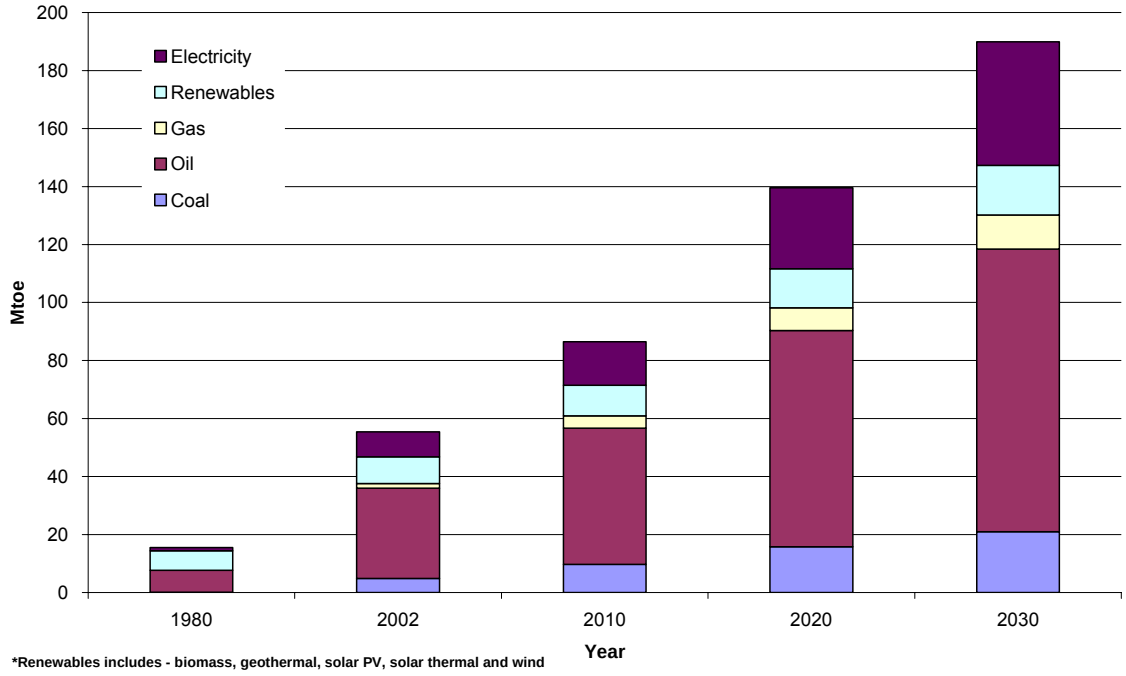
Source: APERC (2006).

f) Primary Energy Demand



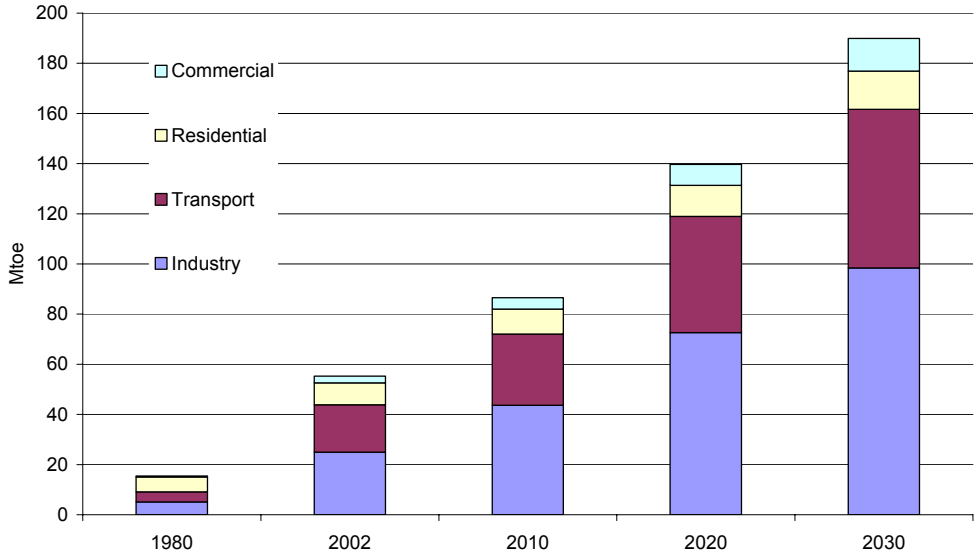
Source: APERC (2006).

g) Total Final Energy Demand by Source



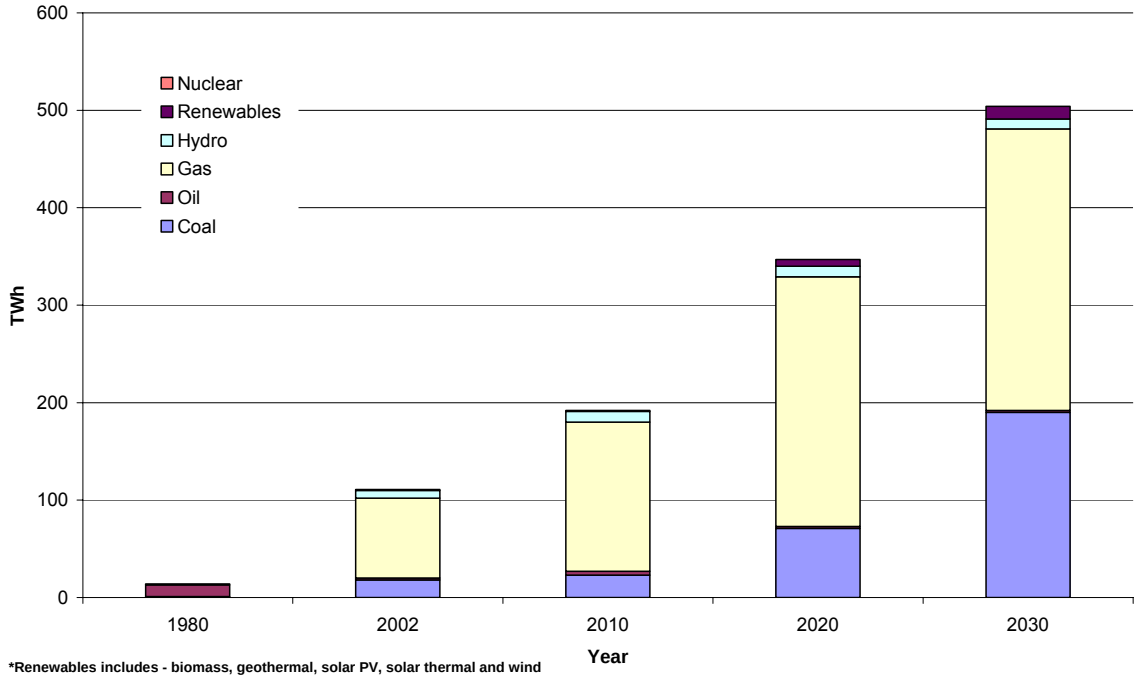
Source: APERC (2006).

h) Total Final Energy Demand by Sector



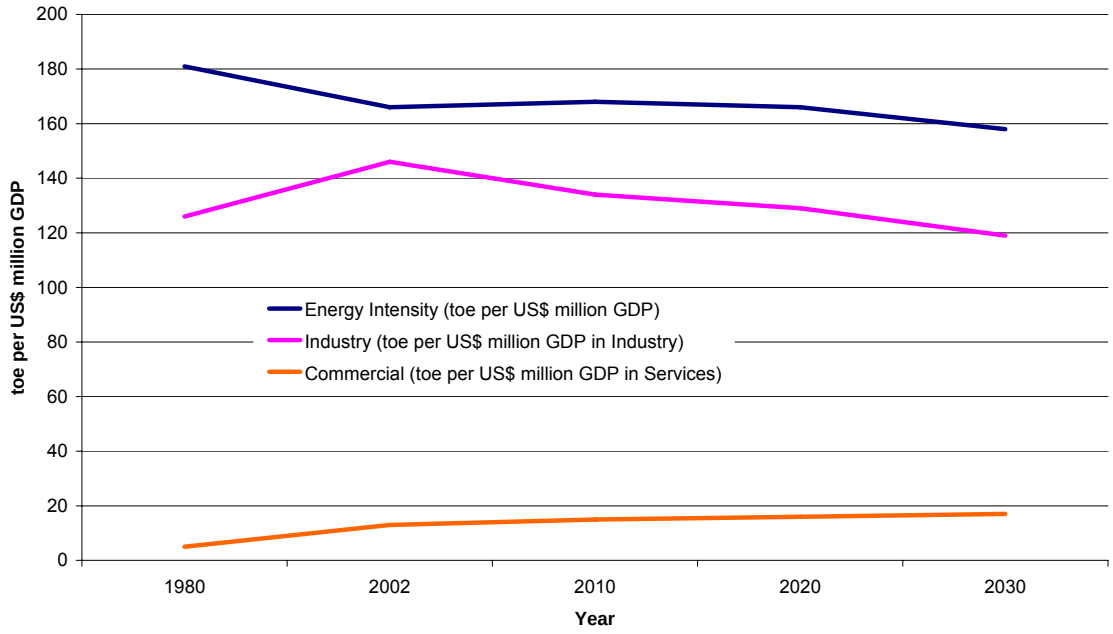
Source: APERC (2006).

i) Total Electricity Generation



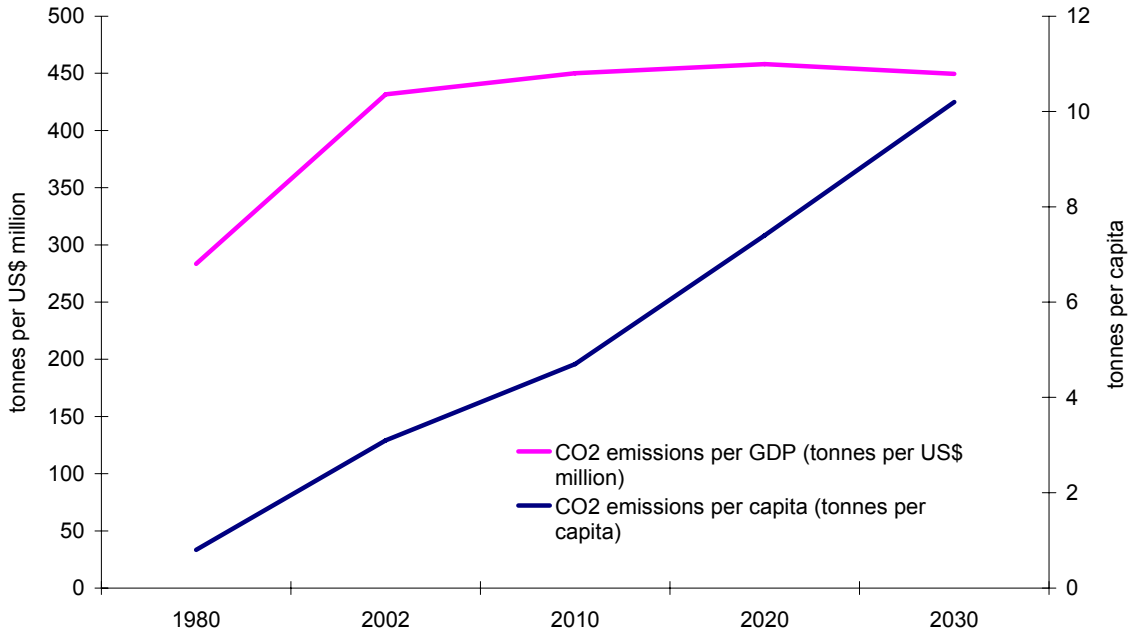
Source: APERC (2006).

j) Energy Intensity



Source: APERC (2006).

k) CO_2 Emissions Intensity



Source: APERC (2006).

l) Retail Price of Various Energy Sources

Fuel type	2000	2001	2002	2003	2004	2005
Gasoline (Cent US$/liter)			36.98	40.31	46.64	58.75
NG (Vehicles) [Cent US$/ MBTU]			19.10	18.15	19.15	21.66
Electricity (Household) (Cent US$/KWh)	6.00	6.61	6.81	6.66	7.02	7.26
Electricity (Industry) (Cent US$/KWh)	5.70	6.19	6.16	6.24	6.37	6.60
Electricity (Commercial) (Cent US$/KWh)	5.68	6.25	6.05	6.25	6.58	6.86

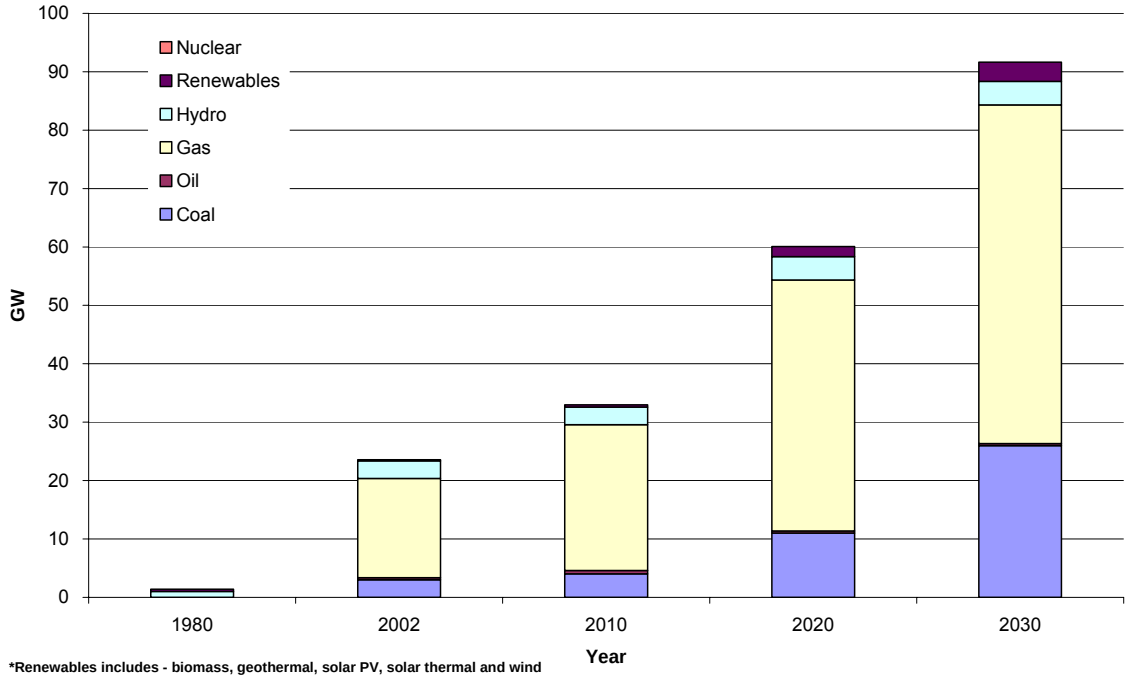
Source: EPPO, DEDE.

m) Energy Reserves Status

Energy Reserves (2005)	Total	Proven	Probable	Production	R/P ratio
Coal (million ton)	2870	1354	1516	9	150
Oil (million barrel)	1098	453	645	82	6
NG (billion cubic meter)	903	304	599	23	13

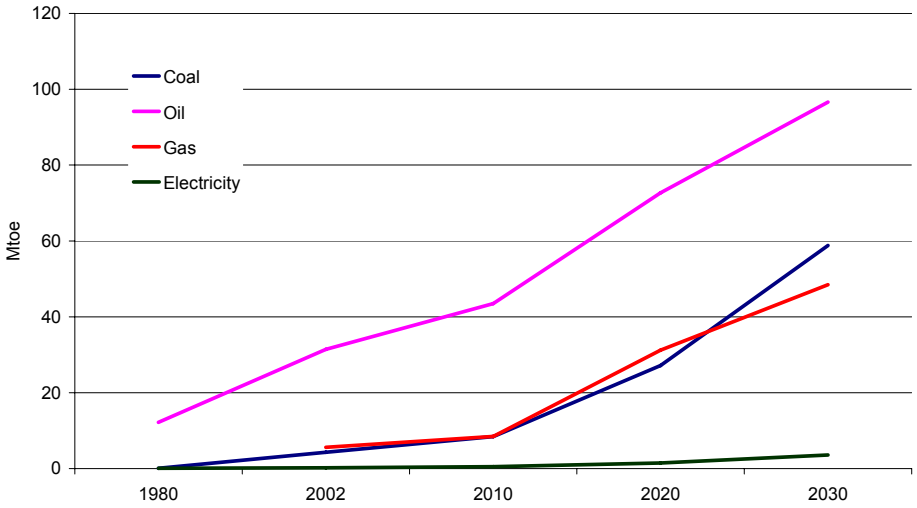
Source: Compiled by ECO-Asia from various sources

n) Electricity Installed Generation Capacity



Source: APERC (2006).

o) Demand Supply Gap Analysis

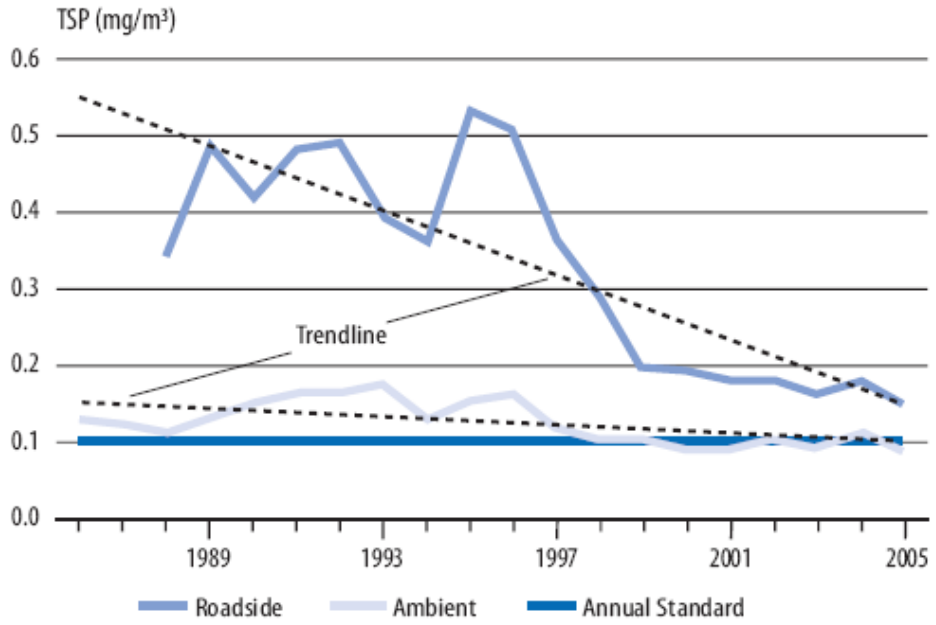


Source: APERC (2006).

Section 3. Environmental impacts related to energy use

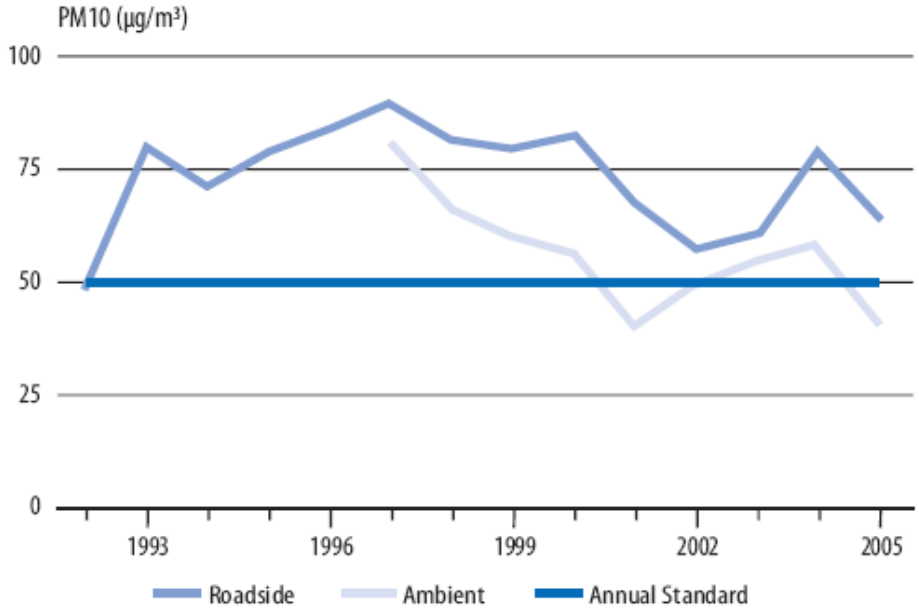
p) Ambient Levels of Various Criteria Pollutants in Bangkok

Roadside and Ambient TSP Levels in Bangkok, 1996–2005



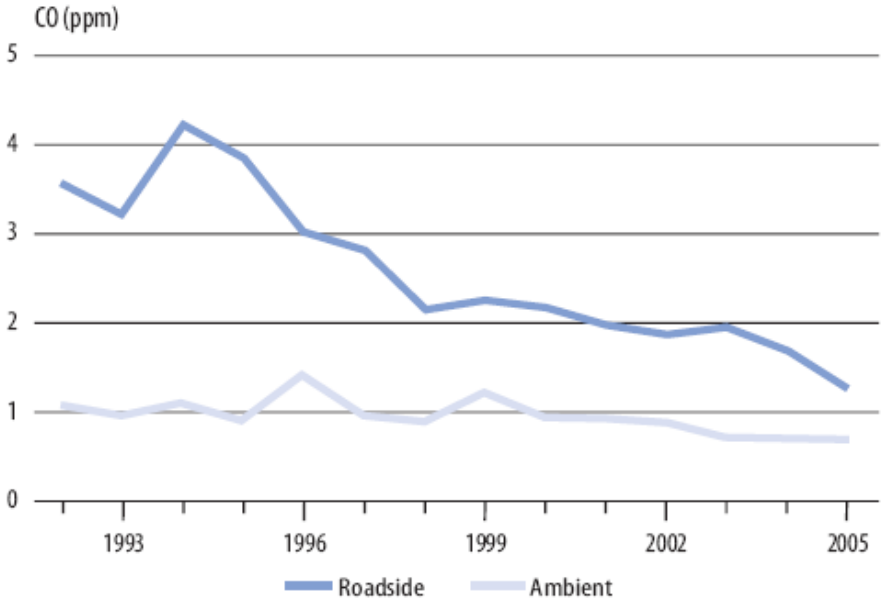
mg/m^3 = milligram per cubic meter, TSP = total suspended particulates
Source: Pollution Control Department, 2006.

Ambient and Roadside PM_{10} Levels in Bangkok, 1992–2005



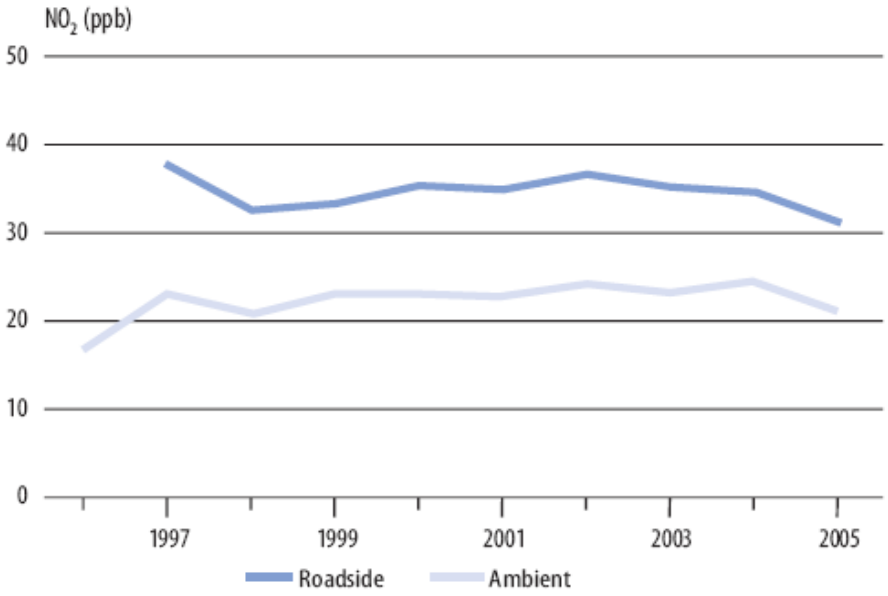
ug/m^3 = micrograms per cubic meter, PM_{10} = particulate matter with diameter not more than 10 microns
Source: Pollution Control Department, 2006.

Annual Roadside and Ambient CO Levels in Bangkok, 1992–2005



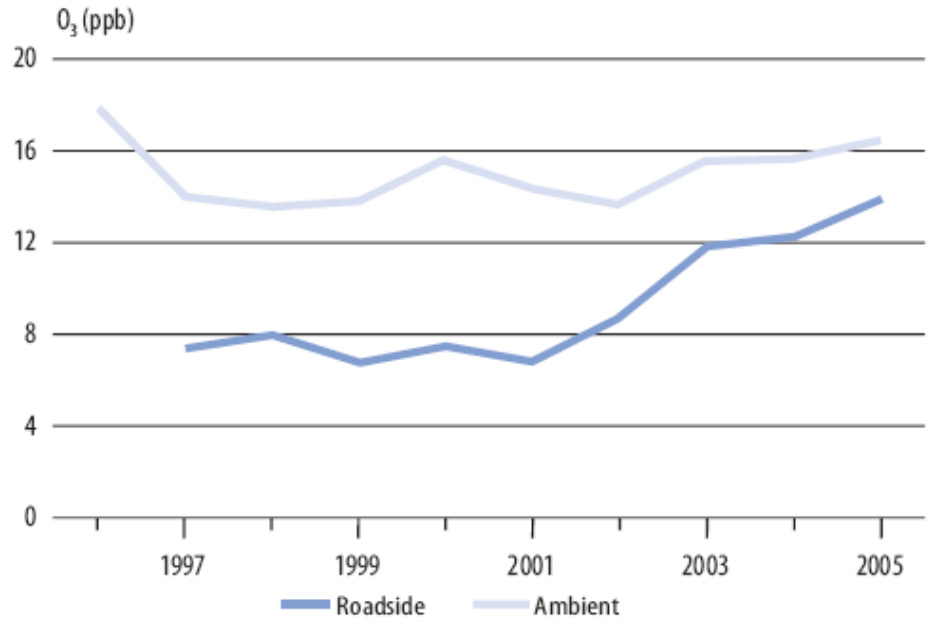
CO = Carbon monoxide, ppm = parts per million
Source: Pollution Control Department, 2006.

Annual Roadside and Ambient NO_2 Levels in Bangkok, 1996–2005



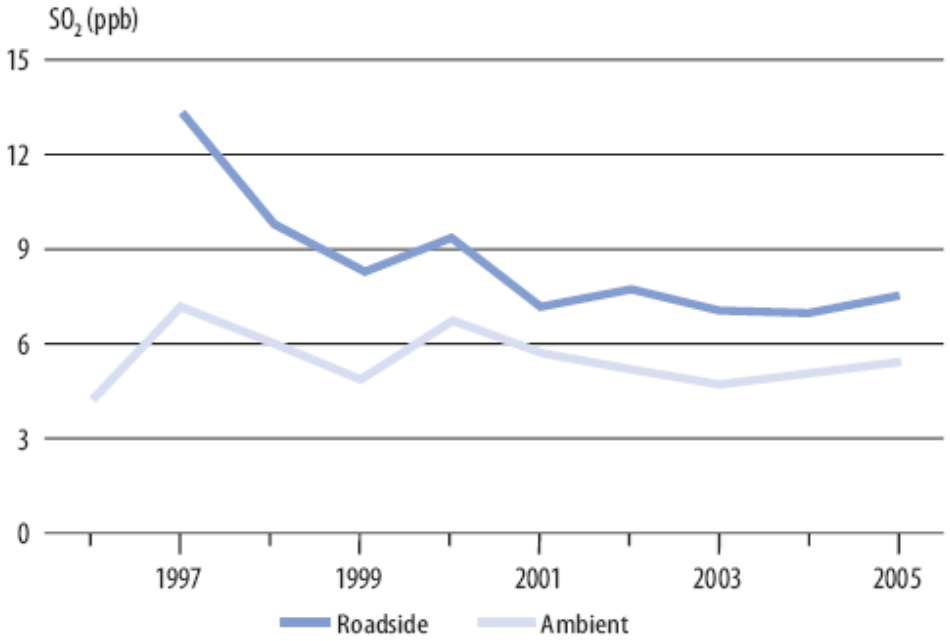
NO_2 = Nitrogen dioxide, ppb = parts per billion
Source: Pollution Control Department, 2006.

Annual Roadside and Ambient Ozone Levels in Bangkok, 1996–2005



Source: Pollution Control Department, 2006.

Annual Roadside and Ambient SO_2 Levels in Bangkok, 1996–2005



Source: Pollution Control Department, 2006.

Thailand's NAAQS vs. WHO Guidelines and US Standards (µg/m³)

Pollutant	Average Time	Thailand	WHO	US EPA
TSPs	24 hours	330	–	–
	1 year	100[a]	–	–
PM_{10}	24 hours	120	50[b]	150
	1 year	50[a]	20[b]	revoked
Pb	1 month	1.5		
	1 year	–	0.5[c]	
SO	24 hours	300	20[b]	365
	1 year	100[a]	–	78
NO_2	1 hour	320	200[b]	
	1 year	–	40[b]	100
O_3	8 hours	–	100[b]	157
	1 hour	200		235
CO	8 hours	10,260	10,000[c]	10,000
	1 hour	34,200	30,000[c]	40,000

Guidelines refer to the safe level of a pollutant, for a given average time, to protect the public from acute health effects.
CO = Carbon monoxide, NAAQS = National Ambient Air Quality Standards, NO_2 = Nitrogen dioxide, O_3 = Ozone, Pb = lead, PCD = Pollution Control Department, SO = Sulfur dioxide, TSP = total suspended particulates, US EPA = United States Environmental Protection Agency, WHO = World Health Organization, µg/m³ = micrograms per cubic meter
[a] Arithmetic mean
Source: [b] WHO Global Update 2005, [c] WHO 2000, PCD, 2006c, US EPA, 2006.

Notes:

Ozone levels in Bangkok are a cause for concern as shown in the above figure. Similar trends have been observed in other BMR provinces and the eastern region of Thailand. Rising emissions of VOCs and NOx, which are precursors for O_3 along with meteorological conditions, are causes of increasing maximum levels downwind in urban centers. However, several studies have indicated that the O_3 problem in Bangkok is controlled by VOCs and not by NOx. This means that VOCs emissions will have to be reduced to lower the levels of O_3.

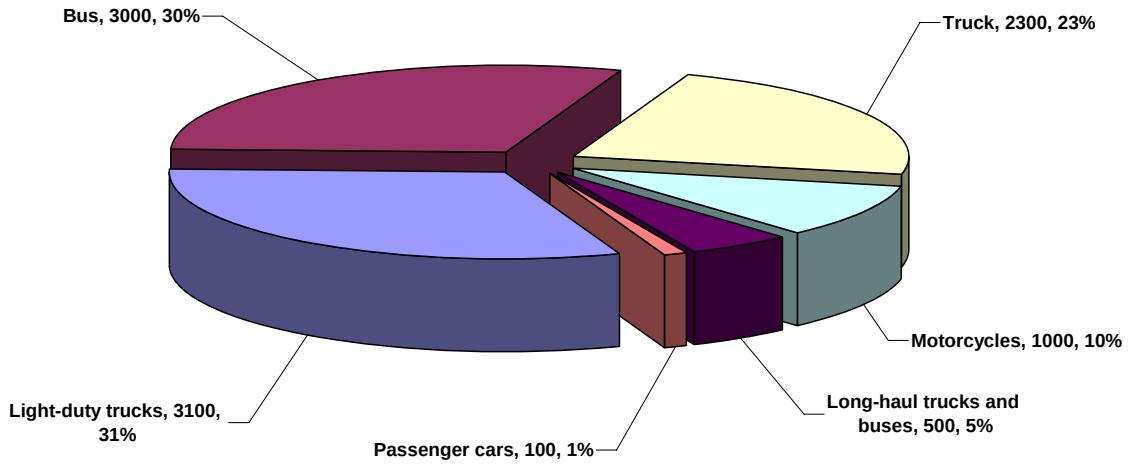
Lead in ambient air is not an issue in Thailand anymore. Since Thailand's complete phaseout of leaded gasoline at the end of 1995, lead levels were observed to have fallen to almost nil.

SO_2: PCD has identified power plants as the major source of SO_2. Thus, measurements are made near power stations around the country. In Mae Moh, 13 lignite power plants are responsible for the excessive levels of SO_2. Following a serious incident in its power plants in 1992, the Electricity Generating Authority of Thailand introduced a comprehensive policy for environmental protection. Desulfurization technology has been progressively installed in power plants that resulted in the declining level of ambient SO_2 in Mae Moh. With EGAT's power generating plants' improved compliance with the environmental policy, emissions have begun to decline. Ambient levels of

SO_2 around cities have been within standard levels for a long time In 2005, ambient and roadside measurements in Bangkok showed that average measurements of SO_2 were well below the national standard. In Bangkok's adjoining provinces, SO_2 concentrations were similar to those of Bangkok.

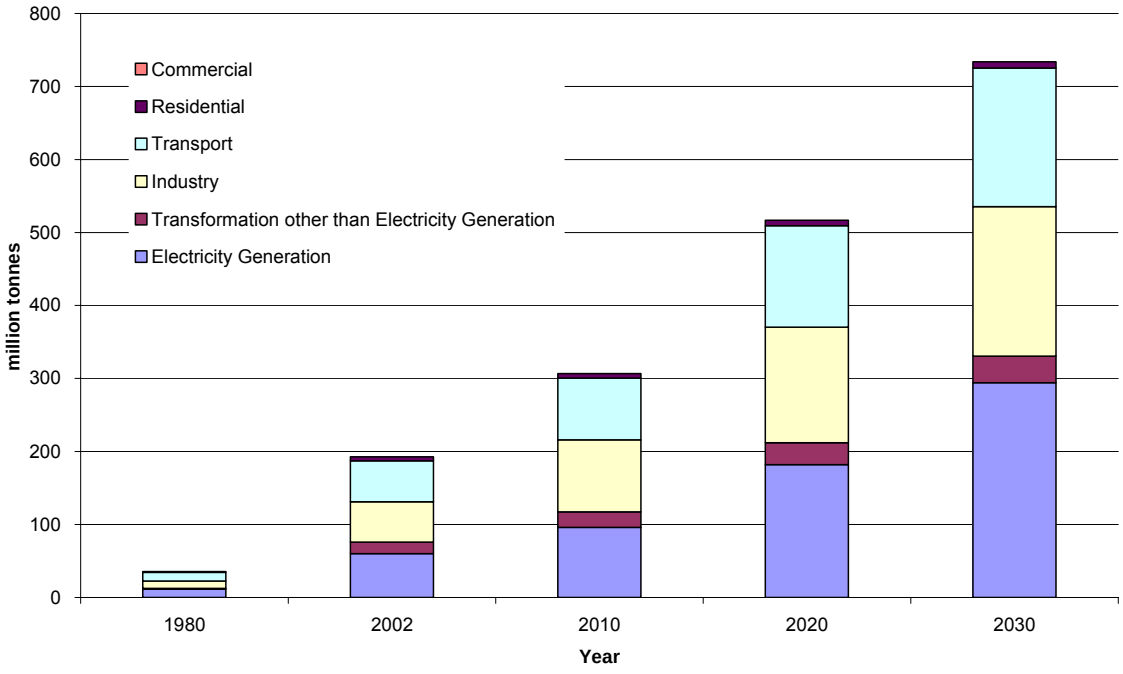
Source: ADB (2006).

q) Vehicular Related Emissions in Bangkok (in tonnes of $PM_{10,}$ 2001)



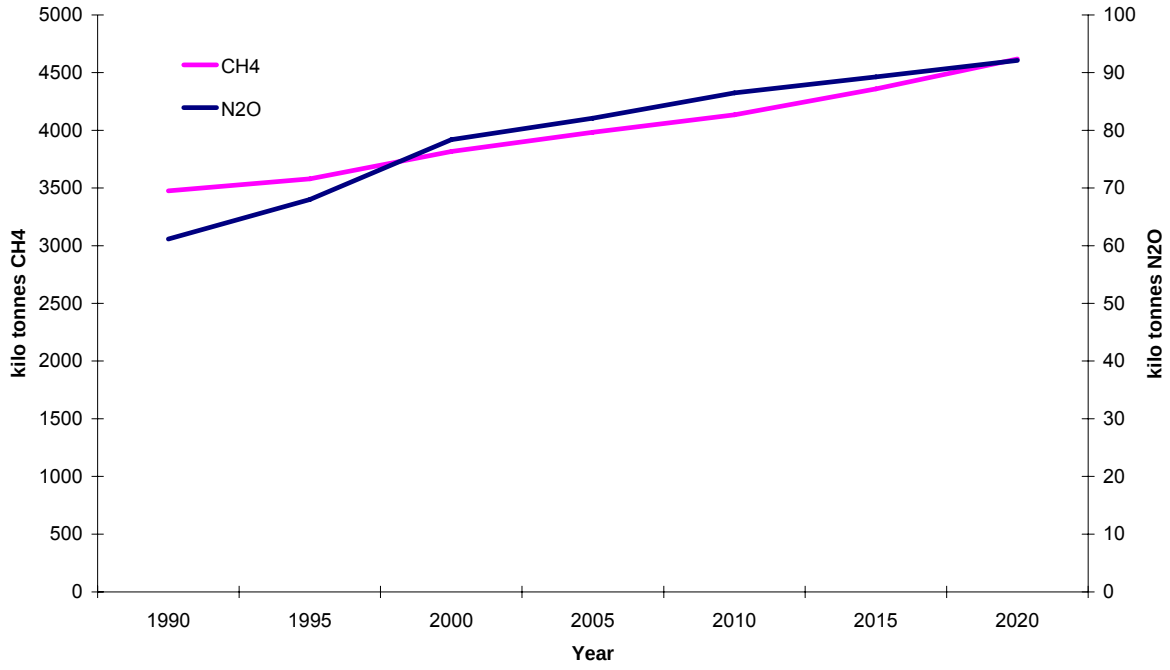
Source: ADB (2006).

r) CO_2 Emissions by Sector



Source: APERC (2006).

s) Emission of Other GHGs



Source: EPA (2006).

t) National aggregate emission of other gases

Type of emission	1995[2]	1999	2000	2001	2002	2003	2004	2005
PM (kilo tons)	10,000							
CO (kilo tons)	555			2,791	2,887	2,973	3,038	3,102
SO_2 (kilo tons)				350	359	335	377	381
NO_X (kilo tons)	287	659	656	703	752	801	865	889

Source: DEDE.

Section 4. Health impacts

u) Health Impacts

Health impact	1998	2005	Remarks
Death - human/year	700-2000	285 - 814	The reduction of dust particle size resulted from the modification of diesel oil by reduce the sulfur content from 500 ppm to 350 ppm
New chronic respiratory diseases (hospitalization) - human/year	3000 - 93000	1221 - 3785	
Health impact to economy - Million US$/year	1400 - 3500	569.8 - 1424.5	

Source: PCD.

[2] Except PM values - all other values in 1995 has been sourced from UNFCCC national communications

Notes:

In 2001, airborne PM was estimated to have caused 3,300 premature deaths that led to almost 17,000 hospital admissions, at a total health care cost of up to $6.3 billion. One study reports that Bangkok's population has been affected adversely by increases in PM - with an estimated 5,000 premature deaths annually.

The Mae Moh valley has recorded an unusual number of deaths from heart failure and a high incidence of chronic respiratory problems. In one 1998 incident, 400 villagers were hospitalized as local **SO_2** levels of 2,200 $\mu g/m^3$ per hour were reported (compared to the standard value of 1,300 µg/m3). Public exposure to air pollution in Bangkok is estimated to cause thousands of premature deaths and several million cases of ailments every year. Some preliminary studies on the health costs associated with increases in air pollution were conducted. One recent study examined the relationship between **PM** and acute daily respiratory problems on a sample group of 251 subjects in Bangkok. It was estimated that a 10 $\mu g/m^3$ reduction in annual average of **PM_{10}** concentrations would result in reduced health problems and an improved quality of life valued between 35 and 88 billion baht (B) ($1.4–3.55 billion).

An analysis of the cost on health of exposure to PM_{10} in six major cities in Thailand Bangkok, Chiang Mai, Nakhon Sawan, Khon Kaen, Nakhon Ratchasima, and Songkhla was undertaken for the World Bank Environment Monitor (released in 2002). The total cost of the exposure to PM_{10} in these cities for excess deaths and bronchitis is estimated at $644 million per year and is a lower bound of the health damage.

Economic evaluation of air pollution in Bangkok has been well documented compared to other Asian cities. The World Bank-funded study found that Bangkok residents spent an average of 12.5 per cent of their total medical expenses on respiratory illnesses alone. It was also determined that a 20 $\mu g/m^3$ reduction in annual average PM_{10} concentrations in Bangkok would result in an estimated savings of B65–175 billion. These savings largely outweigh the costs of mitigation measures used to reduce PM.

Source: ADB (2006).

Section 5. Clean energy outlook

v) Renewable Energy Outlook

	Potential (MW)	Installed (MW)		Target (MW)		
		2004	2005	2010	2019	2025
Wind			39			
Biomass	2,000		670			
Solar Thermal						
Solar PV		5	24	48	273	
Geothermal			0.3			
Small Hydro	1770		350			
Biodiesel		350,000 liters per day				
Biogas	245 MW in 2004 & 278 MW in 2005		20	100-300		

Source: Compiled by ECO-Asia from various sources.

w) Energy Efficiency Outlook

Notes:

- Thailand's goal is to reduce energy elasticity from the current 1.4:1 to 1:1 by 2007.
- The results of a scenario analysis indicate that Thailand's industrial sector has an achievable potential for energy savings of about 1,893.9 GWh/year considering a conservative scenario, and an energy savings of about 5,502.70 GWh/year for an optimistic scenario.
- Energy savings potential and energy efficiency improvements in the commercial sector are 127 GWh/year (conservative scenario) or 522 GWh/year (optimistic scenario). Potential exists in the improvement of air conditioning and lighting systems through replacing chillers and ballast, lighting retrofits, and using voltage regulators.

Source: ADB (2006b).

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PCD. Pollution Control Department, Thailand; available at http://www.pcd.go.th/

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