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ANNEX 12

# DATA ANNEX: VIETNAM

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).

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## DISCLAIMER

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datasets offer the advantage of data consistency (definitions and units) and higher data quality, they are often outdated relative to national country data sets.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

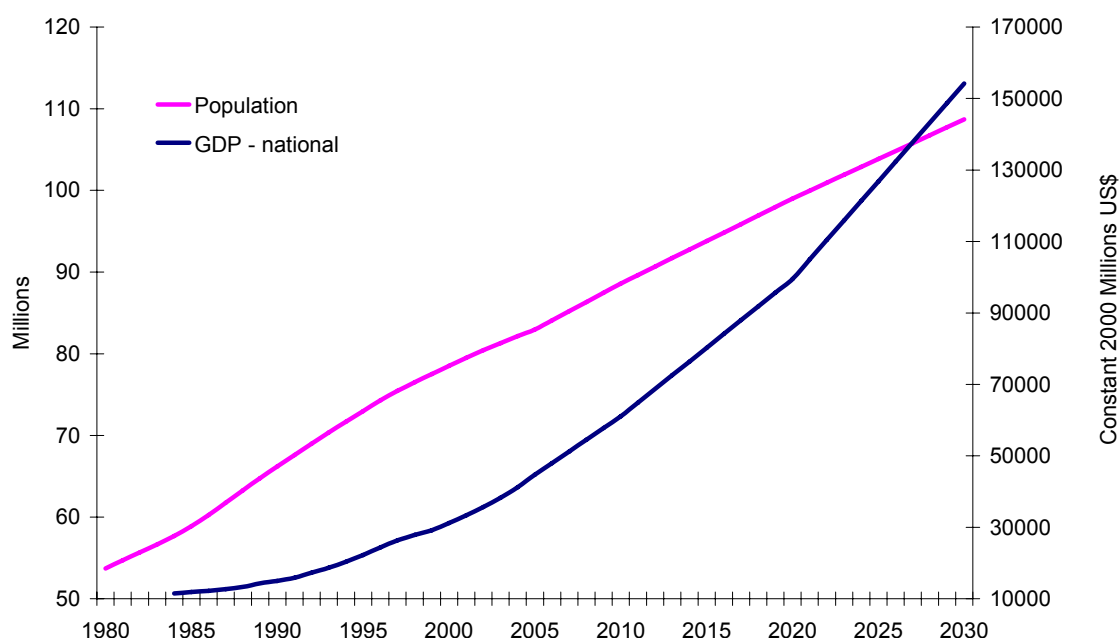
#### a) General data

|  |          |
|--|----------|
| Population (2005) #  | 83535576 |
| Country area (km <sup>2</sup> ) #                              | 331690   |
| GDP - per capita (constant 2000 US\$) [2005] ##                | 539      |
| Percentage of total population living in urban areas (%) #     | 25.2     |
| Percentage of people connected to the grid (electricity) * [%] | 91.53%   |

\*Urbanization level is expected to reach 43% by 2030 \*\*

Source: # RECIPES (2006), ## WDI (2006), \*# APERC (2006), \*EVN (2006).

#### b) Growth in Population and GDP



Source: WDI (2006), APERC (2006)<sup>1</sup>.

<sup>1</sup> Future projections

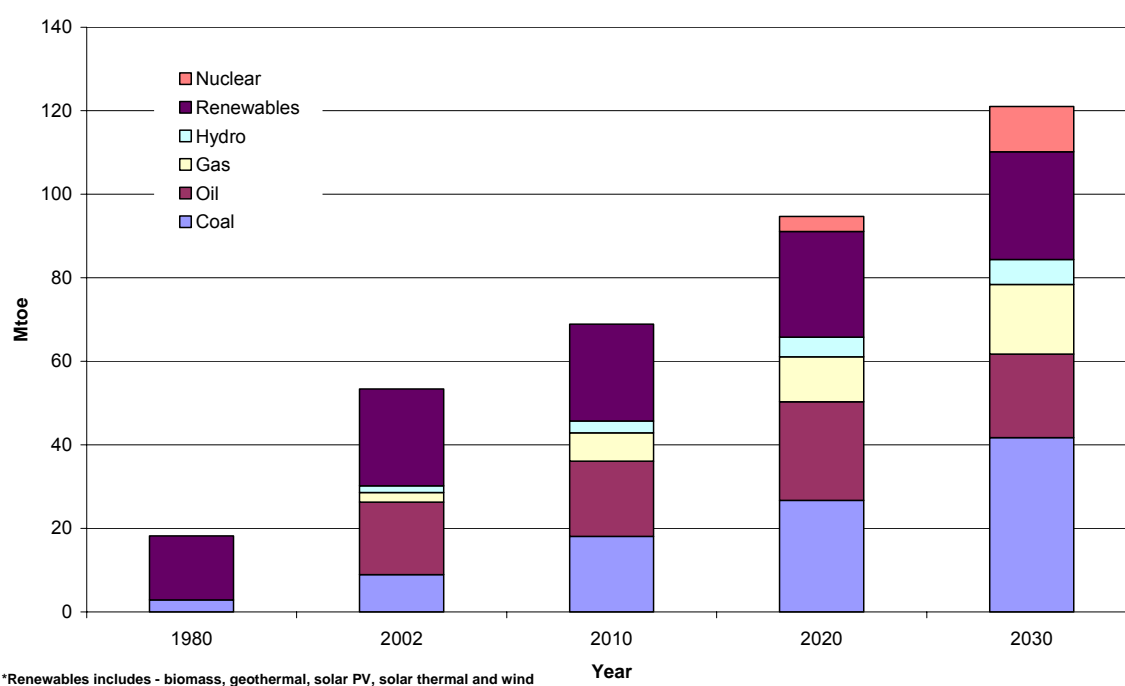
c) Number of Vehicles in Vietnam

| Type of Vehicle     | 1996    | 1997    | 1998    | 1999    | 2000    | 2001    |
|---------------------|---------|---------|---------|---------|---------|---------|
| Car                 | 105050  | 117230  | 129140  | 89120   | 99022   | 109841  |
| Bus                 |         |         |         | 47806   | 53118   | 69845   |
| Truck               |         |         |         | 126246  | 140274  | 140691  |
| Specialised vehicle | 131350  | 135770  | 149560  | 32283   | 37981   | 42430   |
| others              |         |         |         | 19450   | 22375   | 24739   |
| Motorcycle          | 4208247 | 4827218 | 5200000 | 5600000 | 6478954 | 8000000 |

Source: IAPV (2002).

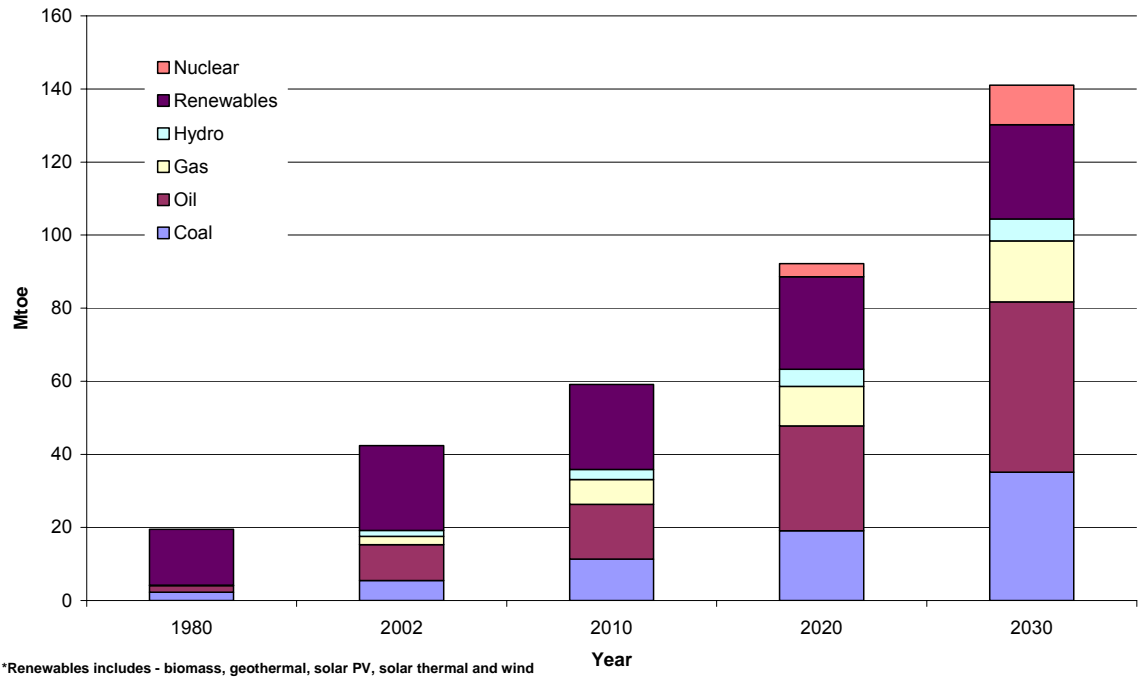
**Section 2. Current status of energy supply and demand**

d) Energy production by source



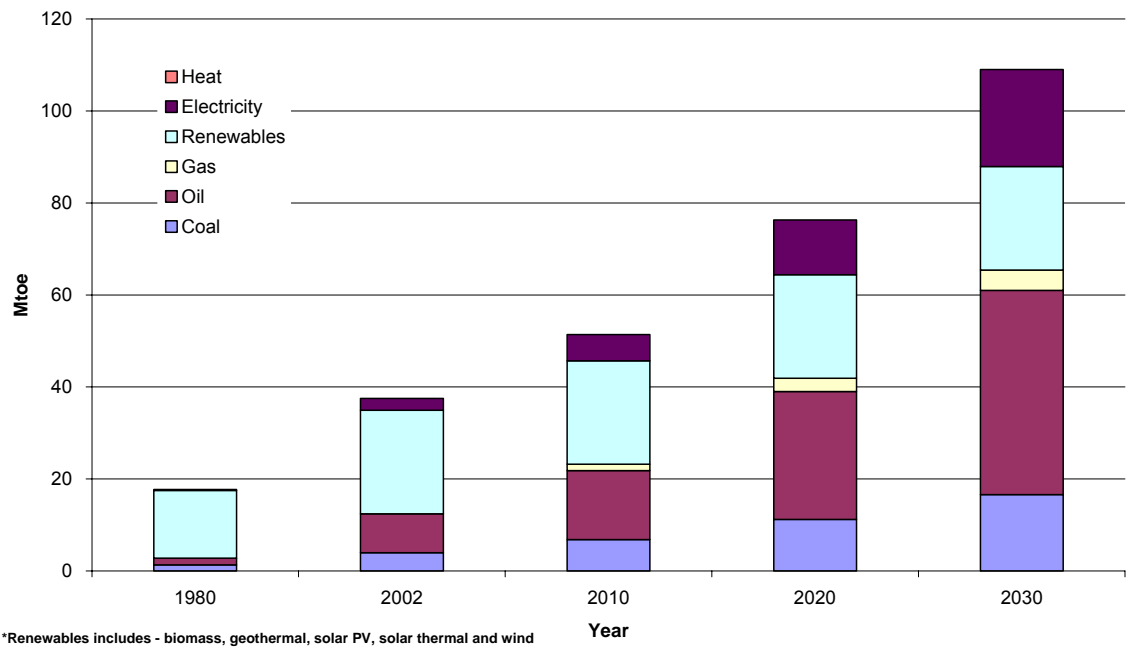
Source: APERC (2006).

e) Primary Energy demand



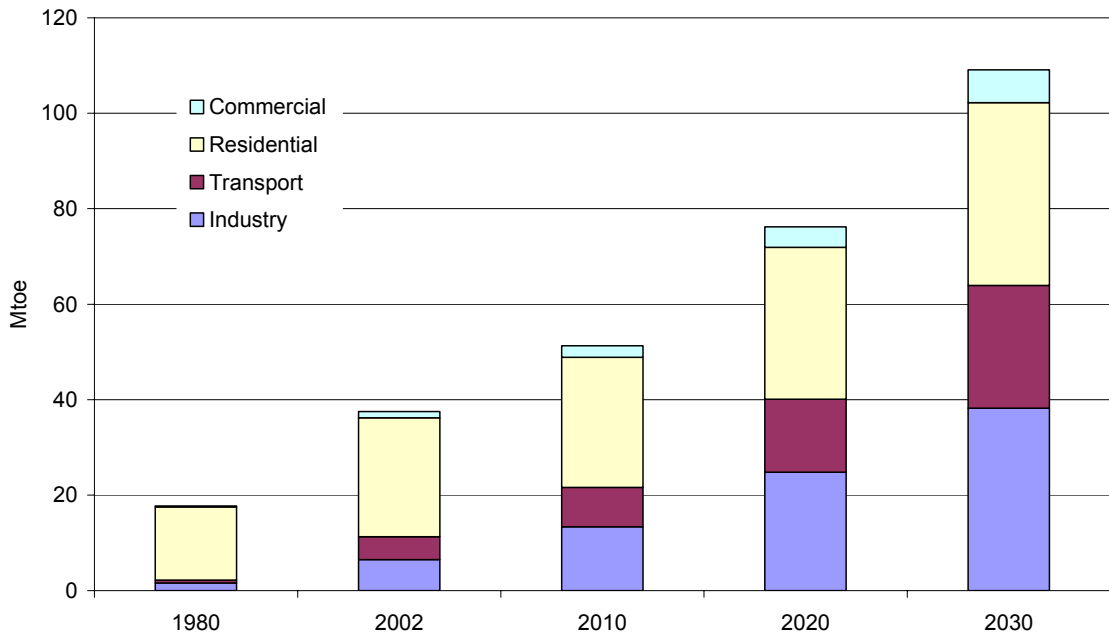
Source: APERC (2006).

f) Total final energy demand by Source



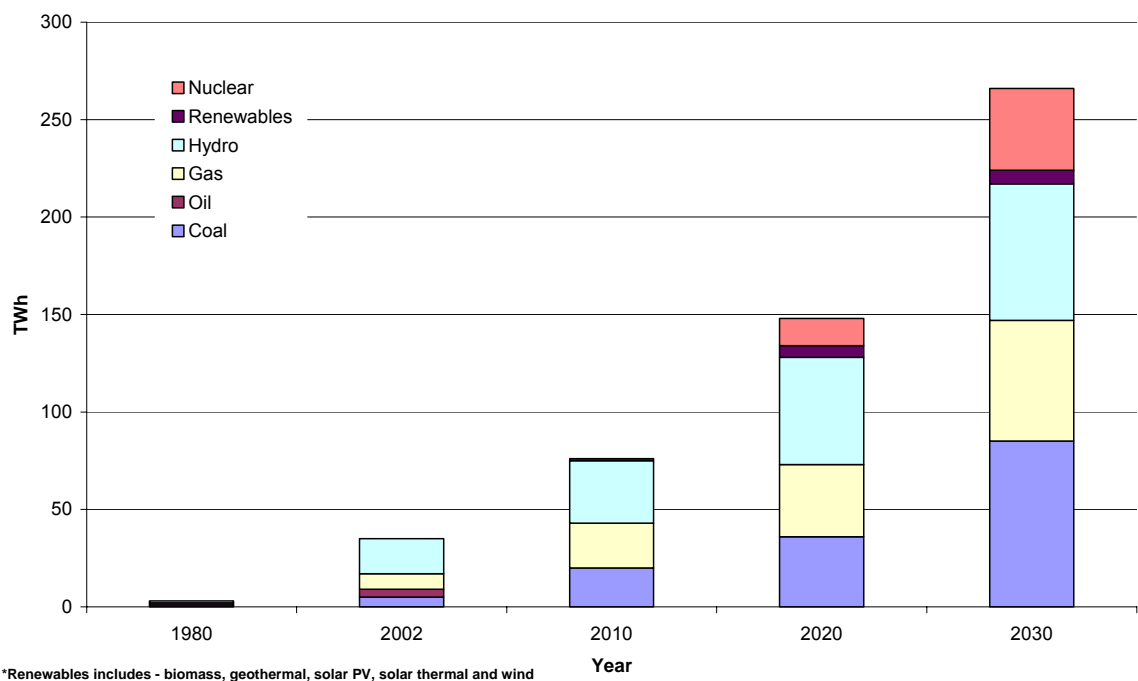
Source: APERC (2006).

g) Total final energy demand by sector



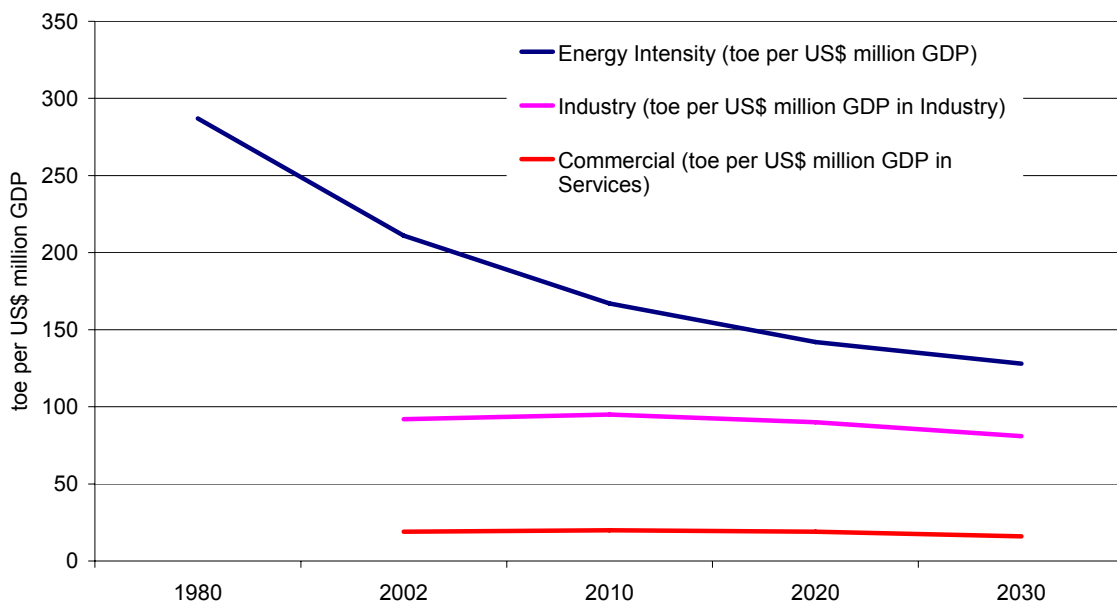
Source: APERC (2006).

h) Total electricity generation



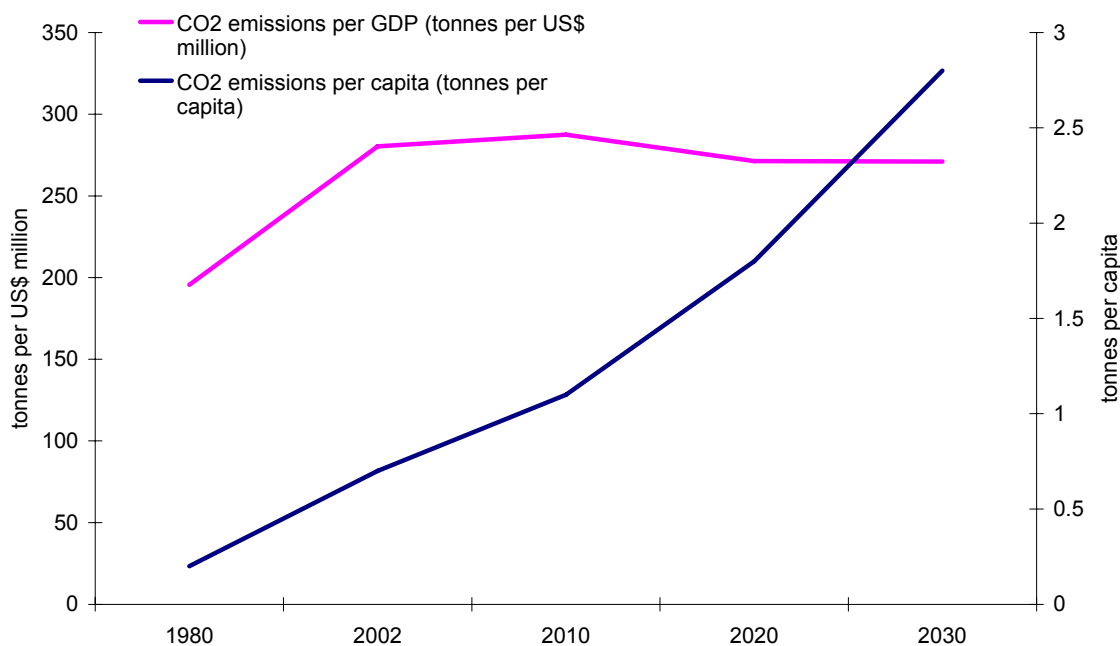
Source: APERC (2006).

i) Energy intensity



Source: APERC (2006).

j) CO<sub>2</sub> emissions intensity



Source: APERC (2006).

## k) Retail price of various energy sources

| <b>Fuel type</b>  | <b>Most recent year available data</b> |
|---|--|
| Gasoline (Cent US\$/liter) A95                                | 67 ( 1800 VND)                         |
| Diesel (Cent US\$/liter)                                      | 53.75 (8600 VND)                       |
| Kerosene (Cent US\$/liter)                                    | 53.75 (8600 VND)                       |
| Coal (Cent US\$/kg) – average; depends on the quality of coal | 0.78                                   |
| LNG (Cent US\$/kg)  | N/A                                    |
| LPG (Cent US\$/kg)  | Average 86.25 (13800 VND)              |
| NG (Household) [US\$/ MBTU]                                   | 11.2                                   |
| NG (Fertilizer Industry) [US\$/ MBTU]                         | N/A                                    |

Source: Compiled by ECO-Asia from various sources.

| <b>Electricity<sup>‡</sup></b>                  | <b>Average price per unit<br/>[Unit: VND/kWh]</b> |
|---|---|
| <b>Industry</b>                                 |   |
| ≥ 100 kV  | 785   |
| 22 kV – 110 kV                                  | 815   |
| 6 kV – 22 kV                                    | 860   |
| < 6 kV  | 895   |
| <b>Urban Residential</b>                        |   |
| First 100 kWh/month                             | 550   |
| Next 50 kWh/month                               | 1,110   |
| Next 50 kWh/month                               | 1,470   |
| Next 100 kWh/month                              | 1,600   |
| Next 100 kWh/month                              | 1,720   |
| Over 401 kWh/month                              | 1,780   |
| <b>Rural Residential (ceiling retail price)</b> | 700   |
| <b>Commercial &amp; Service</b>                 |   |
| ≥ 22 kV   | 1,410   |
| 6 kV – 22 kV                                    | 1,510   |
| < 6 kV  | 1,580   |

1 USD= 16000 VND

Source: Compiled by ECO-Asia from various sources.

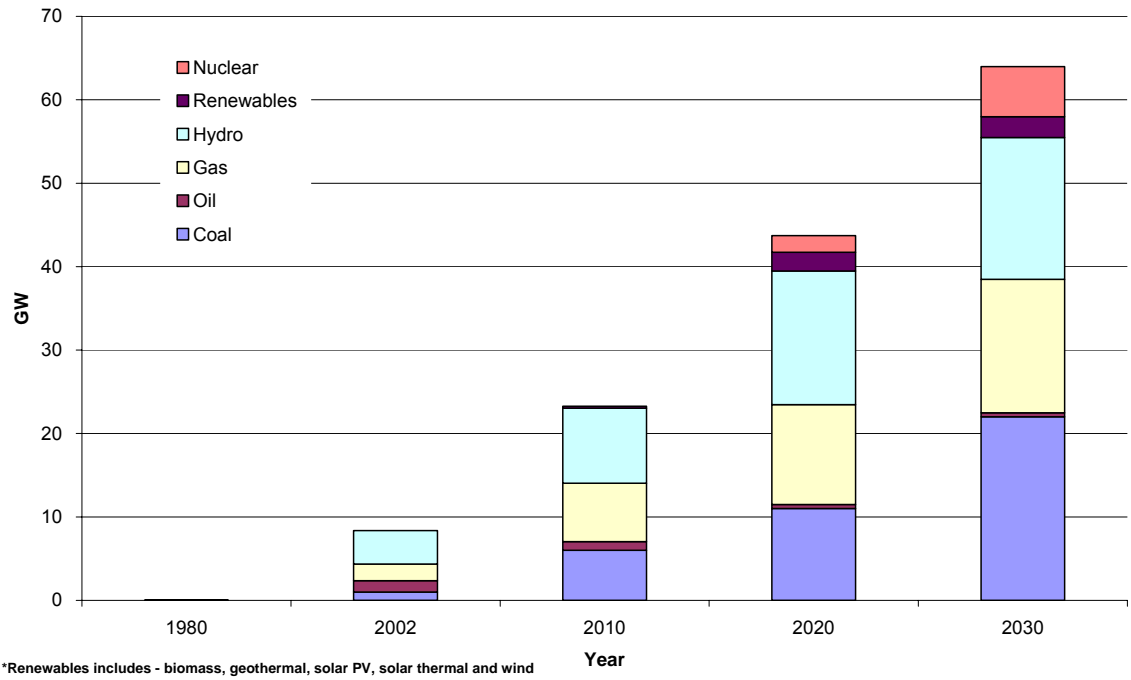
## l) Energy reserves status

| <b>Energy Reserves (2005)</b> | <b>Total</b> | <b>Proven</b> | <b>Production</b> | <b>R/P ratio</b> |
|-------------------------------|--------------|---------------|-------------------|------------------|
| Coal (million ton)            | 150          | 150           | 28                | 5                |
| Oil (million barrel)          | 3119         | 3119          | 140               | 22               |
| NG (billion cubic meter)      | 235          | 235           | 6                 | 43               |

Source: BP statistics (2006).

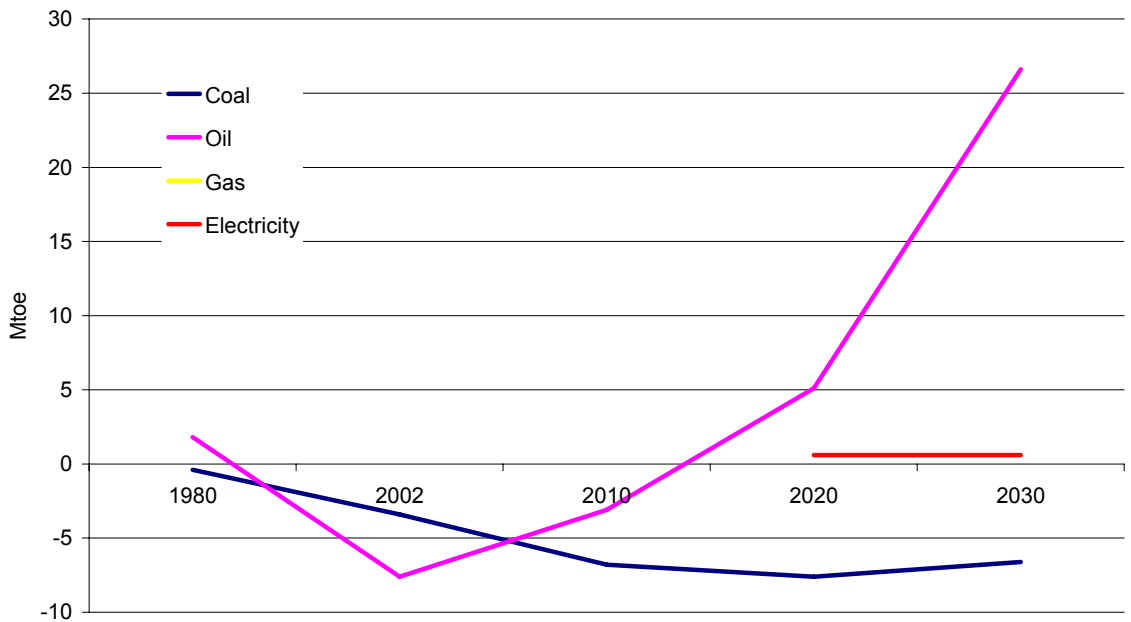
<sup>‡</sup> Effective from 1st January, 2007

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

| Emission      | Unit                     | Current Ambient Level |       |
|---------------|--------------------------|-----------------------|-------|
|               |                          | 2000                  | 2004  |
| CO - Ambient  | $\mu\text{g}/\text{m}^3$ | 1,480                 | 1,250 |
| CO - Roadside | $\mu\text{g}/\text{m}^3$ | 4,300                 | 4,050 |

Source: ADB (2006).

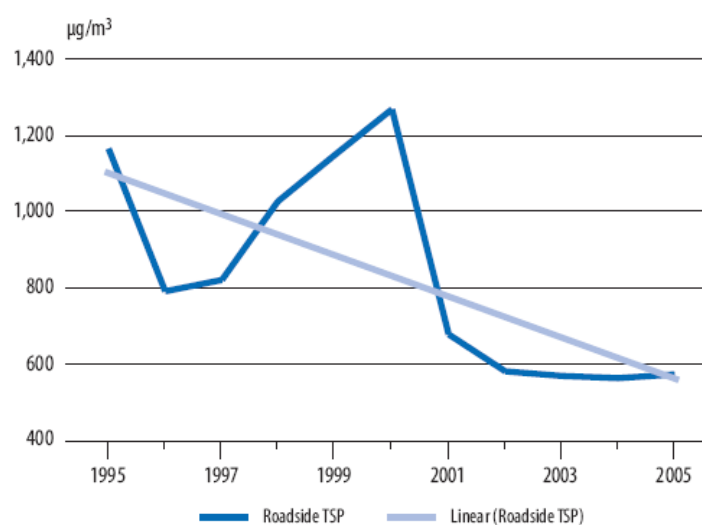
#### Annual Air Pollutant Concentrations in Hanoi (CEETIA location) ( $\mu\text{g}/\text{m}^3$ )

| Pollutant        | Year | 1999   | 2000   | 2001  | 2002   | 2003  |
|------------------|------|--------|--------|-------|--------|-------|
| CO               | Mean | 2,456  | 2,209  | 2,122 | 2,468  | 3,520 |
|                  | Max  | 14,410 | 11,060 | 8,737 | 12,391 | 8,750 |
| NO <sub>2</sub>  | Mean | 6      | 9      | 16    | 29     | 33    |
|                  | Max  | 23     | 117    | 160   | 173    | 90    |
| SO <sub>2</sub>  | Mean | 6      | 8      | 22    | 38     | 38    |
|                  | Max  | 82     | 150    | 261   | 208    | 142   |
| PM <sub>10</sub> | Mean | 155    | 126    | 122   | 90     | 112   |
|                  | Max  | 970    | 1,000  | 997   | 777    | 589   |
| O <sub>3</sub>   | Mean | 14     | 16     | 21    | 22     | 19    |
|                  | Max  | 57     | 75     | 86    | 48     | 42    |

CEETIA = Center for Environmental Engineering of Towns and Industrial Areas; CO = Carbon monoxide; NO<sub>2</sub> = Nitrogen dioxide; SO<sub>2</sub> = Sulfur dioxide; PM<sub>10</sub> = particulates with a diameter of not more than 10 microns; O<sub>3</sub> = Ozone

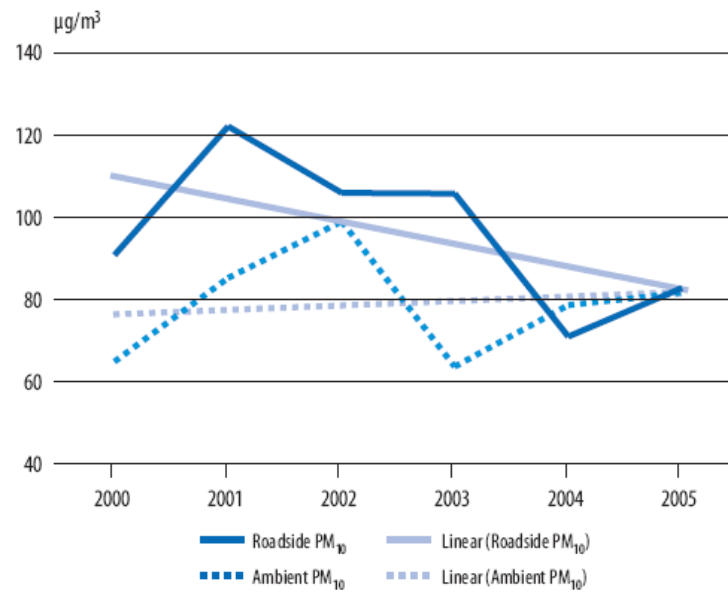
Source: Khaliqzaman, 2005.

#### HCMC Roadside TSP



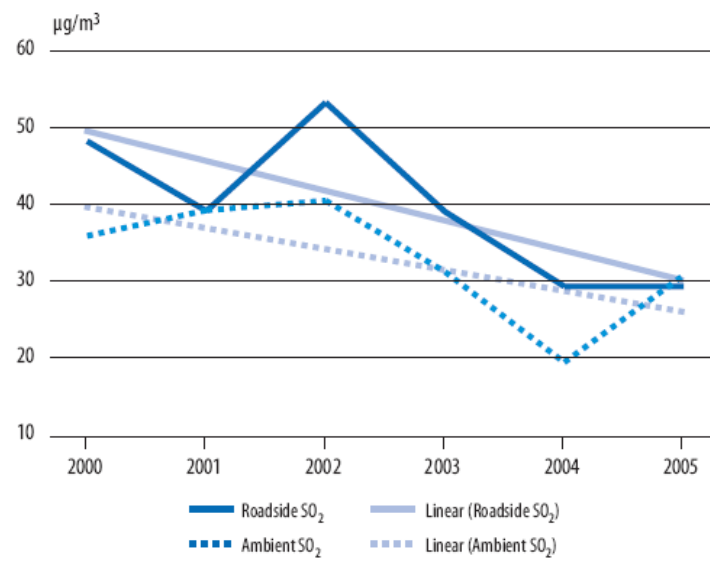
Source: HEPA, 2006.

### Ambient and Roadside PM<sub>10</sub> Concentrations in HCMC



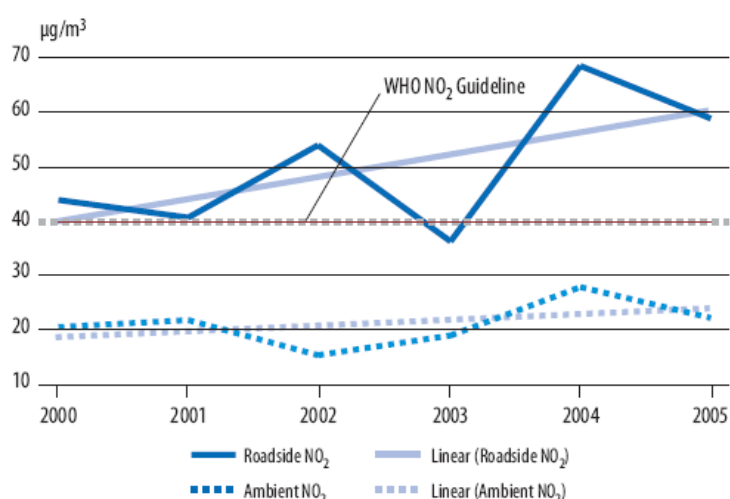
Source: HEPA, 2006.

### Sulfur Dioxide Concentrations in HCMC



Source: HEPA, 2000.

### Nitrogen Dioxide Concentrations in HCMC



### HCMC Air Quality Index

|               |           |
|---------------|-----------|
| 0 to 50       | Good      |
| 51 to 100     | Moderate  |
| 101 to 200    | Poor      |
| 201 to 300    | Bad       |
| 300 and above | Hazardous |

### Viet Nam Ambient Air Quality Standards vs. WHO Standards (µg/m<sup>3</sup>)

| Pollutant        | Averaging Time | WHO Guidelines <sup>a</sup> | Viet Nam Standards <sup>c</sup> |
|------------------|----------------|-----------------------------|---------------------------------|
| SO <sub>2</sub>  | 1 hour         | 500 (10 min)                | 500                             |
|                  | 24 hours       | 20                          | 300                             |
|                  | Annual         | -                           | -                               |
| NO <sub>2</sub>  | 1 hour         | 200                         | 400                             |
|                  | 24 hours       | -                           | 100                             |
|                  | Annual         | 40                          | -                               |
| O <sub>3</sub>   | 1 hour         | -                           | 200                             |
|                  | 8 hours        | 100                         | -                               |
|                  | Annual         | -                           | 60                              |
| CO               | 1 hour         | 30,000 <sup>b</sup>         | 40,000                          |
|                  | 8 hours        | 10,000 <sup>b</sup>         | 10,000                          |
| TSP              | 1 hour         | -                           | 300                             |
|                  | 24 hours       | -                           | 200                             |
|                  | Annual         | -                           | -                               |
| PM <sub>10</sub> | 24 hours       | 50                          | -                               |
|                  | Annual         | 30                          | -                               |
| Pb               | Annual         | 0.5 (2)                     | 5 (hourly)                      |

SO<sub>2</sub> = Sulfur dioxide; NO<sub>2</sub> = Nitrogen dioxide; O<sub>3</sub> = Ozone; CO = Carbon monoxide; TSP = total suspended particulates; PM<sub>10</sub> = particulates with a diameter not more than 10 microns; Pb = Lead; - = not applicable

Source: <sup>a</sup>WHO (2006), <sup>b</sup>WHO (2000), and <sup>c</sup>Sivertsen et al. (2005).

Source: ADB (2006).

p) Air monitoring data in Hanoi city 97-2000 (mg/m<sup>3</sup>):

| Traffic joint   | Nga Tu Vong (hot-pot) |       |       | Nga Tu So (hot-pot) |       |       |       | Allowable standard of Vietnam (TVNC 5937-95) |
|-----------------|-----------------------|-------|-------|---------------------|-------|-------|-------|--|
|                 | 1997                  | 1998  | 2000  | 1997                | 1998  | 1999  | 2000  |  |
| CO              | 5.822                 | 5.478 | 4.333 | 5.32                | 5.713 | 5.44  | 4.933 | 5  |
| SO <sub>2</sub> | 0.792                 | 0.839 | 0.723 | 0.752               | 0.742 | 0.801 | 0.723 | 0.3  |
| NO <sub>2</sub> | 0.239                 | 0.221 | 0.073 | 0.145               | 0.205 | 0.21  | 0.063 | 0.1  |
| PM              | 1.239                 | 1.237 | 0.567 | 1.121               | 1.151 | 1.191 | 0.633 | 0.2  |

Source: ADB-MONRE SEF II project (2005).

q) Pollutant concentration in Ho Chi Minh city (1998 – 2002)

| Indicator       | Average concentration (mg/m <sup>3</sup> ) |       |       |       |       | Allowable standard of Vietnam |
|-----------------|--|-------|-------|-------|-------|-------------------------------|
|                 | 1998                                       | 1999  | 2000  | 2001  | 2002  |                               |
| PM              | 0.39                                       | 0.51  | 0.51  | 0.45  | 0.52  | 0.2                           |
| SO <sub>2</sub> | 0.093                                      | 0.149 | 0.146 | 0.155 | 0.160 | 0.3                           |
| NO <sub>2</sub> | 0.061                                      | 0.077 | 0.088 | 0.120 | 0.130 | 0.1                           |

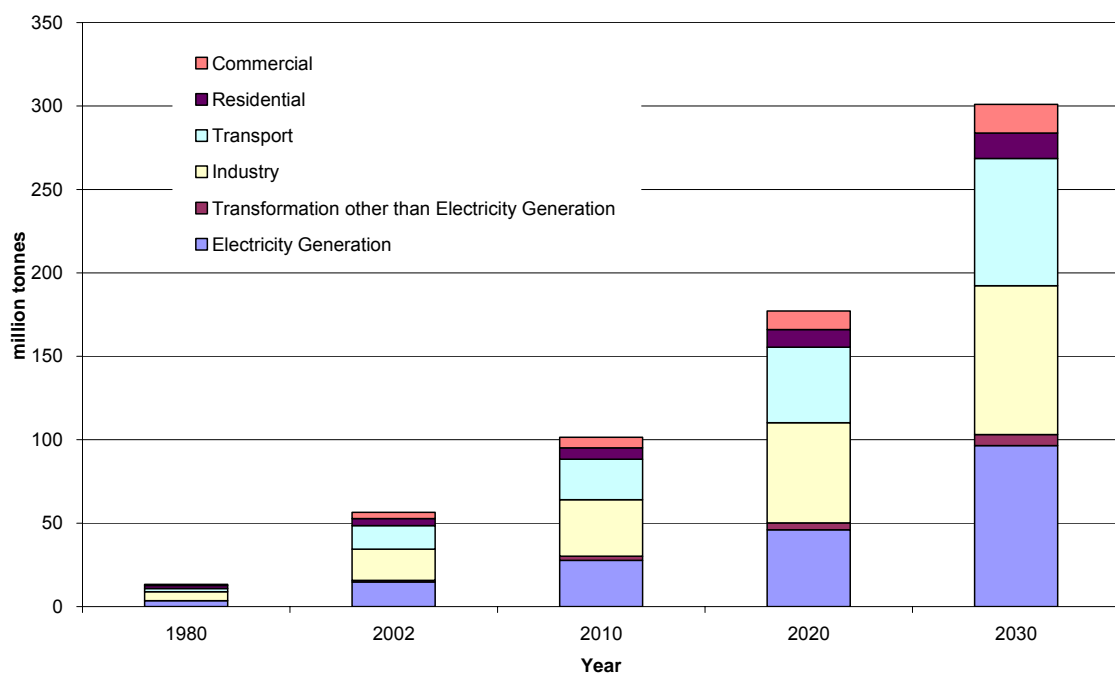
Source: ADB-MONRE SEF II project (2005).

r) Vehicular related emissions

| Emission type   | Unit        | 1997   | 2000   |
|-----------------|-------------|--------|--------|
| CO              | tonnes/year | 113255 | 186843 |
| SO <sub>2</sub> | tonnes/year | 4331   | 6843   |
| NO <sub>x</sub> | tonnes/year | 16368  | 25846  |
| TSP             | tonnes/year | 2014   | 3182   |
| HC              | tonnes/year | 13295  | 21006  |

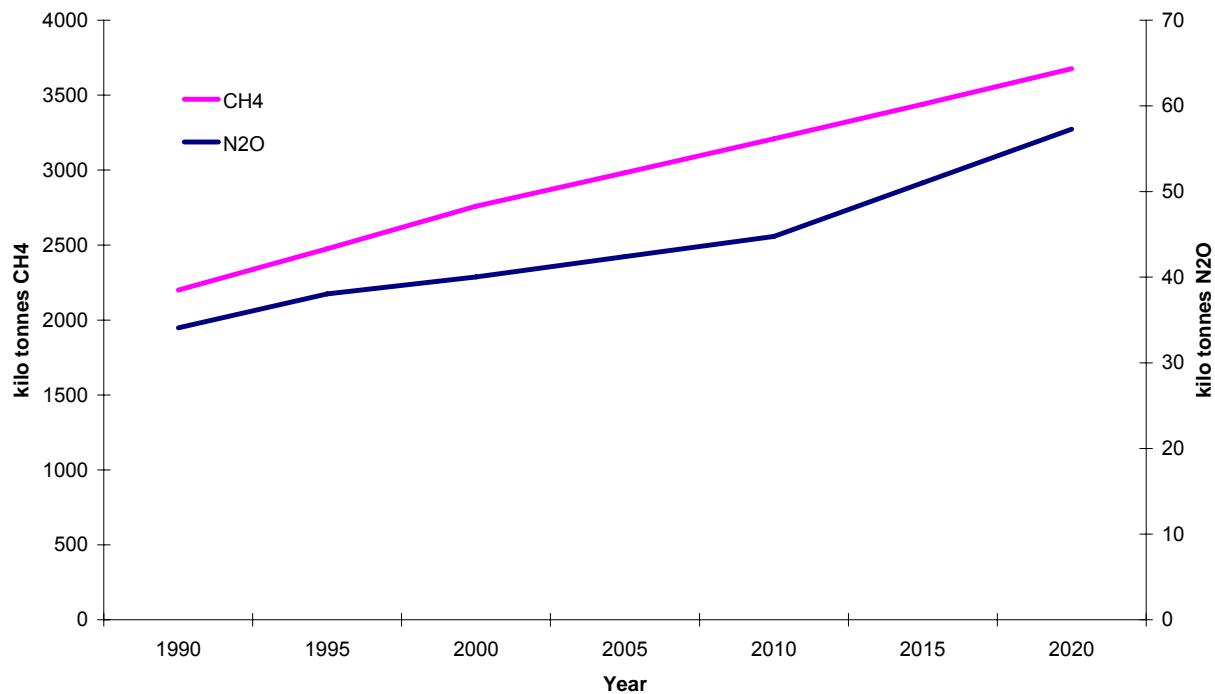
Source: ADB (2006).

s) CO<sub>2</sub> emissions sector wise



Source: APERC (2006).

t) Emission of other GHGs



Source: EPA (2006)

## u) National aggregate emission of other gases

| Type emission                      | Amount |
|------------------------------------|--------|
| SO <sub>2</sub> (kilo tons - 1994) | 299    |
| CO (kilo tons - 1994)              | 2,130  |
| NO <sub>x</sub> (kilo tons - 1994) | 129    |

Source: UNFCCC national communication.

## v) Pollution Emissions from Main Industrial Activities in HCMC (tons/year)

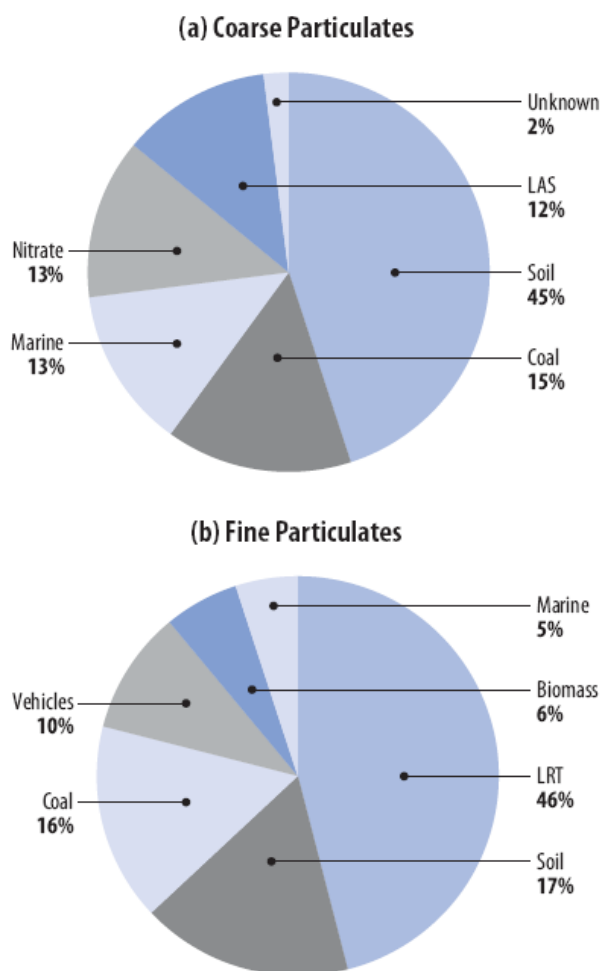
| Industrial Activities                   | Capacity                      | TSP    | NO <sub>2</sub> | SO <sub>2</sub> | CO     | HC  |
|---|-------------------------------|--------|-----------------|-----------------|--------|-----|
| Power Plants                            | 1,751 MW                      | 646    | 8,773           | 54,633          | 1,966  | 727 |
| Boilers and Furnaces                    | 210,000 tons<br>fuel oil/year | 578    | 2,016           | 78              | 84     | 52  |
| Steel Mills                             | 259,00 tons<br>steel/year     | 1787   |                 | 466             | 18,907 |     |
| Construction Material<br>(cement, tile) |                               | 12,793 | 1,336           | 624             | 153    | 40  |

HCMC = Ho Chi Minh City; MW = megawatts; TSP = total suspended particulates; NO<sub>2</sub> = Nitrogen dioxide; SO<sub>2</sub> = Sulfur dioxide; CO = Carbon monoxide; HC = hydrocarbons

Source: ADB (2006).

w) Particulates Emissions in Hanoi

**Source Apportionment of Coarse and Fine Particulates in Hanoi  
(Jan 2001–July 2002 Sampling)**



LAS = local ammonium sulfate; LRT = long-range transport (LRT) aerosols  
Source: Hien, 2003.

Source: ADB (2006).

**Section 4. Health impacts**

x) Health impacts in Ho Chi Minh City (HCMC)

Note:

In 1995, the health effects of air pollution on traffic police officers was studied by the Labor Protection Unit of HCMC. Police officers were observed to have higher incidences of ear, nose, and throat infections because of long exposure to high levels of air and noise pollution. Traffic police personnel suffer a higher incidence rate of nose, throat, and ear infections (76%) and 32% of them have reduced hearing abilities.

Source: ADB (2006).

**Section 5. Clean energy outlook**

## y) Renewable energy outlook table

|                      | Potential (MW)    | Installed (MW) |                              | Generation Cost (US \$/KWh) | Target (MW) |                                |      |
|----------------------|-------------------|----------------|------------------------------|-----------------------------|-------------|--------------------------------|------|
|                      |                   | 2001           | 2005                         |                             | 2010        | 2020                           | 2025 |
| <b>Wind</b>          | 3572              | 1.05           | 70                           | 6                           |             | 18232 households <sup>§</sup>  |      |
| <b>Biomass</b>       | 250-405           | 50             | 150                          |                             |             |                                |      |
| <b>Solar Thermal</b> |                   |                |                              |                             |             |                                |      |
| <b>Solar PV</b>      |                   |                | 4.63 kWh/m <sup>2</sup> /day |                             |             | 11093 households <sup>**</sup> |      |
| <b>Off grid</b>      | 2                 | 0.6            |                              |                             |             |                                |      |
| <b>Geothermal</b>    | 472               |                | 50                           |                             | 100         | 200                            |      |
| <b>Small Hydro</b>   | 2887              |                | 213                          |                             |             | 4303 households <sup>††</sup>  |      |
| <b>Biodiesel</b>     |                   |                |                              |                             |             |                                |      |
| <b>Biogas</b>        | 2billion kWh/year |                |                              |                             |             |                                |      |

Source: Compiled by ECO-Asia from various sources.

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<sup>§</sup> Expected to serve

<sup>\*\*</sup> Expected to serve

<sup>††</sup> Expected to serve

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