## 3.3 Air Pollution

Air is essential for human existence. Together with water and soil, it is one of the three environmental elements used by man and other living organisms to survive. The maintenance of clean air is therefore a key component of environmental policy. It is moreover an area, which raises a number of crucial issues in public health, so that addressing air pollution becomes a priority for protection of both people's health and the global environment.

The government has accordingly given priority to the prevention of air pollution caused by development-related activities. It has taken positive initiatives, including logical planning for productive investment, adoption of "state of the art" technologies for prevention of air pollution, rational adjustment of urban scale and location, and control of emissions from vehicles in and around cities.

### *3.3.1 State*

#### Air Quality

The concentration of pollutants in the air is closely linked to point source emissions and meteorological conditions. In general terms, the pollutant density level in the air around urban and industrial areas is relatively higher than that found in rural areas. Together with industrial development and population growth, air pollution has thus tended to go from bad to worse, particularly in urban and industrial areas.

In DPR Korea, data available on levels of air pollution are limited. Most studies on the topic have been confined to the central area of Pyongyang City and its surroundings. Here, the major causes of atmospheric pollutions have been associated with industrial boilers, kilns, motor vehicles and residential areas in and around the city.

Figure 3.1 traces recent variations in precipitated particulates in central districts of Pyongyang.

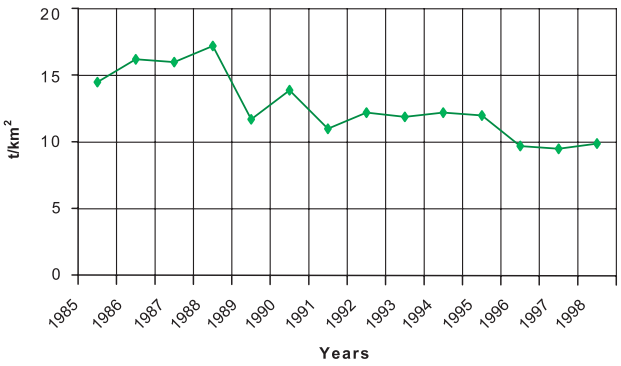


***Figure 3.1*** *Variation of precipitated dust*
***Source:*** *Li Ju Hyop (2000).*

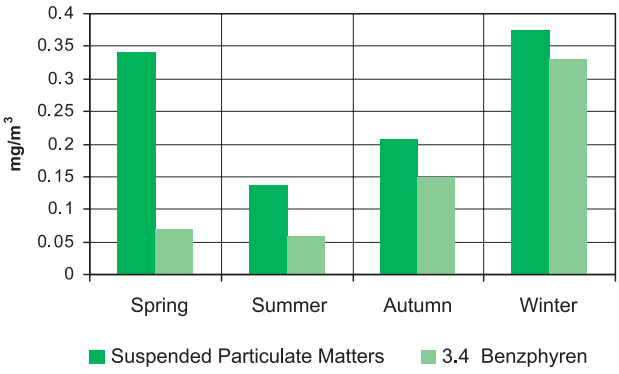


***Figure 3.3*** *Seasonal variation of suspanded particulate matters and 3.4 Benzphyren concentration.*
***Source:*** *Li Ju Hyop (2000).*

As shown in the Figure, the level of particulates has fallen progressively in central districts between 1985-1998. The seasonal variation of precipitated dust is quite substantial. Month-to-month conditions in Pyongchon are closely related to dust pollution in Pyongyang City (shown in Figure 3.2). By 1998, the density of suspended particulates revealed a falling trend, being lower by an average of 62.6 percent compared with 1993 levels. Average seasonal variation of suspended particulates and 3.4 Benzphyren (carcinogenic substance) is shown in Figure 3.3.

The next two figures show annual average density of sulphur dioxide and nitrogen dioxide decreasing in the air around Pyongyang City during the 1990s.

The density of environmental pollutants in the air around Pyongyang City now exceeds environmental protection standards of the DPR Korea. A substantial contributing factor to air pollution is the number of coal combustion boilers in Pyongyang City. This is because certain factories/plants and enterprises consuming fossil fuel are not operating on a regular basis. However, proper control and response options to address air pollution are being fully developed and consolidated at a national level. The standards established for major air pollutants are given in Table 3.12.

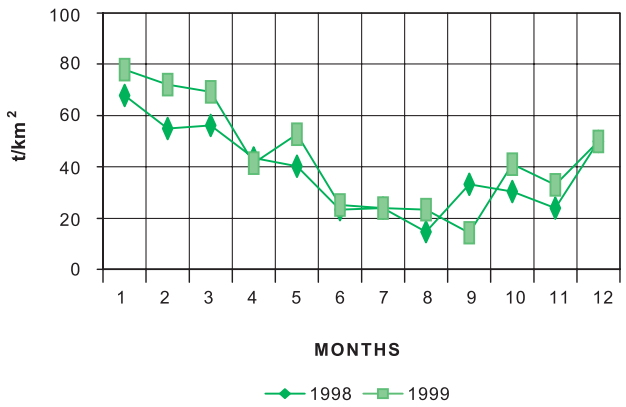


***Figure 3.2*** *Monthly variation of precipitatied dust*
***Source:*** *Li Ju Hyop (2000).*

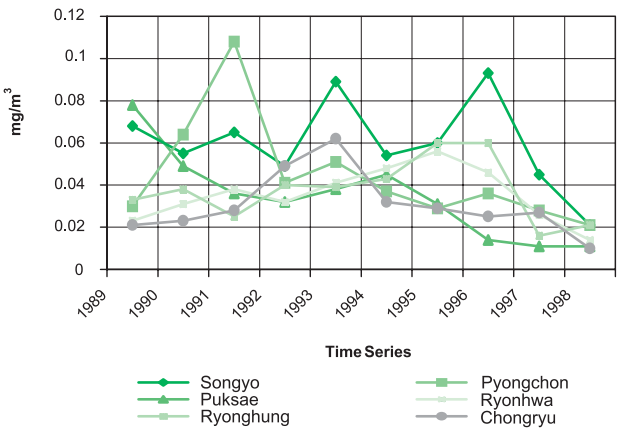


***Figure 3.4*** *$SO_2$ yearly variation*
***Source:*** *Li Ju Hyop (2000).*

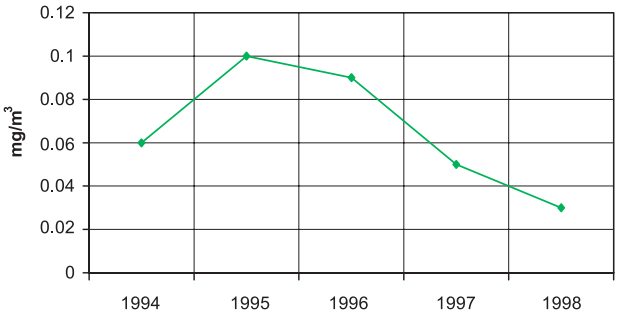


***Figure 3.5*** *$NO_2$ yearly variation*
***Source:*** *Li Ju Hyop (2000).*

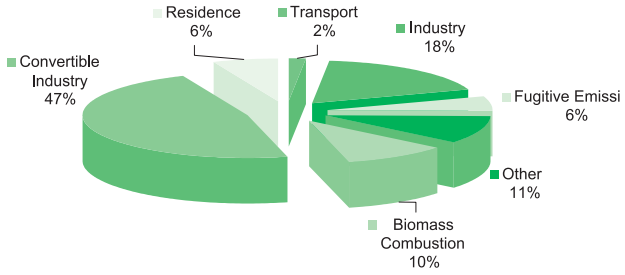


**Figure 3.6** *Emissions across economic sectors*
***Source:*** *DPR Korea (1999)*

## Air Pollutants and Greenhouse Gas Emissions (GHG)

Using the guidelines for GHG inventory (1996) distributed by the Inter-governmental Panel on Climate Change, emissions in 1990 of GHGs and other pollutants were estimated for industrial, commercial, residential, agricultural, transportation, forest and land-use sectors.

The constitution of GHG emissions by national economic sectors is given into Figure 3.6.

Energy conversion and industry are both considered as key sources of $SO_2$ emissions from coal combustion.

**Table 3.12 Air Environment standards by areas ( mg/cu.m )**

| No | Substances | Special class | | First grade | | Second grade | | Third grade | |
|---|---|---|---|---|---|---|---|---|---|
| | | Daily maximum | A day average | 1 | 2 | 1 | 2 | 1 | 2 |
| 1 | Suspended matters | 0.05 | 0.03 | 0.10 | 0.50 | 0.30 | 0.10 | 0.50 | 0.20 |
| 2 | $SO_2$ | 0.05 | 0.03 | 0.10 | 0.05 | 0.30 | 0.10 | 0.50 | 0.15 |
| 3 | $NO_2$ | 0.04 | 0.01 | 0.06 | 0.03 | 0.10 | 0.04 | 0.15 | 0.05 |
| 4 | CO | 3.0 | 1.0 | 4.0 | 2.0 | 6.0 | 3.0 | 15.0 | 10.0 |
| 5 | Oxidant | 0.05 | 0.02 | 0.10 | 0.03 | 0.12 | 0.04 | 0.14 | 0.06 |

- Special grade: natural reserves/areas under particular concern by the country
- First grade: resort, health cure site, recreation site, tourist site
- Second grade: residential area
- Third grade: industrial area

***Source:*** *Ministry of Land and Environment Protection (2000)*

## Table 3.13 DPRK's National Greenhouse Gas inventory in 1990

| Sources and Sinks | $CO_2$ Emission | $CO_2$ Removals | Net $CO_2$ | $CH_4$ | $N_2O$ | $NO_x$ | CO | $CO_2$ Equivalent |
|---|---|---|---|---|---|---|---|---|
| **Total National Emissions** | **169,445** | **-14,631** | **154,814** | **975** | **39** | **432** | **478** | **187,379** |
| **1. All Energy (Fuel Combustion +Fugitive)** | 159,942 | - | 159,942 | 649 | 17 | 425 | 475 | 178,341 |
| **A . Fuel Combustion** 159,942 | - | 159,942 | 44 | 17 | 425 | 475 | 165,636 | |
| Energy and Transformation Industry | 90,775 | - | 90,775 | 1 | 13 | 279 | 19 | 94,826 |
| Industry34,273 | - | 34,273 | 3 | 5 | 105 | 50 | 35,88 | |
| Transport | 3,473 | - | 3,473 | - | - | 24 | 94 | 3,473 |
| Commercial-institutional | 2,824 | - | 2,824 | - | - | 3 | 55 | 2,824 |
| Residential | 10,610 | - | 10,610 | 32 | - | 11 | 11 | 11,282 |
| Traditional Biomass Burned for Energy | (20,257) | - | (20,257) | - | - | - | - | 20,257 |
| Others 15,735 | - | 15,735 | - | - | - | - | 15,735 | |
| **B.Fugitive Fuel Emissions** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| Oil and Natural Gas Systems | - | - | - | - | - | - | - | - |
| Coal Mining | - | - | - | 606 | - | - | - | 12,726 |
| **2. Industrial processes** | 9,503 | - | 9,503 | - | 1 | 7 | - | 9,813 |
| **A. Cement Production** | 6,929 | - | 6,929 | - | - | - | - | 6,929 |
| **B. Others** | | | | | | | | |
| Lime production | 1,146 | - | 1,146 | | - | - | - | - |
| Chemical production | 595 | - | 595 | | 1 | 7 | | 905 |
| Metal production | 833 | - | 833 | | - | - | - | 833 |
| **3. Agriculture** | - | - | - | 255 | 20 | - | - | 11,555 |
| **A. Enteric Fermentation** | - | - | - | 52 | - | - | - | 1092 |
| **B. Manure Management** | - | - | - | 39 | - | - | - | 819 |
| **C. Rice Cultivation** | - | - | - | 164 | - | - | - | 3444 |
| **D. Agricultural Soils** | - | - | - | - | 20 | - | - | 620 |
| **4. Land use Change and Forestry** | - | -14,631 | - | - | - | - | 4 | - |
| **A. Changes in Forest & Other Woody Biomass Stocks** | - | -15,021 | - | - | - | - | - | - |
| **B. Forest and Grassland Conversion** | 298 | - | 298 | - | - | - | 4 | 298 |
| **D. Others(please specify)** | - | - | - | - | - | - | - | - |
| **5. Waste** - | - | 71 | - | - | - | 1,491 | - | |
| **A. Solid Waste Disposal on Land** | - | - | - | 67 | - | - | - | 1,407 |
| **B. Wastewater Treatment** | - | - | - | 4 | - | - | - | 84 |

***Source:*** *DPR Korea (1999)*

## 3.3.2 Pressure

### Energy Consumption

As in most countries, the energy sector in DPR Korea plays an important role in developing the national economy. Over the past decades, energy consumption has been coupled to economic growth rates, and thus has been steadily increasing. DPR Korea is now among countries consuming energy at the greatest level.

National energy consumption per capita is therefore very high in relation to GDP. In DPR Korea, imbalance between supply and demand is generated by the growth in energy demand and has led to economic hardship in some end-use sectors in recent years.

Since coal is the vital source of primary energy in DPR Korea, $SO_2$ emissions, particulate precipitation and $NO_2$ are mainly linked to coal combustion. Energy consumption by sectors and fuel types in 1990 is set out in Table 3.14 below. Estimates of primary energy consumption show a doubling from 47.974 Mtoe in 1990 to 95.948 Mtoe by 2020.

The more industry is developed and energy consumption increases, the higher the level of atmospheric emissions, suggesting that air pollution will continue to be a crucial problem.

### Growth in Population & Urban Development

Over the period 1990-1998, average population growth was 0.8 percent per annum. For the period 2000 - 2020, an average annual growth rate of 1.2 percent is projected. This suggests that the total population of DPR Korea will be 29.164 million by 2020, if present trends continue.

Apart from the growth in population, demand for energy (particularly from fossil fuel) will inevitably rise, creating heavier pollution load in the atmosphere. In 1990, existing boilers and industrial kilns in Pyongyang consumed 3,398,372 tonnes of coal. In the same year, household consumption for heating and cooking amounted to 357,665 tonnes.

### Use of Ozone-depleting Substances

Household appliances such as refrigerators and air-conditioners are more broadly used in urban settlements than in the rural areas of DPR Korea. In 1996, the volume of CFC-12 used as a refrigerant (in refrigerators as well as cooling facilities) was 165 tonnes.

## 3.3.3 Response

The commitment to control air quality is an important link to the health of the individual as well as to the sustainable development of society at large, and this issue is therefore of direct concern to the government of DPR Korea. In particular, priority has been given by government to the prevention of air pollution in Pyongyang City and major industrial

***Photo 3.11*** *Pyongyang thermal power plant*

***Photo 3.12*** *A Station of Pyongyang Metro*

**Table 3.14 Primary energy consumption in 1990 ('000 tonnes)**

| | Industry | Residence | Transport | Agriculture | Other |
|---|---|---|---|---|---|
| Anthracite | 34,614 | 2,178 | 1,820 | 1,886 | 4,911 |
| Bituminous coal | 7,995 | 1,918 | 740 | - | 1,281 |
| Gasoline | - | - | 215.6 | 7 | 90 |
| Diesel | - | - | 420 | - | 263 |
| Heavy oil | 1,015 | - | - | - | 885 |
| LPG | 45 | 6 | - | - | 24 |
| Naphtha | 220 | - | - | - | - |
| Kerosene | - | 150 | - | - | 40 |
| Coke | 4,020 | - | - | - | - |

***Source***: *CSB (1997)*

towns, with positive measures being drawn up for policy implementation.

## Prevention of Pollution by Coal Combustion.

The government focuses a great deal of attention on atmospheric pollution caused by coal combustion, taking into account the fact that coal is still the major source of primary energy. Active steps are being undertaken, both to enhance combustion efficiency and exhaust gas purification in boilers and industrial kilns, and also to achieve maximum reduction of coal consumption in the household sector.

**Table 3.15 Energy growth, DPR Korea**

| | 1990 | 1998 | 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|---|---|
| GDP (Million US $) | - | 10,273 | 11,156 | 12,309 | 23,789 | 39,365 | 63,618 |
| Coal (000 t) | 60,000 | 22,070 | 22,290 | 24,610 | 45,000 | 68,000 | 120,000 |
| Electric Power (Billion KWh) | 56.4 | 25.6 | 25.9 | 28.6 | 50.0 | 70.0 | 100.0 |

***Source:*** *DPR Korea (2000)*

**Table 3.16 Timetable relating to the production and phase-out of ozone-depleting substances**

| Substances | Particulars | Timetable |
|---|---|---|
| CFC-11 | Closure down of production facility<br>Phase out of consumption | December 2003<br>December 2010 |
| CFC-12 | Closure down of production facility<br>Phase out of consumption | December 2003<br>December 2010 |
| CFC-113 | Closure down of production facility<br>Phase out of consumption | December 2003<br>December 2010 |
| Halon | Phase-out of Halon consumption | Already done |
| CTC | Closure down of production facility<br>Phase out of consumption | December 2003<br>December 2010 |
| Methyl chloroform | Closure down of production facility<br>Phase out of consumption | December 2003<br>December 2010 |

***Source:*** *Minisry of Land and Environment Protection (1996)*

The appropriate rules relating to emission sources like factories/plants and enterprises using boilers and industrial kilns are laid down by government to ensure strict compliance with the law and reinforce social controls. In addition, encouragement is given to the installation of fuel-efficient technologies, such as thermal insulation of furnaces, high efficiency of combustion, more effective heat use, and active elimination of exhaust gas emissions. In recent years, steps have been taken to remove certain factories and polluting enterprises in Pyongyang and other industrial towns and relocate them to the perimeter of towns or other areas.

Finally, an energy strategy was compiled by the government and its implementation is now underway. The strategy aims at building capacity for the national economy and improving people's well-being by securing energy stability while meeting the increasing energy demand. Key long-term priorities for policy implementation include the following:-

- To secure stability of supply and increase the uptake of energy efficiency in end-use sectors by satisfying the need for energy through exploitation of local resources, particularly coal.
- To improve energy efficiency by means of effective energy use.
- To minimize the environmental impact of energy generation and use, increase efficiency of conversion and end-use and secure environmental sustainability by promoting a switch to the use of renewable energy use.

The improvement of energy efficiency and energy savings are the highest priorities in the energy strategy. The energy mix of DPR Korea for 1990 - 2020 is given in the Table 3.15.

## Measures in Traffic and Transportation Sectors

The government has taken positive measures both to ease the pressures on public transport and control exhaust gas emissions from vehicles in urban areas. In particular, government puts the limit on wide use of private cars, whereas zero-emission public transport modes (trolley bus, tram car and trains) are encouraged in urban areas. In order to decrease the load on public transport, and taking into account the health benefits, there is a campaign for people to walk 10,000 steps each day, as well as promotion of bicycle use.

## Initiatives for Protection of the Ozone Layer

The DPR Korea signed the Montreal Protocol in January 1995 and ratified it in April that year. The timetable for the phase-out of ozone-depleting substances is included in the national action plan to implement the Montreal Protocol and is reproduced in the Table 3.16.

## *3.3.4 Conclusion*

The key sources of air pollution are listed as coal-fired boilers, industrial kilns and households. Population growth and industrial development is likely to lead to increased levels of pollution with more serious implications for human health. With recent economic hardships, coal production and consumption have been considerably restricted, but as a result of continued economic development, demand and consumption of coal are both expected to grow steadily.

Assessment of atmospheric pollution is limited to certain urban areas - Pyongyang and Hamhung cities - and pollutant indices are only available for particulate precipitation, suspended solids, $SO_2$ and $NO_2$. Statistical analysis on the number of patients suffering from respiratory diseases is still not carried out, while no studies concerning air quality impacts on ecosystems and socio-economic development have been undertaken.

A comprehensive monitoring system of atmospheric conditions needs to be set up and in-depth study of the impact of air pollution on human health and ecosystems is also called for. In addition, state-of-the-art technologies for clean coal combustion, exhaust-gas purification and renewable energy alternatives need to be widely adopted.

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