Country Synthesis Report on Urban Air Quality Management

Mongolia

Discussion Draft, December 2006

ADB

CLEAN AIR INITIATIVE for Asian Cities

Country Synthesis Report on
Urban Air Quality Management

Mongolia

Discussion Draft, December 2006

Printed in the Philippines.

ADB facilitated this study through its Regional Technical Assistance 6291: Rolling Out Air Quality Management in Asia.

The Study was led by the CAI-Asia Secretariat and the information contained in this report was developed by the CAI-Asia Secretariat with inputs by a range of organizations and air quality experts from across Asia and elsewhere.

Table of Contents

Tables and Figures

Tables

Figures

Abbreviations

$\mu g/m^3$	micrograms per cubic meter
ADB	Asian Development Bank
AQM	air quality management
AAQS	ambient air quality standards
CO	Carbon monoxide
CO_2	Carbon dioxide
CHP	combined heat-and-power plants
GDP	gross domestic product
GHG	greenhouse gases
HOB	heat-only boilers
km	kilometer
ktoe	kiloton of oil equivalent
LPG	liquefied petroleum gas
NGO	nongovernment organization
NO_2	Nitrogen dioxide
NOx	Nitrogen oxide/s
O_3	Ozone
PM	particulate matter
PM_{10}	particulate matter with a diameter not more than 10 microns
$PM_{2.5}$	particulate matter with a diameter not more than 2.5 microns
ppb	parts per billion
ppm	parts per million
NAMHEM	National Agency for Meteorology, Hydrology, and Environmental Monitoring
SO_2	Sulfur dioxide
SOx	Sulfur oxides
SPM	suspended particulate matter
toe	ton of oil equivalent
TSP	total suspended particulates
UNEP	United Nations Environment Programme
NMVOC	Nonmethane volatile organic carbons

Note: "$" means "US dollar" in this publication.

Acknowledgments

This series of country reports is the first time that a comprehensive overview of urban air quality management (AQM) at the country level has been prepared in Asia. Research compilation for this country synthesis report (CSR) on Urban Air Quality Management was led by the Clean Air Initiative for Asian Cities (CAI–Asia) Secretariat with inputs by a range of organizations and air quality experts from across Asia and elsewhere and facilitated by the Asian Development Bank (ADB) through its Regional Technical Assistance No. 6291: Rolling Out Air Quality Management in Asia. The primary authors of the reports are Ms. Aurora Fe Ables, Ms. May Ajero, Mr. Herbert Fabian, and Ms. Ninette Ramirez, all from CAI–Asia under the supervision of Mr. Cornie Huizenga, Head of Secretariat, CAI–Asia.

The CSRs were prepared with assistance from volunteer authors from the different countries and facilitated by CAI–Asia local networks in Nepal (Clean Air Network–Nepal), Pakistan (Pakistan Clean Air Network), Philippines (Partnership for Clean Air [PCA]), the People's Republic of China (PRC) (CAI–Asia Project Office), Sri Lanka (Clean Air Sri Lanka), and Viet Nam (Viet Nam Clean Air Partnership). CAI–Asia local networks have also organized in the respective countries a development partners meeting on clean air where initial drafts of the CSRs were presented to local AQM stakeholders.

For the Mongolia Country Synthesis Report, CAI–Asia extends its sincerest thanks to Ms. Oyunchimeg Dugerjav, the Air Quality Management Secretary of the National Agency for Meteorology, Hydrology, and Environmental Monitoring (NAMHEM), for preparing the first draft of the report and providing more information; Director Erdenebat Eldev-Ochir of the International Cooperation Division and Director General Enkhtuvshin Sevjid of NAMHEM for reviewing the report; and Mr. Erdenebat Ulziidalai from Mon-Energy Consult for providing information.

CAI–Asia would like to thank ADB for facilitating the research and especially to Mr. Masami Tsuji, Senior Environment Specialist; Dr. David McCauley, Senior Environmental Economist; and Mr. Nessim Ahmad, Director—all from the Environment and Social Safeguard Division, Regional and Sustainable Development Department—for providing guidance. Ms. Glynda Bathan, Mr. Michael Co, Ms. Agatha Diaz, and Ms. Gianina Panopio of CAI–Asia are also acknowledged for their logistical and technical support for the CSR team.

CAI–Asia and the respective country Ministries of Environments reviewed the volume—with technical review inputs from Prof. Frank Murray of Murdoch University. Ms. Agnes Adre and Ms. Ma. Theresa Castillo copyedited this series of country reports. Mr. Segundo dela Cruz, Jr. handled the graphic design and the layout.

» Part One

General Information

Geography and Climate

Mongolia is a landlocked country located between the People's Republic of China and the Russian Federation. Its borders are mostly formed by natural boundaries of mountain ranges and the boreal forests of Siberia in the north and the Gobi Desert, spanning the southernmost border of the permafrost and the northernmost deserts of Central Asia. The country's total land area is 1,564 million square kilometers (km^2), of which only less than 1% is considered arable; 8%–10% forested; and the rest, mainly for pasture, including the semidesert in the Gobi region.

About half of Mongolia is at an altitude of 1,400 meters (m) or more above mean sea level, which makes it one of the highest countries in the world. The altitude ranges from 560 m at the lowest point of Khokh Nuur in the eastern steppes to 4,374 m (the highest) at Khuiten Peak in the Altai Mountains (UNEP 2002).

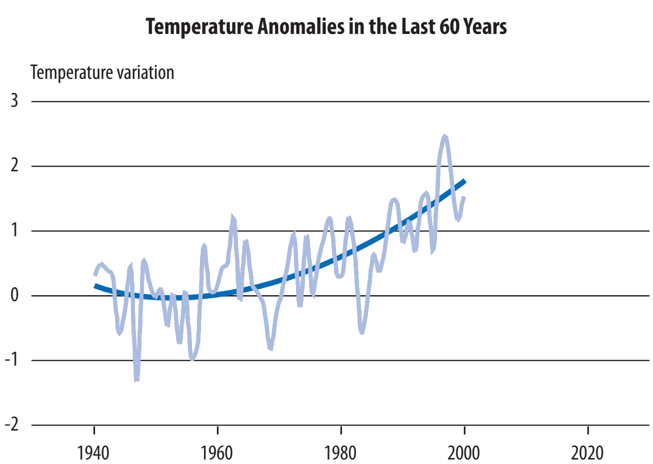
Owing to its geographical and topographical characteristics, Mongolia's climate is generally cold and dry. It has distinctive climate regions from north to south: *taiga* (moist and subarctic); *steppe* (temperate, semiarid); and desert. In general, the extreme continental climate is characterized by long, cold winters lasting for about 8 months and short, relatively hot, wet summers. Precipitation is highest in the north and lowest in the south, with some areas in the Gobi Desert receiving almost no precipitation at all throughout the year.

Average temperatures of Mongolia are below freezing from November through March and about freezing between April and October. The months of January and February have average temperatures of -20^{o}C, with winter nights of -40^{o}C. The Southern Gobi region sometimes has high temperatures of up to 38^{o}C and Ulaanbaatar, 33^{o}C. Mongolia also experiences blizzards, as well as frequent dust storms.

Aside from casual observations indicating the change in Mongolia's climate, measurements of temperature and precipitation patterns have also confirmed that over the last 60 years, the annual mean temperature in the county has increased (Figure 1.1), with an apparent decrease in precipitation (Figure 1.2). Any change in the climate can affect

FIGURE 1.1

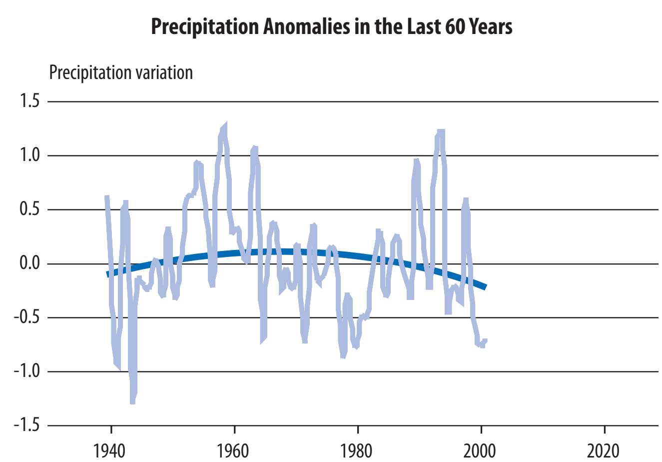
Annual Mean Temperature Trends in Mongolia, 1940–2000



Source: Oyunjargal L. and Sarantuya Ch. (2001).

FIGURE 1.2

Annual Total Precipitation Trends in Mongolia, 1940–2000



Source: Oyunjargal L. and Sarantuya Ch. (2001).

the air pollution levels in Mongolia especially since rainfall reduces the levels of particulate matter (PM) in ambient air while increased wind and storms may also lead to increased transboundary pollutants.

Ulaanbaatar, the capital city, is located in a valley surrounded by mountains with elevations ranging from 1,652 m to 1,949 m above sea level. Its location causes Ulaanbaatar to experience many temperature inversions, at least 80%–96% of which occur during the months of October to April. The average depth of the inversions is from 650 m to 920 m.

Population and Urbanization

As of mid-2005, the total population of Mongolia was estimated at 2.6 million, with an annual growth rate of 1.5%. The country's population density is one of the lowest in the world, with only 1.5 persons/km^2 (UNEP 2002). Its urban population, estimated at 60.2% of the total population, has increased by an average of 2.6% annually (ADB 2006). The urban areas are defined as Ulaanbaatar, the country's capital; the 21 provincial capitals; and 22 village capital centers. Thirty-nine percent of the urban population is concentrated in Ulaanbaatar, Erdenet, Darkhan, and Choibalsan. Ulaanbaatar by far is the largest, the most populous, and dense urban center (World Bank 2004).

Ulaanbaatar had an estimated 915,530 residents as of 2005. The city is the center of Mongolia's political, economic, cultural, and educational activities. Ulaanbaatar—also considered as the coldest capital city in the world—requires heating somewhere between mid-September and mid-May of the following year. About half of all the residents live in apartment blocks. Of these, about 80% are supplied with central heating and hot water from three combined heat-and-power plants (CHP); 7% by heating boilers (275 of them in the city, with the majority connected to a centralized heating network); and 13% by individual stoves. The rest of the residents live in individual dwellings called *ger* (traditional tent dwelling), where coal and fuelwood are used for heating. Ger areas are found on the outskirts of the city (ADB 2005).

Economy and Industry

The main sectors of the Mongolian economy are mining, agriculture, and light industry. Its main export products are copper, gold and other minerals, cashmere products, meat, etc., while its main import products are oil, equipment and machinery, food, and consumer products.

In 2005, the services sector contributed the most (48.1%) to the country's gross domestic product (GDP) while the industry and agriculture sectors contributed 30.2% and 21.7%, respectively, for the same year. GDP growth in 2005 was estimated at 6.2%, a value lower than the 10.7% GDP growth in 2004. The agriculture sector also experienced the same decline in growth: in 2004, growth was a high 17.7% compared to only 7.7% in 2005. The industry sector experienced a negative growth (-0.9%) in 2005 compared to a high 15% in the previous year (ADB 2006).

Ulaanbaatar accounts for more than 50% of Mongolia's GDP. The city also accounts for 30% of the total industrial output, more than 50% of the construction and assembly work, 85% of power generation, and half the total investment in the country (World Bank 2004).

Mongolia's economy is growing, but at a slow rate. Inflation remains contained (4.7% in 2003). Trade continues to expand—exports were in excess of $600 million per annum for the first time, with the share of mining increasing in importance—although the trade balance continues to deteriorate (ADB 2005). As of 2003, GDP per capita was $547.2 in Mongolia.

Energy

Mongolia has three primary sources of energy—traditional (biomass), conventional (fossil fuels, such as coal and oil), and alternative energy (mostly renewable). Coal is the most abundant fossil fuel and a highly utilized source of energy. Coal consumption is typically allocated to power stations (66%), heating in houses (21%), and *ger* areas (13%) (Batbayar 2006). A large amount of lignite coal is used as household fuel in Mongolia especially in the winter season. Lignite—the most abundant and cheapest fuel in Mongolia—will remain as the main source of energy and heating in the future (Sundui 2006).

In Ulaanbaatar, the three CHP consume about 3 million tons (t) of coal per year, the individual boilers about 1 million t, and the households in *ger* areas another 300,000–400,000 t of coal, in addition to fuelwood (ADB 2005).

Transportation

As a landlocked and mountainous country, Mongolia's main means of transportation are road, rail, and air transport. Mobility in urban areas relies only on road transport. As of 2002, the total road network of the country measured 49,250 kilometers (km), of which only 3.6% was paved (IRF 2004). The country has a single 1,815 km-long main-line railway and an additional 200 km of feeder lines and sidetracks. The railways are mainly used for freight transportation (UNEP 2002).

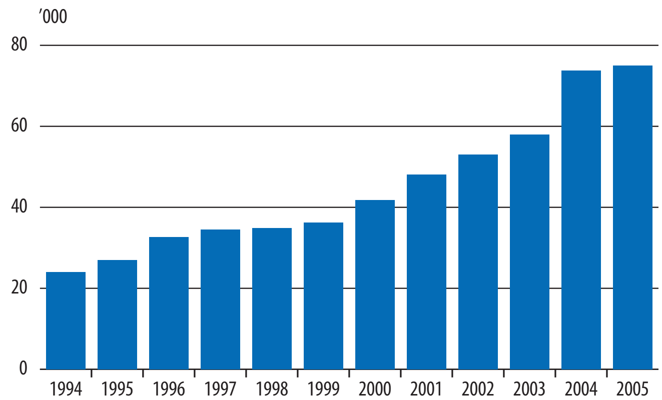
There are more than 4,000 km of motor roads in Mongolia, of which 3,325 km are improved roads and 1,471 km are paved with hard cover. Most of the passenger trips in Mongolia are carried by on-road transportation.

The vehicle fleet of the capital city has grown more than twice the total number (from 30,000 to 75,000) in the period 1995–2005 (Figure 1.3). Sixty percent of the motor vehicle fleet in Mongolia is found in Ulaanbaatar. Most of these vehicles are second hand; about 80% of them do not meet fuel consumption or emission standards and about 54% of the vehicle fleet is 11 years or older (Bat-Ochir 2006). Figure 1.4 shows the vehicle fleet based on available information for different modes.

Public transportation in Ulaanbaatar and other urban centers is mainly by bus, microbus, (van), trolleybus, and taxis.

FIGURE 1.3

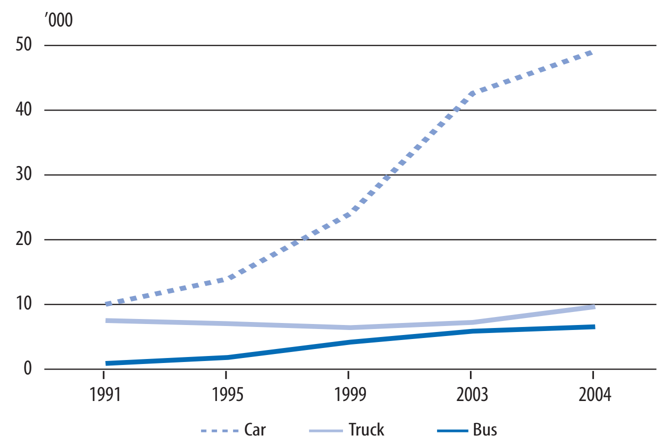
Number of Vehicles in Ulaanbaatar



Source: Batbayar (2006).

FIGURE 1.4

Number of Buses, Cars, and Trucks in Ulaanbaatar



Source: Bat-Ochir (2006).

» Part Two

Sources of Air Pollution

Emissions inventories of air pollutants are compiled annually by the National Agency for Meteorology, Hydrology, and Environmental Monitoring (NAMHEM) of the Ministry of Nature and Environment. The inventory of emissions covers the following air pollutants: PM_{10}, $PM_{2.5}$, Nitrogen oxides (NOx), nonmethane volatile organic compounds (NMVOC), and Carbon monoxide (CO) from two sources (forest and grass fires, and vehicles).

Sources of air pollution include emissions from motor vehicles; stationary sources—CHP, heat-only boilers (HOB), and industry; and area sources—household stoves, refuse burning, road dust, and sandstorms (World Bank 2004). One of the main problems is caused by use of low-level technologies and inadequate pollution control devices used in small- and medium-sized industries. This is further aggravated by the fact that operators do not have sufficient training in the heating stations using coal as fuel source.

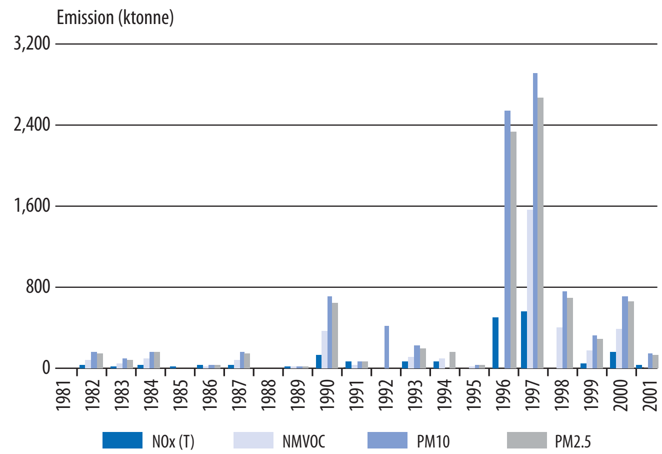
About 5.7 million t of coal and 160 million cubic meters of wood are used for energy generation, heating, and cooking in Mongolia annually. The three CHP in Ulaanbaatar, which consume about 5 million t of coal per year, and the 250 HOB, which burn an annual average of 400,000 t of coal, release emissions, including Sulfur dioxide (SO_2), PM, and Nitrogen dioxide (NO_2) in the air (World Bank 2004).

About half of Ulaanbaatar's population lives in *gers*, which use wood and coal for cooking and heating without any pollution control devices whatsoever, are considered to substantially contribute to urban ambient air pollution.

Forest and grass emissions inventories conducted by NAMHEM showed that emissions from wildfires peaked in 1996 and 1997 for all pollutants (Figures 2.1 and 2.2). This was due to the large wildfires in the same time period, in which total burned area amounted to 12,440 hectares. CO emissions (80%) dominate the total emissions from wildfires (Figure 2.3). The methodology used for the emissions inventory was developed by the Stockholm Environment Institute through its *Manual for Preparation of Emissions Inventories for Use in Modeling of Transboundary Air Pollution* (2000).

FIGURE 2.1

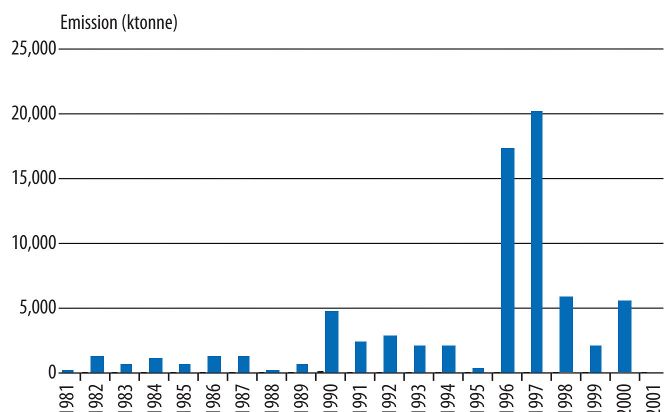
Emissions of Air Pollutants from Forest and Grass Fires, 1981–2001



Source: Oyunchimeg D (2005).

FIGURE 2.1

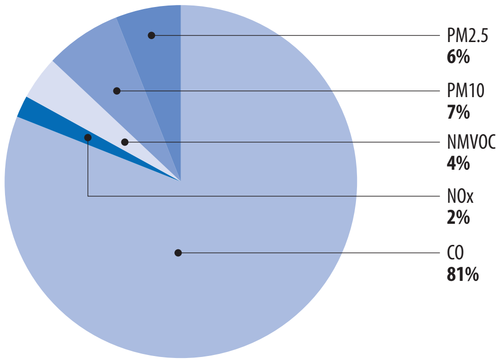
CO Emissions from Forest and Grass Fires, 1981–2001



Source: Oyunchimeg D (2005).

FIGURE 2.3

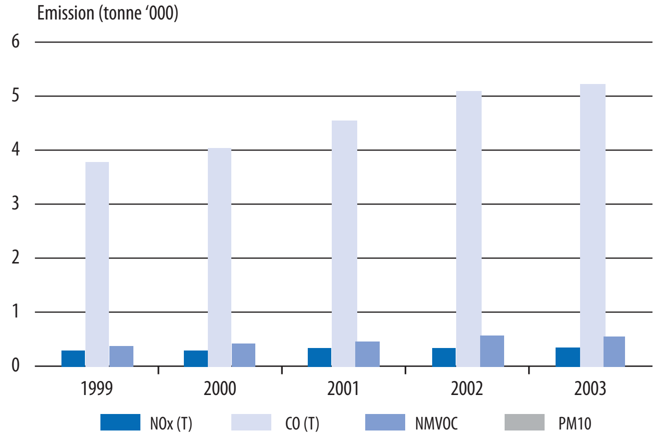
Share of Various Pollutants in Total Emissions from Forest and Grass Fires



Source: Oyunchimeg D (2005).

FIGURE 2.4

Emissions Inventory from Motor Vehicles, 1999–2003



Source: Oyunchimeg D (2005).

Emissions from vehicles have increased (Figure 2.4), as the size of the vehicle fleet has grown. The figure also shows that CO emissions have dominated (86%) the total emissions load from motor vehicles as shown in this inventory.

Aside from emissions of common air pollutants, Mongolia also routinely compiles inventories of greenhouse gas (GHG) emissions. The GHG inventories are compiled using statistics published from the statistical yearbook of Mongolia (especially for the energy sector), as well as from satellite data for the land-use change and forestry sector. Total GHG emissions in Mongolia, net of carbon sequestrations from forestry, shows a relatively decreasing tendency from 1990 to 2002.

» Part Three

Status of Air Quality

Air Quality Monitoring

Apart from being responsible from developing the emissions inventories for Mongolia, NAMHEM is also responsible for monitoring air pollution.

There are four ambient air quality monitoring stations in Ulaanbaatar City and no other stations outside the city. However, these stations have not been measuring ambient concentrations regularly, and various studies of air pollution have yielded different results (World Bank 2004). The measuring methodology used in these monitoring stations is shown in Table 3.1.

TABLE 3.1

Measuring Methods of Air Pollutants for Air Quality Monitoring

Pollutants	Measuring Method	Type
SO_2	Pararosaniline (spectrophotometer)	Manual (Solution)
NO_2	Saltzman	Manual
TSP	High volume sampler	Manual (filter)

Source: Ekhmaa (2006).

The four monitoring stations are placed in selected areas in Ulaanbaatar and labeled as UB-1 in the industrial district; UB-2 in the west crossroad; UB-3 in the Bayankhoshuu *Ger* Area; and the UB-4 in the 13th district (ADB 2005).

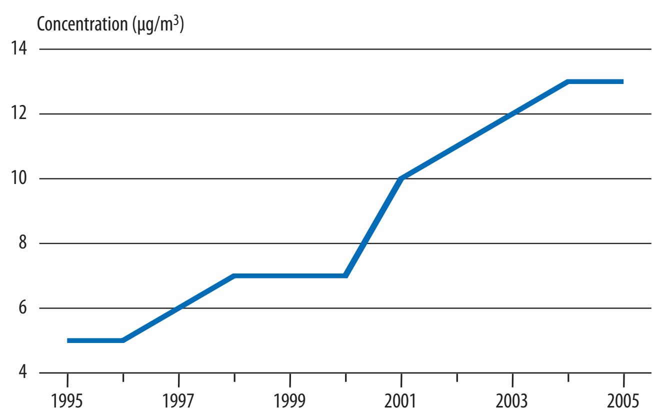
Air Quality Status

Much of the atmospheric SO_2 in Mongolia is caused by the combustion of fossil fuels by CHP, HOB, and industry, whereas industrial processes—such as smelting, petroleum refining, and the manufacture of sulfuric acid—are the greatest producers of SO_2.

Concentrations of SO_2 are highest between October and March due to increased emissions from local heating sources and electricity generation. In these months, peak SO_2 concentrations of 45 µg/m^3 have been recorded in the evenings between 4 pm and 8 pm. Figure 3.1 shows the annual average concentrations of SO_2 in the capital from 1995 to 2005. The annual average concentrations are found to be within the WHO (2005) standards for SO_2 at 50 µg/m^3. The ambient air quality standards for SO_2 in Mongolia, considering a 24-hour averaging time, is 30 µg/m^3 while that of the WHO (2005) is 20 µg/m^3.

FIGURE 3.1

Annual Average Concentration of Sulfur Dioxide in Ulaanbaatar



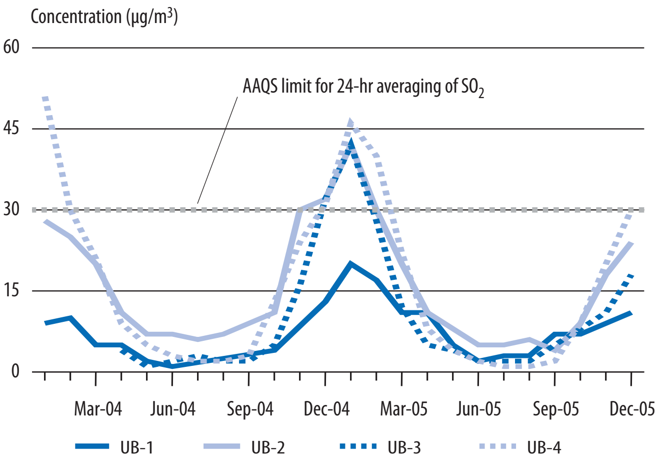
Source: Ekhmaa (2006).

The monthly averages of SO_2 and the peaks observed during the colder season (from October to March) are shown in Figure 3.2. The maximum monthly concentrations of SO_2 in the same time period are shown in Figure 3.3.

The maximum 24-hr concentrations of SO_2 were about 2.6 times higher, on average, than the Ambient Air Quality Standard (AAQS). The annual average of SO_2 is 13 µg/m^3, while

FIGURE 3.2

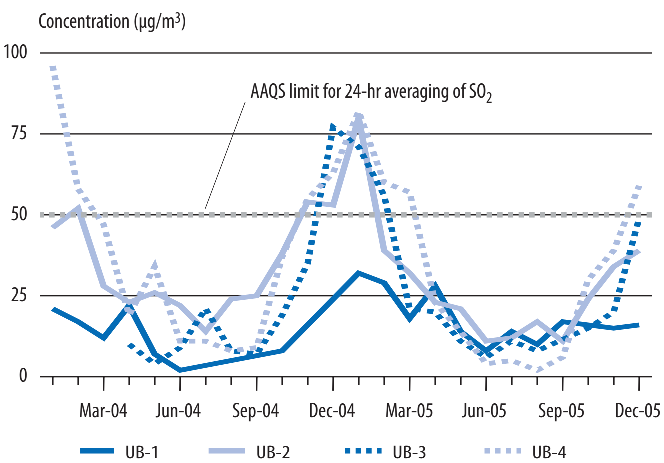
Trend of SO_2 Monthly Averages of 24-hr Averaging from Four Ambient Monitoring Stations in 2004–2005



Source: Ekhmaa (2006).

FIGURE 3.3

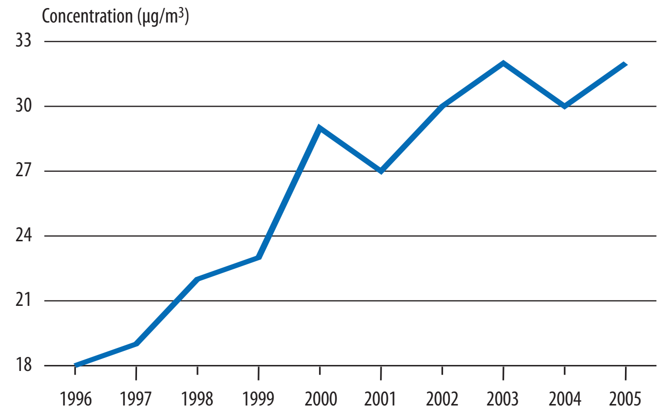
Trend of SO_2 for Maximum 24-hr Concentration from Four Ambient Monitoring Stations in 2004–2005



Source: Ekhmaa (2006).

FIGURE 3.4

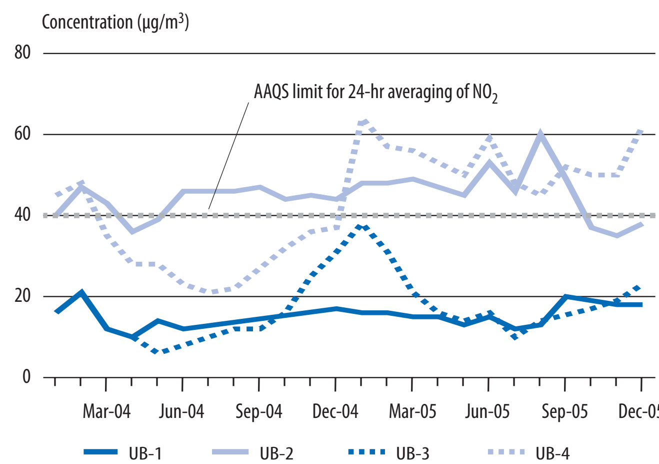
Annual Average Concentrations of Nitrogen Dioxide in Ulaanbaatar



Source: Ekhmaa (2006).

FIGURE 3.5

Trend of NO_2 Monthly Average of 24-hr Concentrations from Four Ambient Monitoring Stations in 2004–2005



Source: Ekhmaa (2006).

the average maximum concentration is 82 µg/m³. In 2005, 130 readings were found to be higher than AAQS.

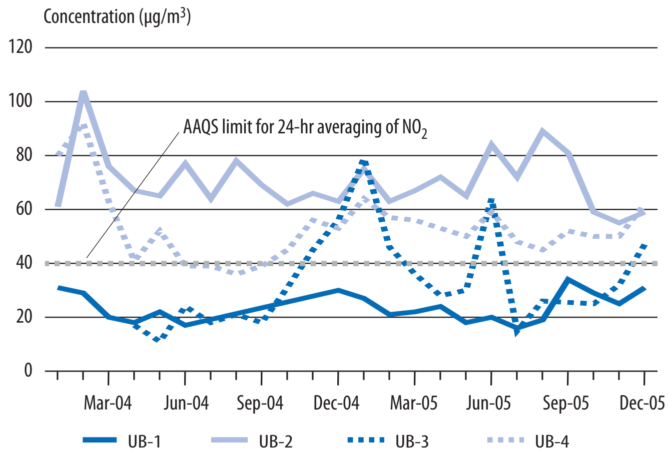
NO_2 and NO_x are considered to be one of the emerging problems in Ulaanbaatar. NO_x are mainly emitted from a high-temperature combustion process with the major oxide in combustion emission being NO and then oxidized to NO_2 in the atmosphere. Atmospheric NO_2 is formed by both industrial processes and exhaust gases from vehicles.

The annual averages of NO_2 from the four ambient air quality monitoring stations are shown in Figure 3.4. NO_2 ambient concentrations have increased from 18 µg/m³ in 1995 to 32 µg/m³ in 2005, increasing at an average of 1–2 µg/m³ year by year.

Figure 3.5 shows the monthly averages of NO_2 for each station and AAQS for 24-hr monitoring of NO_2 (40 µg/m³) in Mongolia, which is equivalent to the WHO Guideline value for annual averaging. Concentrations of NO_2 for UB-1and UB-3 stations are within AAQS, while UB-2 and UB-4 stations exceed the WHO Guideline values. In 2005, a total of 370 24-hr observations were found to exceed AAQS, increasing by 4.8% compared with that in 2004. The maximum 24-hr concentration of NO_2 for UB-1 station is within AAQS, while all the other monitoring stations frequently exceed AAQS (Figure 3.6).

FIGURE 3.6

Trend of NO_2 for Maximum 24-hr Concentration by Four Ambient Monitoring Stations in 2004–2005

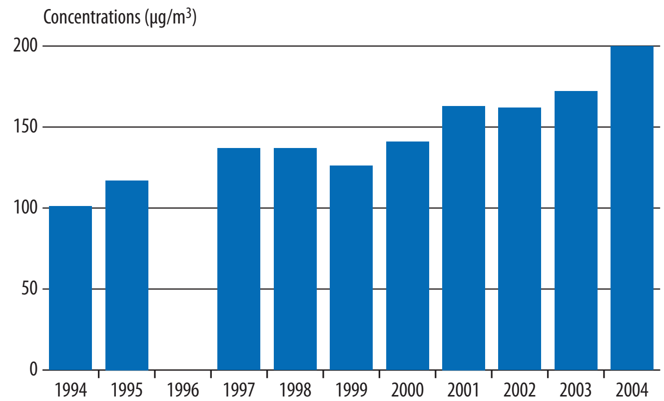


Source: Ekhmaa (2006).

PM is the single largest problem pollutant in Ulaanbaatar. Its daily mean concentration ranges from 131 μg/m³ to 162 μg/m³ (World Bank 2004). The observed trends show that similar to the other pollutants SO_2 and NO_2, PM concentrations also peak during the colder season. Figure 3.7 shows the annual averages of suspended particulate matter (SPM) or total suspended particulates (TSP) only in the UB-1 station because of the lack of equipment in the other monitoring stations. The figure also shows that the levels have exceeded AAQS for SPM or TSP for 24-hr monitoring (150 μg/m³). Monthly trends of $PM_{2.5}$ in 2005 are shown in Figure 3.8. Trends show that the observed levels exceed the WHO (2005) Guideline values of 10 μg/m³ for annual averaging. The Government of Mongolia currently has no standards for PM_{10} and $PM_{2.5}$.

FIGURE 3.7

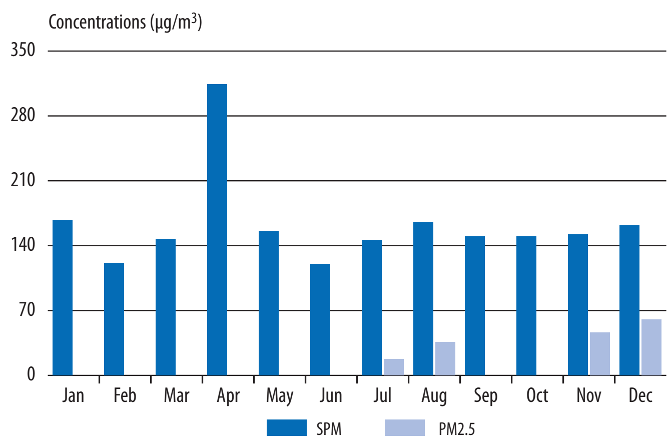
Trend of Annual Averages of Suspended Particular Matter or Total Suspended Particulates in Ulaanbaatar



Source: Ekhmaa (2006).

FIGURE 3.8

Monthly Average Concentrations of SPM and $PM_{2.5}$ in UB-1 Station in 2003



Source: Ekhmaa (2006).

» Part Four

Impacts of Air Pollution

There has been no comprehensive epidemiological study conducted in Mongolia to assess the impact of air pollution on public health mainly due to poor hospital and air quality information. An air pollution survey in 2004 conducted by the Municipal Professional Inspection group in Ulaanbaatar investigated the occurrence of respiratory disease in the population by age and has correlated this with ambient concentrations of NO_x and SO_2. The highest correlation was observed for the occurrence of asthma for people between ages 25 and 64 and bronchitis for infants less than a year old (Batbayar 2006).

A 2002 study conducted by WHO reported a strong statistical link between air pollution and respiratory disease requiring hospitalization among children in Ulaanbaatar and Tungkhel areas. Two studies conducted in 1996 and 2001 also reported the negative impact of air pollution on the physical growth of children (World Bank 2004).

The widespread use of lignite coal as fuel for household heating gravely affects health, particularly of children, especially in the winter season. During winter, visibility in Ulaanbaatar is very poor due to the large amounts of smoke emitted from houses and *gers*.

» Part Five

Air Quality Management

Legal Basis

The basic law for air quality management in Mongolia was adopted in 1995. An Air Protection Program was subsequently enacted in 1999. The Act covers environmental conservation; pollution control and prevention; conservation of natural heritage sites; operation of environmental funds; additional incentives to minimize pollution; and compensation for environmental damage. NAMHEM, under the Ministry of Nature and Environment, became mainly responsible for monitoring air pollution, developing pollution inventories, and implementing national air quality action plans (World Bank 2004).

The program, however, was not sufficiently implemented and as such needed to be reinforced. In August 2006, the Ministry of Nature and Environment established an Air Quality Management Service in the structure of NAMHEM in order to develop, implement, and monitor air quality management action plans.

The Government has begun limited testing of tailpipe emissions in Ulaanbaatar. However, no comprehensive vehicle emissions standards and appropriate fuel quality standards have been enacted in the country. There is no legislation in Mongolia that sets the country's fuel standards. Leaded gasoline is still being sold in Mongolia's market.

The Government has recognized the need to replace or refurbish old boilers and furnaces to reduce emissions from these sources. Lower tax and other incentives have been considered for industries to adopt cleaner technologies and other energy-conserving measures.

The Ministry of Fuel and Energy, through its "coal" program, plans to introduce clean coal technologies and provide incentives to develop smokeless, carbonized coal briquette. The Ministry is also implementing a program to promote the use of LPG for residential purposes, as well as transportation fuel (Sundui 2006).

Ambient Air Quality Standards

Ambient air quality standards (AAQS) were legislated in 1998 through legislation MNS4585-98.

TABLE 5.1

Ambient Air Quality Standards of Mongolia

Pollutants	Averaging time	Concentration (μg/m^3)
SO_2	20 minutes 24 hours	500 30
NO_2	20 minutes 24 hours	85 40
TSP	20 minutes 24 hours	500 150
Ozone	1hour	120
Lead	24 hours	1
Benzo(a)pyrene	24 hours	0.001

Source: Mongolian Agency for Standardization and Metrology (1998).

Public/Nongovernment Participation

Several environmental nongovernment organizations (NGOs) have emerged over the last 10 years. In 1999, about 30 of them formed the Union of Mongolian Environmental NGOs. An environmental information column is published in the *Daily News,* and the Ecological Guard is broadcast regularly on national public radio (World Bank 2004). However, this includes the various environmental issues and problems in Mongolia and does not focus solely on air pollution issues.

Within the Ministry of Nature and Environment, the Civil Society Committee was established to ensure that public opinion is taken into account in crucial environmental decision-making and to coordinate public participation activities between government agencies and NGOs at the national and local levels. An Information Unit was also formed to facilitate the dissemination of environment-related information and to educate people on environmental laws and regulations (World Bank 2004).

The Government of Mongolia has been actively participating with international organizations in programs addressing air pollution, especially those addressing the problem of dust and sandstorms (through the Prevention and Control of Dust and Sandstorms in Northeast Asia by ADB and the United Nations Agencies) and acid rain monitoring (through the Acid Deposition Monitoring Network in East Asia [EANET]).

» Part Six

Conclusion

Mongolia is experiencing rapid rates of urbanization similar to other Asian countries. A large percentage of this urbanization is occurring in the country's capital, Ulaanbaatar. The city is also experiencing problems brought about by the growing number of automobiles, and industrialization. Ulaanbaatar is also inherently vulnerable to air pollution because of its topography and climate.

PM is the main pollutant of concern in the urban areas of Mongolia, particularly in Ulaanbaatar. NO_2 and SO_2 levels are also increasing and will need to be addressed. All of these pollutants can reach particularly excessive levels during the colder season. The ambient concentrations of PM are at levels likely to adversely affect the health of urban residents.

As problems brought about by emissions from brick kilns have been addressed by the Government, emissions from mobile sources, and emissions of PM are now the Government's primary concerns. A comprehensive action plan to reduce emissions from mobile sources needs to be developed; this will ensure that the increasing number of motor vehicles in Ulaanbaatar will not aggravate the growing air pollution problem. There is need to address fuel quality, vehicle emission standards, and emissions from in-use vehicles, as well as measures to encourage use of public transport.

The use of coal—the primary source of indoor heating—is gravely affecting the health of the population, especially during the winter season. The emissions from extensive coal usage in the urban area have greatly contributed to urban air pollution, and will need to be addressed.

Air quality management in Mongolia is focused on its capital city of Ulaanbaatar. The Government has played important roles in activities, such as raising public awareness campaigns and routinely monitoring the quality of the atmosphere. Private associations, advocacy groups, and NGOs, as well as external funding agencies, have also contributed to the improvement of air quality management in Mongolia.

The role of coordination and collaboration between the National Agency for Meteorology, Hydrology, and Environmental Monitoring with other relevant government agencies in areas, such as energy, transport, and health, may need to be strengthened to successfully develop and implement air quality management plans.

References

ADB. 2006. *Key Statistics 2006.*

ADB. 2005. *Mongolia: Country Environmental Analysis.* Available: http://www.adb.org/Documents/Studies/Ctry-Environmental-Analysis/2005/MON/mon-cea.pdf

Batbayar, T.S. 2006. *Air Pollution in Ulaanbaatar City, its Mitigation Approaches and Cooperation.* T.S. Batbayar, Mayor and Governor of Ulaanbaatar City.

Bat-Ochir, Mungunbayar. 2006. *Urban Public Transport in Mongolia.* Available: http://www.ivv.tuwien.ac.at/fileadmin/mediapool-verkehrsplanung/Diverse/Lehre/Gastforscher_und_studenten/3_Mongolian_Urban_public_transport.pdf#search=%22mongolia%20public%20transportation%22

Ekhmaa, S. 2006. *Annual Report 2005.* National Agency for Meteorology, Hydrology and Environmental Monitoring.

International Road Federation. 2004. *World Road Statistics Data 1998–2002.*

IPCC/OECD. 1996. *IPCC Guidelines for National Greenhouse Gas Inventories.* 3 volumes: Reporting Instructions, Vol. 1; Workbook, Vol. 2; Reference Manual, Vol. 3. Intergovernmental Panel on Climate Change, Organization for Economic Co-operation and Development. Paris, France.

Oyunchimeg, D. 2005. *Proceedings of the First International Symposium on Terrestrial and Climate Change in Mongolia.* Ulaanbaatar, 2005.

Oyunjargal, L. and Sarantuya C. 2001. *Climate Review of Mongolia in 2001.* Institute of Meteorology and Hydrology of Mongolia.

State Statistical Office of Mongolia. 2003. Mongolian Economy and Society in 2002. *Statistical Yearbook.* Ulaanbaatar, Mongolia.

Sundui, Tugsbayar. 2006. Policy of Ministry of Fuel and Energy to Decrease Air Pollution. Tugsbayar Sundui, Fuel Technology Division, Ministry of Fuel and Energy, Mongolia.

United Nations Environmental Programme. 2002. *Mongolia State of the Environment Report.* Available: http://www.rrcap.unep.org/reports/soe/mongoliasoe.cfm

World Bank. 2004. *Mongolia Environment Monitor 2004.* Available: http://siteresources.worldbank.org/MONGOLIAEXTN/Resources/MEM04.pdf#search=%22Mongolia%20environment%20monitor%202004%22