Air Monitoring and Health Impact Baseline Study

What is AMHIB?

- **AMHIB – Air Monitoring and Health Impact Baseline Study.** A World Bank study to assess air pollution using best locally available data and to evaluate the health impacts associated with air pollution in UB. The Government of Korea and Netherlands provided substantial assistance to hire experts for this study.

Who is involved?

- **AMHIB Core Team:** National University of Mongolia, the Public Health Institute of Mongolia, and the Norwegian Institute for Air Research (NILU) and Steinar Larssen, consultant and formerly with NILU, Resources for the Future, and the World Bank.
- **AMHIB Steering Committee is main counterpart of the study:** Chaired by Vice Minister of Nature, Environment and Tourism and includes National Agency for Meteorology Hydrology, Public Health Institute, and Environmental Monitoring, City of Ulaanbaatar Air Quality Department.
- **Guidance also provided by National Committee on Coordination, Management, and Oversight of Activities of Government Agencies with regard to the Implementation of the Government Policy on Air Pollution Reduction (NCC),** chaired by the Minister of Mineral Resources and Energy (MMRE) and vice-chaired by the Vice Mayor of Ulaanbaatar City Administration, and includes Ulaanbaatar Municipality (Department of Urban Development and Ulaanbaatar Environmental Protection Bureau), Ministry of Mineral Resources and Energy, Ministry of Nature, Environment and Tourism.

Why AMHIB?

- **The broader purpose of the Bank’s recent analytical work, including this AMHIB study, is to introduce an objective, analytical framework by which pollution reduction programs could be prioritized and their results evaluated.** There has been so much debate about how to reduce air pollution, but few studies have tried to understand how effective pollution abatement programs should be. By how much should pollution in ger areas be reduced to have a visible impact and real health impact in all of Ulaanbaatar?

What is a Discussion Paper?

- **This is an early version of a Final Report which will be issued in Spring 2010. The purpose of a Discussion Paper is to release preliminary study results.** It is hoped that this will help introduce some key analytical concepts that are useful in choosing among various abatement measures. The report also compares current measurements with national and international standards.
What’s Different from other studies?

- **AMHIB monitored air pollution in ger areas systematically for the first time.**
- **AMHIB brought together different organizations that had monitoring equipment to carry out the baseline data collection. AMHIB’s 8 monitoring stations came from National University of Mongolia (2), NAMHEM (5), Central Laboratory for Environmental Monitoring (1).**
- **AMHIB brought together air quality experts with public health experts to systematically study health impacts for the first time.** Part of the AMHIB project is collecting data from hospitals in UB located close to the air pollution monitoring stations. These include 8 family and village hospitals, 7 district hospitals, 1 ambulatory facility, and 3 tertiary hospitals. Data on daily admissions connected to respiratory and cardiovascular diseases, based on diagnoses, has been collected to perform statistical analysis with variables connected to PM concentrations.
- **AMHIB conducted an Ulaanbaatar-specific willingness-to-pay study which will help make more precise economic impacts evaluation.** Few cities have this kind of data.
- **AMHIB used a state-of-the-art dispersion model to forecast air pollution impacts from emission reductions from key pollution sources.**

What are preliminary results?

- **Although pollutants such as SO$_2$ also are higher than international standards, Particulate Matter (PM) is the largest and relatively most severe air pollution problem in Ulaanbaatar. In terms of PM, Ulaanbaatar is among the most polluted cities in the world.** The largest emissions sources may not be the largest contributors to the ground level pollution people inhale. In UB the main sources of ground level PM$_{2.5}$ (fine particle) concentrations are primary carbonaceous particles from coal combustion for heating and cooking (Ger households) and industrial activities (heat-only-boilers and power plants). Suspension of dust from streets and other surfaces contribute to larger yet also harmful coarse particles contributing up to 50% of total annual average PM$_{10}$ concentrations in one part of the city (NUM station).

- **In the most polluted parts of the city, based on available data, annual average concentrations of PM$_{10}$ are 2-10 times higher than Mongolian and International Air Quality Standards (AQS). The PM$_{2.5}$ concentrations are less well documented by measurements but available data indicate that the PM$_{2.5}$ situation is equally severe compared to AQS.** Annual average concentrations of PM$_{10}$, measured at the National University of Mongolia (NUM) campus area to the east of central UB (the station with the longest series of PM measurements) were as high as 141, 157 and 279 µg/m$^3$ for 2006, 2007 and 2008 respectively. Measurements at monitoring stations in other parts of Ulaanbaatar since June 2008 under this AMHIB study give even higher concentration levels. Based on this AMHIB study’s modeling results, the concentrations are likely to be
higher in the north-central areas of Ulaanbaatar than at the NUM station. These measured UB PM$_{10}$ levels are 2-5 times higher than Mongolia’s AQS of 50 µg/m$^3$, 5-10 times higher than the WHO Guideline Value of 20 µg/m$^3$, and 3-7 times higher the European Limit value of 40 µg/m$^3$. WHO has set interim target values realizing that the Guideline Values cannot be met in the short term in many developing countries. The highest interim target value is 70 µg/m$^3$. Thus, the present PM$_{10}$ level in UB is at least three times higher than this target in the most polluted areas of the city. The spatial distribution of the pollution is wide-spread across UB city and its surroundings. The PM$_{2.5}$ concentrations are less well documented by measurements but limited samples taken in November 2008 indicate the severity of the PM$_{2.5}$ situation. The measuring equipment used until the end of 2008 is affected by sampling artifacts, resulting in too low PM$_{2.5}$ levels. A measurement campaign during last part of November 2008 provided parallel PM$_{2.5}$ and PM$_{10}$ measurements indicating that 50-60% of PM$_{10}$ was in the PM$_{2.5}$ fraction on those days. The PM$_{2.5}$ concentrations reached as high as over 400 µg/m$^3$ as daily average and maximum hourly levels of up to 1300 µg/m$^3$.

**How does this compare with other cities?**

- Some cities in northern China and south Asia still had even higher annual average concentrations, i.e. above 200 µg/m$^3$ up to a few years ago, but PM levels are coming down I Chinese cities. The annual average PM$_{10}$ concentrations in European and US cities are much lower, the highest levels are in the range 60-100 µg/m$^3$ (although some desert cities in the US have higher levels), and in most cities the concentrations are below 40 µg/m$^3$.

**What can be done?**

- **Socially acceptable, technically feasible emission reduction targets should be set to give a clear direction for action plans.** Targets will be determined by technical options and the ability and willingness to pay for pollution reduction by civil society. The costs of air pollution are paid from the pocketbook, the budget and future health costs through higher incidences of pollution related illnesses. What and how to pay for air pollution is a choice to be made by civil society and its representatives. Due to the complex nature of air pollution, an open discussion of options and their estimated impacts based on an analytical framework using best available data is recommended. Cost effectiveness or cost-benefit analysis can be used for each policy option. These estimates together with other factors that are considered important to civil society can be considered in choosing clean air strategies. Setting targets that have been openly discussed helps build widespread support for pollution abatement activities that involve asking people to change behaviors. Many in civil society, especially the poorest, will be asked to change their behavior in some way to improve air quality. They should become active allies in the reduction of air pollution in UB. This approach provides policy makers with
realistic options for developing air quality management strategies that are suited to the current socio-economic situation in Mongolia.

- A large share of the PM$_{10}$ concentrations come from these wintertime peaks that may correspond to the cold start ignition and re-loading phases for heating stoves combined with the poor meteorological dispersion conditions at those hours. There is an indication that, as a short term measure, significant reductions in emissions can be achieved from changing the way raw coal is lighted for heating.\textsuperscript{1}

- To achieve Mongolian AQS, 80% emissions reductions are needed. This can only be achieved realistically in the long term. An emissions reduction strategy that sets ambitious but realistic short term targets is recommended. Different sources of air pollution show different impacts on air quality. To meet the Mongolian standard in Ulaanbaatar for the most harmful particulates, PM$_{2.5}$, the model predicts more than 80% of emissions reductions are needed. The results also show that different source sectors have different impacts on air quality. Based on available data, reducing emissions in the ger areas by half yields an improvement in PM concentrations by about one-third – much more than similar emissions reductions in other source sectors.

- The AMHIB team also wishes to thank the JICA air quality monitoring experts for their kind support and peer review.

\textsuperscript{1} See Lodoysamba & World Bank’s Heating in Poor, Peri-Urban Ger Areas (June 2009).