"Over the last years the exposure of the air in Vienna due to sulphur dioxide (SO₂) has been reduced significantly on the basis of different measures such as the extension of the district heating network or the use of modern exhaust gas treatment procedures in the industry." –

"The Urban Air Initiative is a comprehensive package of measures that will help to safe the quality of the air in Vienna on a continuous basis and to continue to improve the same." – Municipal Department of Environmental Protection – MA 22

"With its modern flue gas purification plant our listed crematorium building will contribute to the environmental role model city Vienna." – Cemeteries of Vienna
Air quality in Vienna

On the basis of long-term and targeted measures partially high emission reductions could be achieved during the last two decades. This resulted in a substantially improved air quality in Vienna and its surrounding area. However, air pollution remains a serious problem - not least due to the strong increase in traffic volume.

Specifications on the basis of the Pollution Protection Act - Air

Solutions for particulate matters, NO₂, and ozone

In order to meet a corresponding EU directive, the Pollution Protection Act - Air (IG-L) has been enacted, which specifies generally applicable pollution limits. The IG-L specifies that, along with the hitherto measured components sulphur dioxide (SO₂), nitrogen dioxide (NO₂), carbon monoxide (CO), particulate matter PM10 (particles up to a diameter of 10 micrometres), and ozone (O₃), the toxic components in the particulate matter and in the benzene are to be detected as well. Additionally, deposit measurements for dust deposits, as well as for the pollutants lead and cadmium contained therein are to be implemented. As of 2007, monitoring the components arsenic, cadmium, nickel, and benzopyrene has been specified for the PM10 as well. At the moment, there are only target values for these particulate matter components, which however will be converted into limits as of 2013. As the amended range of the IG-L also defines alarm limits for sulphur dioxide and nitrogen dioxide, the hitherto applicable smog alarm act has been repealed. On the basis of the results of IG-L measurements of several years there are locations of high exposures regarding the pollutants particulate matter (PM10), NO₂, and ozone in Vienna, Austria. The currently applicable human hygienic limits for the remaining toxic components are met and largely even fallen below substantially.

Status survey in case of exceeding the limits

Cases of exceeding the pollution limits specified in the IG-L are documented in monthly and annual reports. If exceeding the limits cannot be attributed to a failure or a temporary, non-recurring exposure, a status survey has to be implemented describing the pollution and emission situation, as well as the meteorological conditions.

Furthermore, it has to be determined which concrete renovation measures are to be implemented in which area. By means of a decree a catalogue containing emission-reducing measures for the renovation area may be enacted. As possible measures, for example emission limitations for operating plants, traffic limitations, or restrictions regarding the use and the production of certain substances may be specified. Regarding exceedances since 2005, a so called “programme” has to be developed, which additionally shall contain measures that may be implemented in the own sphere of action of the countries.

Air measurement network

The condition of the air in Vienna is monitored continuously by an area-wide pollution measurement network with 17 stationary air measurement locations all over Vienna and a mobile air measurement vehicle. Nearly all measurement locations are located in modern measurement containers. Partially even locations exposed to traffic have been selected as installation sites allowing for a description of the air situation even in these particularly critical areas.

Where what is measured

All measurement locations are equipped with measurement devices for nitrogen oxides. Additionally, sulphur dioxide is measured at ten measurement locations and carbon monoxide at four measurement locations. At two of the measurement locations exposed to traffic the benzene values are registered on a regular basis. Five locations have been equipped with their own ozone measurement devices. Since the beginning of 2005 the PM10 concentration is monitored at thirteen and the PM2.5 exposure at two measurement locations. At two further measurement locations (Laaer Wald and East motorway) lead and cadmium are determined in the dust deposit additionally. Furthermore, as of 2007 there will be a chemical analysis of the particulate matter samples regarding heavy metals and benzopyrene at two locations. Meteorological sensors detect wind speed, wind direction, air temperature, air pressure, and relative humidity at suitable locations.

EU-compatible data collection

The air samples are sucked in a EU- and IG-L-compliant manner in order to be able to comment on the air quality in all areas the urban
population may stay in. This procedure allows for the data to be compared in a pan-European manner, and not only within Austria. In order to control the prevention of air pollution a proprietary environmental measurement vehicle is used, which is designed for mobile pollution measurements of the toxic components sulphur dioxide, nitrogen oxides, PM10, carbon monoxide, and ozone. The measurement vehicle - alike the remaining 17 stationary air measurement locations - is monitored by a central computer and transmits the data 24 hours a day directly into the control centre of the Municipal Department of Environmental protection – MA 22.

**Modifications in the monitoring of pollutants**

The extension of the particulate matter measurements initiated in 2002 was finished in 2004. Since 2005 the particulate matter measurement network is in complete assembly. Minor amendments are only designed for PM2.5 at the moment.

However, the air measurement network of Vienna has to be adapted to new legal and technical requirements on a continuous basis. New measurement containers have to be erected at two locations. The measurement location Taborstraße has been renewed in order to allow for the particulate matter fractions PM10 and PM2.5 being measured at this location. The erection of a supermarket at the old measurement location “Stadlau” required the new development at a location nearby.

**Air pollution balance 2006–2007**

The air quality in Vienna is mainly affected by toxic emissions from the combustion of fossil energy sources, from the vehicle traffic, and from emissions from commerce and industry. On the basis of the geographic and climate circumstances, but also due to a very low share of industrial areas with high levels of pollution, there are very favourable basic conditions in Vienna in principle.

However, emissions for example of nitrogen oxides and particulate matter, still affect the air quality in Vienna. Apart from its own emissions, Vienna as an area of high population density now and again is exposed to large distance toxic transports from Poland, the Czech Republic, Slovakia, and Hungary. Creation of ozone near the ground level affects air quality as well. Strong reduction of SO₂ in the last decades

Since the 70ies a substantial reduction of the exposure towards pollution could be observed in Vienna, Austria. The reduction until the beginning of the 90ies can be attributed to substantial reductions of the sulphur dioxide (SO₂) emissions both in Vienna and in Austria as a whole (flue gas purification plant, changeover to natural gas in the field of combustibles, step-by-step reduction of the sulphur content in combustibles, reduction of building fire emissions by extending the district heating system). There is a strong connection between sulphur dioxide pollutions and weather influences. Thus, wide-area increased episodes always occur in winter times, with long-lasting cold high pressure weather conditions. In the conditions mentioned above SO₂ may also be transported over large distances.

Thus, the reduction of the SO₂ emissions beginning at the end of the 90ies in the neighbouring states of Austria to the north and to the east resulted in a further reduction of the measured sulphur dioxide exposure in Vienna as well. In the summer the measurement results are so low that they barely exceed the detection limit of the measurement devices.
Particulate matter - PM10

The particulate matter component PM10 has been measured since 2002. The limit of 40 micrograms per cubic metre shown to be the annual average value has been complied with in 2006 and 2007 at all four measurement locations in Vienna. A limit of 50 micrograms per cubic metre of air also has been defined for the daily average value, at which this limit may be exceeded on up to 30 days per year. Alike in many European areas with high population densities, exceedances of this limit for daily average values are monitored in Vienna as well.

On the basis of the relatively short detection period of six years and the strong dependency on the weather during the winter, comments on the trend of the PM10 pollutant development in the urban area of Vienna are very difficult at the moment. Compared to the results obtained hitherto, 2004 and 2007 were years of low exposure levels. During the course of a year the highest concentrations normally occur during the winter months. In this season the transport of pollutants over large distances, as well as frequent temperature inversions adding to a poor dilution of the pollutants caused the majority of limit exceedances.

As a contribution to reduce the particulate matter exposure in the urban area, all vehicles of the city of Vienna driven by a diesel motor were retrofitted with diesel particulate filters in 2005, if this was possible from a technical point of view. Furthermore, the use of the humid salt technology has been fostered in recent years in winter weather service. In doing so, it was possible to save substantial amounts of winter road sand that otherwise would have led to an increased formation of dust.

Main factors for high PM10 values

Present surveys showed that the most important source of particulate matter in Vienna are emissions of the road traffic (e.g. raising road dust, exhaust fumes, and tyre, brake, and road particles). In certain areas emissions from commerce and industry, as well as raising dust in case of soft road surfaces contribute to the aforementioned as well. An additional source for the formation of particulate matter are gaseous precursor substances such as nitrogen oxides, sulphur dioxide, and ammonia transported large distances (500km and more).

Thus, it is not only regional sources contributing to the particulate matter exposure, but supra-regional sources as well. The contribution of these supra-regional sources that cannot be identified in more detail to the pollution
exposure in Vienna is approximately 75%. Thus, the emissions in Vienna are responsible for 25% of the pollution exposure on average, at which these emissions may be divided as shown in the representation "PM10 emissions in Vienna [%]".

**NO2 main pollutant**

Along with their direct effects as air pollutants, nitrogen oxides are precursor substances for ozone and particulate matter. In Vienna, the road traffic is the main cause of nitrogen dioxide emissions, taking a share of 60 percent. This has been confirmed by the "NO2 status survey" published in spring 2005 (in the internet at: www.wien.at/ma22/luft/pdf/iglstatus2003-no2.pdf)

There are many aspects indicating that the nitrogen dioxide concentration depends on weather conditions and air temperature. Low temperatures in combination with temperature inversions result in the exposure of the NO2 increasing during the winter months. However, exposure peaks can also occur in the summer on the basis of the interactions of traffic exhaust fumes and ozone.

At measurement locations near road traffic an increase in the NO2 exposure could be monitored during recent years. One reason for the aforementioned is the increasing share of modern diesel vehicles that are characterised by reduced particle emissions, but a substantially higher share of NO2 in the flue gas at the same time.

**Often an issue in the summer: ozone (O3)**

Ozone at ground level is not emitted directly. In case of high-pressure, summer weather – at high temperatures, no wind, and dry air – this pollutant mainly results from nitrogen dioxides and hydrocarbons. The majority of the precursor substances for ozone formation stems from emissions caused by road traffic, but also from other industrial, commercial, and domestic combustion processes.

In corresponding weather conditions the "information limit" has been reached in recent years on several days. As the ozone exposure strongly depends on the weather conditions trend comments are difficult. In this, the annual average values for ozone correlate relatively well with the annual average of the air temperature. However, the increased ozone exposure cannot be explained alone by the aforementioned.

**Triggering of ozone alarms**

The ozone exposure for the years 2006 and 2007 resulted in the "information limit" being triggered on approx. 20 days – and even in short triggering processes of the "alarm limit" on individual days.

**Ozone forecast model**

Within the framework of the ozone legal network, the city of Vienna has been working intensively with the countries of Lower Austria and the Burgenland for a long time to develop measures to reduce the ozone exposure in the Pannonian Region. However, in order to actually avoid ozone peaks measures have to be set one or two days in advance. Thus, Vienna is working on an ozone forecast model that currently is tested and improved further. The model system to forecast ozone on the basis of the operational regional weather forecast has been developed within the framework of a cooperation of the Central Institute for Meteorology and Geodynamics (ZAMG) with the Institute for Meteorology of the University of Natural Resources and Applied Life Sciences (BOKU-Met) and develops a short-term two-day forecast as regards to the air pollutant exposure in the north-eastern part of Austria.
All ozone alarm reports since 1 July 2003 can be found in the internet at the following link: www.wien.at/ma22/luftgue.html

Air quality information Vienna: Folder, brochures, hotlines, links:
- to request brochures as well as make requests: Environmental hotline, Tel.: 4000/8022
- audiotape service “Ozonix” – hourly updated air quality information 24 hours a day, Tel.: 4000/8820
- current air quality, daily, monthly, and annual reports, status surveys, Ozone warning service and ozone alarm reports at www.wien.at/ma22/luftgue.html
- air quality information from all parts of Austria: www.umweltbundesamt.at/umweltschutz/luft Further information also available on ORF television teletext, page 782, on the cable information channels, as well as in the cable network.

Vienna Urban air initiative

On the one hand, a largely good situation could be achieved as regards to air pollutants or carbon monoxide due to the committed environmental strategy of recent years. On the other hand, there has been an increase as regards to the exceedances of the limits for the pollutants nitrogen dioxide and particulate matter over recent years. These exceedances result from both the local emissions in the metropolitan area of Vienna and from the regional and supra-regional large distance transports. In this, the main sources basically are the sectors road traffic, generation of room heat, and the industrial and commercial sector. In case of some pollutants, such as PM10, the supra-regional shares due to large distance transports constitute the majority of the background exposure.

Already years ago, the Municipal Department of Environmental Protection initiated the establishment of an air quality measurement system. Causes and effects of air pollutants are to be inspected and measures to improve the air situation are to be taken. The Urbane Luft Initiative Wien (Vienna Urban Air Initiative - ULI) is a corresponding programme on administrative level that has been enacted in 2005 by the city councilors Ulli Sima and Rudolf Schicker under project-management of the Municipal Department of Environmental Protection. The responsible persons expect the implementation of the ULI Vienna to make a significant contribution to the reduction of the toxic emissions and thus to the compliance with the “air quality limits”. In total, the long-term aim is to achieve an improvement regarding the air quality situation in Vienna and in the surrounding area.

ULI Vienna combines the expert opinions of specialists from the most different fields. These people jointly develop measures and present the same for decision-making to the responsible political committee. Furthermore, ULI Vienna is an information centre ensuring the exchange of information between administrative authorities, lobbies, and science. Important results of ULI Vienna are catalogues of measures in accordance with the Pollution Protection Act - Air and the air strategy of Vienna.

Modern flue gas purification plant in the crematorium Simmering

Installation of a flue gas purification plant in the crematorium Simmering, Austria

The MA 43 - Department for Urban Cemeteries (since January 2008, “Cemeteries of Vienna”) is the operator of a more than 20 years old crematorium in Vienna Simmering. The existing system is located in a historically valuable building and is under preservation order. The cremation system consists of a total of four electronic furnaces.

A crematorium is a form of sepulture in the meaning of the Sepulture Act of Vienna and may not be used to burn waste in the classic sense. The official approval for the modification of the
The heat exchangers required for the flue gas purification plant are located outdoors and supplied by means of media lines routed through the soil.

The waste heat obtained from the crematorium is supplied into the existing heating system of the fire hall with the help of an hydraulic guide. The connection is implemented directly to the heating manifold in the control room of the fire hall.

By establishing the new flue gas purification plant - with planned project completion and commissioning as of September 2008 - Cemeteries of Vienna contributes to the city of Vienna living up to its reputation of being a role model city as regards to environmental aspects.

For example the Central Cemetery in Vienna is not only a place where the dead find rest. The park with impressive biota is a place to relax and reflect. Its overall area is 2.5 million square metres and thus it is the second largest cemetery in Europe. Numerous protected animal species call this park their habitat.

Important results and further plans

As important partial results 2 comprehensive packages of measures to reduce the local particulate matter and nitrogen dioxide emissions already have been enacted and implemented. These activities have been accompanied by comprehensive informational efforts to form an awareness.

On the basis of the exceedances at measurement stations near road traffic sites, the next step is to develop a measure programme for nitrogen dioxide (NO₂) until June 2008. This is to reduce the likelihood of exceeding the short-term limit for NO₂ significantly.

Building on the aforementioned an air strategy is to be developed for Vienna, with broad participation and high acceptance. The aim of this middle- and long-term planning is to avoid, as far as possible, the adverse effects of air contamination on human health and on ecosystems, and to enforce the position of the region of Vienna as an important economic location. In total, this is to find a balance between regulations and pulses, between limiting and supporting measures, as well as between the dynamics of action and the maintenance of qualities.