A-2: Ambient air quality in urban areas

1) General description

1.1) Brief definition

- The number or percentage of days during a year when air pollution levels (for air pollutants such as at least: particulate matter 10 (PM_{10}), sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and ground-level ozone (O_3)) exceed the established limit values (maximum allowable annual and daily concentrations (MACs)) in urban areas with regular observations of air quality;
- Percentage of urban population (i.e. the total number of people living in urban areas with at least one monitoring station) in a country exposed to air pollution above the established limit values;
- Absolute values of concentration of pollutants in the air.

1.2) Units of measurement

- Days or percentage of days during a year with exceeded daily daily average limit values/allowable concentration;
- Percentage of urban population living in areas with exceeded limit values;
- Concentration of pollutants (µg or ng, as appropriate for a particular pollutant) in cubic metre (m^3) of air.

1.3) Context

Relation to other indicators from the Guidelines: This indicator relates to indicator „A-1: Emissions of pollutants into the atmospheric air".

2) Relevance for environmental policy

2.1) Purpose

The indicator provides a measure of the state of the environment in terms of air quality and the impact of air pollution on the population, the state of the environment and on vegetation/ecosystems.

2.2) Issue

Increased concentrations of pollutants in the low layer of the atmosphere can have various adverse impacts on human health, vegetation/ecosystems and materials. Exposure to PM, measured as concentrations of PM_{10} or $PM_{2.5}$ (particles with mean diameter of 10 and 2.5 μm, respectively) in ambient air, represents, together with heavy metals and persistent organic pollutants (POPs), one of the largest human health risks from air pollution. Short-term inhalation of high concentrations of suspended particulates PM_{10} and $PM_{2.5}$ may cause increased symptoms for asthmatics, respiratory symptoms, reduced lung capacity and increased risk of serious diseases. Moreover, there is considerable evidence of negative impact on human health from carbon monoxide (CO), SO_2, nitrogen oxides (NO_X) and O_3 in ambient air. SO_2, NO_X and ammonia (NH_3) cause acidification and/or eutrophication and O_3 has negative impact on vegetation.

2.3) International agreements and targets

a) Regional level:

The ECE Convention on Long-range Transboundary Air Pollution (CLRTAP) and its eight protocols commit the Parties to reducing and preventing air pollution by SO_2, NO_X, NH_3, non-methane volatile organic compounds (NMVOC), O_3, PM, lead, mercury, cadmium and POPs. WHO Europe recommends in its guidelines guiding[1] air quality limit values for 32 main air pollutants; in the 2006 revision those for SO_2, nitrogen dioxide (NO_2) , PM and O_3.

b) Subregional level:

The Environmental Strategy of countries of South-Eastern and Eastern Europe, Caucasus and Central Asia foresees, in particular, the optimization of standards for ambient air pollution in urban areas with respect to environmental impacts and to combined health impacts (based on WHO criteria). In the European Union, Directive 2008/50/EC of the European Parliament and of the Council on ambient air quality and cleaner air for Europe (Air Quality Framework Directive) has been adopted which regulates ambient air concentrations of PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO, benzene, lead and O_3 and sets detailed rules for air quality assessment. Concentrations of arsenic, cadmium, nickel and polycyclic aromatic hydrocarbons (represented by benzo(a)pyrene) in ambient air are regulated by the Directive 2004/107/EC. Several types of standards are laid down by these directives:

- Limit values for the protection of human health (fixed levels to be attained within a given period of time period not to be exceeded once attained) for PM_{10}, $PM_{2.5}$, SO_2, NO_2, benzene, CO and lead,

[1] Air Quality Guidelines for Europe (revision of Air Quality Guidelines for Europe 1987). WHO Regional Office for Europe, Bilthoven Division, 2000; Air Quality Guidelines Global update 2005. Particulate matter, ozone, nitrogen dioxide and sulfur dioxide. WHO Regional Office for Europe, 2005.

- target values for the protection of human health (fixed levels to be attained where possible) for O_3, $PM_{2.5}$, arsenic, cadmium, nickel and benzo(a)pyrene,[2]
- alert thresholds (fixed levels beyond which there is a risk to human health from brief exposure) for SO_2, NO_2 and O_3,
- critical levels (fixed levels above which direct adverse effects may occur on some receptors, such as trees, other plants or natural ecosystems but not on humans) for SO_2 and NO_X,
- long-term objective (fixed level to be attained in the long term, save where not achievable through proportionate measures with the aim of providing effective protection of human health and the environment) for O_3.
- In the case of $PM_{2.5}$, additional interim standards are set (average exposure indicator, exposure concentration obligation, national exposure reduction target).

All limit values and target values except of those for SO_2, O_3 and CO are set as annual average values. In some cases, shorter-term limit values are set as well. The basic limit values for the protection of human health, as laid down by the above-mentioned directives, are as follows:

- PM_{10} (annual average – 40 μg/m^3, 24-hour limit value – 50 μg/m^3, not to be exceeded more than 35 times a calendar year); compliance deadline 2005.
- $PM_{2.5}$ (target value and limit value for stage 1 - annual average – 25 μg/m^3); compliance deadline 2015.
- $PM_{2.5}$ (limit value for stage 2 - annual average – 20 μg/m^3); compliance deadline 2020.
- SO_2 (hourly limit value – 350 μg/m^3, not to be exceeded more than 24 times a calendar year; 24-hour limit value – 125 μg/m^3, not to be exceeded more than 3 times a calendar year); compliance deadline 2005.
- NO_2 (annual average – 40 μg/m^3, hourly limit value – 200 g/m^3, not to be exceeded more than 18 times a calendar year); compliance deadline 2010.
- Lead (annual average – 0.5 μg/m^3); compliance deadline 2005.
- Benzene (annual average – 5 μg/m^3); compliance deadline 2010.
- CO (maximum daily 8-hour mean – 10 mg/m^3); compliance deadline 2005.
- O_3 (target value – maximum 8-hour mean – 120 μg/m^3, not to be exceeded more than 25 days a calendar year over 3 years); compliance deadline 2012.
- Arsenic (target value – annual average – 6 ng/m^3); compliance deadline 2012.
- Nickel (target value – annual average – 20 ng/m^3); compliance deadline 2012.
- Cadmium (target value – annual average – 5 ng/m^3); compliance deadline 2012.
- Benzo(a)pyrene (target value – 1 ng/m^3);); compliance deadline 2012.

[2] Benzo(a)pyrene is understood as a representative of polycyclic aromatic hydrocarbons.

3) Methodology and guidelines

3.1) Data collection and calculations

The data should be collected from an air quality-monitoring network which consists of fixed manual or automated monitoring stations which may be complemented by mobile stations. The selection strategy for site locations should focus on areas with the highest concentration of emission sources (industrial zones and highways) for direct warnings or on background monitoring stations in residential areas to get an overview of the general exposure of the country's urban population. The data from the monitoring should be calibrated in the National calibration laboratories and validated according to quality assurance/quality control (QA/QC) procedures introduced.

3.2) Internationally agreed methodologies and standards

WHO Air Quality Guidelines for Europe covering 32 pollutants, ISO standards 13.040, Air quality or ECE 2012 Guidelines for Developing National Strategies to Use Air and Water Quality Monitoring as Environmental Policy Tools may be applied for monitoring purposes. Directive 2008/50/EC of the European Parliament and of the Council on ambient air quality and cleaner air for Europe sets detailed rules of air quality assessment including data quality objectives, assessment requirements (measurement or modelling), minimum number and siting of sampling points and reference methods. Detailed rules of reporting are set by the Commission Implementing Decision 2011/850/EU of 12 December 2011 laying down rules for Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council as regards the reciprocal exchange of information and reporting on ambient air quality. Many references are available on the most appropriate and up-to-date air quality monitoring and analysis methods and on proven models estimating ambient air concentrations of air pollutants on the basis of data on emissions.

4) Data sources and reporting:

Data on ambient air pollution concentrations are routinely collected in national monitoring networks. General data on air quality in urban areas are published in annual environmental reports, while actual data are being published at the municipal levels. The WHO Healthy Cities Network and the Air Quality and Health programme of the WHO Regional Office for Europe collect air quality data from participating national agencies. Eurostat, EEA and OECD collect air quality data from their Member States.

5) References at the international level:

- Air Quality Guidelines for Europe (revision of Air Quality Guidelines for Europe 1987). WHO Regional Office for Europe, Bilthoven Division, 2000: http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/pre2009/air-quality-guidelines-for-europe;
- Air Quality Guidelines Global update 2005. Particulate matter, ozone, nitrogen dioxide and sulfur dioxide. WHO Regional Office for Europe, 2005: http://www.euro.who.int/en/what-we-do/health-topics/environment-and-health/air-quality/publications/pre2009/air-quality-guidelines.-global-update-2005.-particulate-matter,-ozone,-nitrogen-dioxide-and-sulfur-dioxide;
- Guidelines for Developing National Strategies to Use Air and Water Quality Monitoring as Environmental Policy Tools. ECE 2012. English and Russian edition: http://www.unece.org/index.php?id=30339;
- Human Exposure Assessment, Environmental Health Criteria Document 214, Program of Chemical Safety. WHO, 2000;
- Monitoring Ambient Air Quality for Health Impact Assessment. WHO Regional Publications, European Series, No. 85.2. WHO, 1999;
- Environmental Health Indicators: Framework and Methodologies. Prepared by D. Briggs, Occupational and Environmental Health. WHO, 1999;
- Directive 2008/50/EC of the European Parliament and of the Council on ambient air quality and cleaner air for Europe;
- Directive 2004/107/EC of the European Parliament and of the Council of 15 December 2004 relating to arsenic, cadmium, mercury and polycyclic aromatic hydrocarbons in ambient air;
- Commission Implementing Decision 2011/850/EU of 12 December 2011 laying down rules for Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council as regards the reciprocal exchange of information and reporting on ambient air quality;
- Commission Decision 2004/461/EC of 29 April 2004 establishing a questionnaire to be used for annual reporting on ambient air quality assessment under Council Directives 96/62/EC and 1999/30/EC and under Directives 2000/69/EC and 2002/3/EC of the European Parliament and of the Council;
- Air Quality in Europe – 2012 Report, EEA report No 4/2012;
- CLRTAP (Convention on Long-range Transboundary Air Pollution) and its protocols: http://www.unece.org/env/lrtap/welcome.html;
- WHO Europe: http://www.euro.who.int/en/what-we-do/health-topics/environment-and-health/air-quality;
- UNSD: http://unstats.un.org/unsd/environment/;
- EEA: http://themes.eea.europa.eu/IMS/CSI;
- Eurostat: http://epp.eurostat.ec.europa.eu/portal/page/portal/environment/introduction;
- European Commission. See http://ec.europa.eu/environment/air/index_en.htm;
- EIONET: http://acm.eionet.europa.eu.