Indicators Related to Air and Climate in the MDG, CSD, NEPAD and ECA list

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MDG Indicators

- Goal 7 Target 7.A: Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources

7.2. CO_2 emissions, total, per capita and per $1 GDP (PPP)

7.3. Consumption of ozone depleting substances

CSD Indicators of Sustainable Development

- Theme: Atmosphere

  Sub-theme: Climate change

  Indicator: CARBON DIOXIDE EMISSIONS

  Emission of greenhouse gases

  Sub-theme: Ozone layer depletion

  Indicator: CONSUMPTION OF OZONE LAYER DEPLETING SUBSTANCES

  Sub-theme: Air quality

  Indicator: Ambient concentration of air pollutants in urban areas

NEPAD indicators

- Air (atmosphere)
  - Air quality
    - Annual mean concentration of SO2 in ambient air
    - Annual mean concentration of NO2 in ambient air
    - Annual mean concentration of SPM10 in ambient air

NEPAD list (cont)

- Air (atmosphere)
  - Climate variability
    - Annual variability in temperature (at least 30 years)
    - Annual variability in rainfall (at least 30 years)
    - Frequency of extreme events (No. of people affected by droughts, floods)

NEPAD list (cont)

- Air (atmosphere)
  - Climate change
    - Emissions of greenhouse gases (SO_2, NO_2, CH_4)
    - Emissions of greenhouse gases (CO_2)

Air and climate indicators in the ECA list

Air quality	Ambient concentrations of air pollutants in urban areas [CSD]
Climate change	Carbon dioxide emissions, total, per capita and per $1 GDP (PPP) [MDG]
	Emissions of greenhouse gases [CSD]
	Frequency of extreme events *
	Annual variability of rainfall (at least 30 years)
	Annual variability of temperature (at least 30 years)
Ozone layer depletion	Consumption of ozone-depleting substances [MDG]

Ambient concentrations of air pollutants in urban areas

- **Brief Definition:** Ambient air pollution concentrations of ozone, particulate matter (PM10, and PM2,5, if those are not available: SPM, black smoke), sulphur dioxide, nitrogen dioxide, lead. Additional: carbon monoxide, , volatile organic compounds including benzene (VOCs). The priority is collection of the indicator in large cities (over 1 million population).

- **Unit of Measurement:**

  µg/m3, ppm or ppb, as appropriate

- **POLICY RELEVANCE**

- The indicator provides a measure of the state of the environment in terms of air quality and is an indirect measure of population exposure to air pollution of health concern in urban areas.
- An increasing percentage of the world's population lives in urban areas. High population density and the concentration of industry exert great pressures on local environments. Air pollution, from households, industry power stations and transportation (motor vehicles), is often a major problem. As a result, the greatest potential for human exposure to ambient air pollution and subsequent health problems occurs in urban areas. Improving air quality is a significant aspect of promoting sustainable human settlements.
- The indicator may be used to monitor trends in air pollution as a basis for prioritising policy actions; to map levels of air pollution in order to identify hotspots or areas in need of special attention; to help assess the number of people exposed to excess levels of air pollution; to monitor levels of compliance with air quality standards; to assess the effects of air quality policies; and to help investigate associations between air pollution and health effects.

- **International Conventions and Agreements:** None.

- **International Targets/Recommended Standards:** World Health Organization (WHO) air quality guidelines exist for all the pollutants of this indicator. Many countries have established their own air quality standards for many of these pollutants.

- **Linkages to Other Indicators:** This indicator is closely linked to others which relate to causes, effects, and societal responses. These include, for example, the indicators on population growth rate, rate of growth of urban population, percent of population in urban areas, annual energy consumption per capita, emissions of sulphur oxides and nitrogen oxides, life expectancy at birth, total national health care as a percent of Gross National Product, share of consumption of renewable energy resources, environmental protection expenditures as a percent of Gross Domestic Product, expenditure on air pollution abatement, childhood morbidity due to acute respiratory illness, childhood mortality due to acute respiratory illness, capability for air quality management, and availability of lead-free gasoline.

- **Underlying Definitions and Concepts:**

- The indicator may be designed and constructed in a number of ways. Where monitored data are available, it is usefully expressed in terms of mean annual or percentile concentrations of air pollutants with known health effects – e.g., ozone, carbon monoxide, particulate matter (PM10, PM2,5, SPM), black smoke, sulphur dioxide, nitrogen dioxide, volatile organic compounds including benzene (VOCs) and lead – in the outdoor air in urban areas.

- Where monitoring data are unavailable, estimates of pollution levels may be made using air pollution models. Dispersion models, however, depend on the availability of emission data; where these are not available, surveys may be conducted using rapid source inventory techniques. Because of the potential errors in the models or in the input data, results from dispersion models should ideally be validated against monitored data.

- **Data Needed to Compile the Indicator:**
  Data must be time and spatially representative concentrations such as, for example, mean annual concentrations (mean concentrations of the pollutant of concern, averaged over all hours, or days, of the year) or percentile concentration (concentration of the pollutant of concern exceeded in 100-X% of hours/days, where X is the percentile as defined by the relevant standards). In addition, information must be available on site location and type (e.g., industrial, transport oriented or residential area).

- **National and International Data Availability and Sources:**

  Data on ambient air pollution concentrations is often routinely collected by national or local monitoring networks. Data is often also collected for research purposes by universities and research institutes. In addition, industry collects many data.

UNSD/UNEP Q 2004 AMBIENT AIR QUALITY

- The tables ask for air quality trends in terms of annual mean concentrations of Sulfur Dioxide (SO2), Nitrogen Dioxide (NO2), and Suspended Particulate Matter smaller than 10 µm in diameter (SPM10) in ambient air. Each of the three tables asks for air quality trends measured in large cities and industrial settlements as well as at background stations. The table further asks for station location and type where multiple stations can be reported within a settlement. The suggested criteria for selection of the **settlement** are as follows:

- Large City: The largest city (by population) in the country OR a city in which a notable portion (5-10 percent) of the national population is concentrated.
- Industrial City: A city where a significant number of inhabitants have been exposed to high levels of industrial pollution.
- Background Area: An area remote from both industrial activities and high populations densities.

Suggested criteria for the selection of **stations** are as follows:

- City/urban centre: An urban location representative of general population exposure in towns or city
  centers, e.g. pedestrian precincts and shopping areas.
- Urban background: An urban location distanced from sources and therefore broadly representative of city-wide background conditions.
- Industrial: An area where industrial sources make an important contribution to long-term or peak concentrations.
- Rural: An open countryside location distanced as far as possible from roads, populated and industrial areas.
- Suburban/residential: A location type situated in a residential area on the outskirts of a town or city.
- Curbside/near road: A site sampling within 1-5 meters of a busy road.

(Source: World Health Organization (WHO) see:
http://www.who.int/environmental_information/Air/Guidelines/Chapter5.htm)

- Please select stations with long time series data as much as possible.
- The recommended annual data completeness criteria would be for the site to collect at least 50% of its scheduled number of annual observations. For example, if the measurement device is a 24-hour bubbler with a scheduled sampling once every six days or 60 observations per year, then the minimum number of samples for the annual data completeness criteria would be to collect at least 30 observations. Data should then be compiled in order to calculate an annual mean.
- Since sampling frequency could vary each year, please indicate the number of samples taken on an annual basis in the footnote space provided.
- Please specify the analytical method of air quality monitoring used in the column entitled "Analytical Method" and provide information on the frequency of sampling and the number of observations in the Supplementary Information Sheet. For Table 11 (Suspended Particulate Matter), if Total Particulate Matter (TPM), including particle sizes between 1-50 μm, is monitored instead of SPM10, please provide the corresponding data and indicate it in the footnotes.

Carbon dioxide emissions, total, per capita and per $1 GDP (PPP) [MDG]

- **Brief Definition: Anthropogenic emissions, less removal by sinks, of carbon dioxide (CO2). In addition to total emissions, sectoral CO2 emissions can be considered. The typical sectors for which CO2 emissions/removals are estimated are energy, industrial processes, agriculture, waste, and the sector of land use, land-use change and forestry (LULUCF).**

- This indicator measures the emissions of carbon dioxide which is known to be the most important, in terms of impact on global warming, anthropogenic greenhouse gas (GHG).

- **International Conventions and Agreements:** The United Nations Framework Convention on Climate Change entered into force in March 1994. The Kyoto Protocol to the Convention was adopted in December 1997 and entered into force on 16 February 2005.

- **International Targets/Recommended Standards:**

  The Climate Change Convention includes a commitment by developed country Parties (Annex I Parties), including economies in transition, to aim to return emissions of CO2 and other GHGs not controlled by the Montreal Protocol to their 1990 levels by 2000.

  The Kyoto Protocol sets individual emission reduction targets for Annex I Parties, which should lead to an overall reduction in GHG emissions from developed countries by at least 5 per cent below the 1990 level in the first commitment period 2008 to 2012. Carbon dioxide amounts to about 80 per cent of total GHG emissions and therefore changes in CO2 emissions determine, to a sizable extent, the trend for total GHG emissions.

- Methodology:

  The IPCC has published two sets of guidelines on methodologies for the estimation of GHG inventories and further elaborated this with guidance on good practice in 2000 and another guidance for land use, land-use change and forestry in 2003. The new (2006) guidelines are waiting for adoption.

- **National and International Data Availability and Sources:** National communications from Parties to the Climate Change Convention, including both developed and developing countries, are available. In addition, developed countries submit their detailed GHG inventories, including CO2 data, to the UNFCCC secretariat annually. At the international level, the UNFCCC Secretariat supports a database with GHG data based on annual data inventory submissions from developed countries and the national communications from developing countries.

- **Alternative Definitions:**
- CO2 emissions can alternatively be measured on a gross instead of net basis in which case no account is taken of removal by sinks.

Emissions of Greenhouse Gases (GHG)

- **Brief Definition:**

  Anthropogenic emissions, less removal by sinks, of the greenhouse gases carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF6).

- **Unit of Measurement:**

  Annual GHG emissions in gigagrams (Gg). Emissions of CH4, N2O, HFCs, PFCs and SF6 can be converted to CO2 equivalents using the so-called global warming potentials (GWPs) provided in assessments of the Intergovernmental Panel on Climate Change.

- **Purpose:** This indicator measures the emissions of the six main GHGs which have a direct impact on climate change, less the removal of the main GHG CO2 through sequestration as a result of land-use change and forestry activities.

- **Alternative Definitions/Indicators:** GHG emissions can alternatively be measured on a gross instead of net basis in which case no account is taken of removal by sinks. There are a number of other gases that indirectly produce GHGs and these could also be included in the scope of the definition.

Frequency of extreme events *

- Adopted under Natural Disasters. Methodology to be developed.

ANNUAL VARIABILITY OF RAINFALL (AT LEAST 30 YEARS)

- **Brief Definition:**

  Precipitation (total volume of water precipitated to a certain surface area for a given period of time) means water, in either liquid or solid state, falling out of the clouds or depositing from the air on the land surface, on various materials or plants. Atmospheric precipitation may take the form of rain, drizzle, snow, sleet, snow pellets or small hail, hail or sleet.

- **Unit of Measurement:**

  The indicator is measured by the layer thickness of the precipitated water in millimetres (mm) as a percentage of perennial standards.

- **Purpose:**

  The indicator provides a measure of the state of the climate system as well as the impact on the quantity of surface waters and groundwaters, soil and biota. Analysis of the perennial sets of the main climate formation characteristics, such as atmospheric precipitation, air temperature and air humidity, makes it possible to evaluate the precipitation structure change in a certain area and to assess the dynamics of future changes in precipitation volumes and related climate changes.

- The WMO Convention facilitates worldwide cooperation in establishing and operating networks of meteorological stations, including observations of atmospheric precipitation and hydrological, meteorological and other geophysical observations. The member countries of the Global Climate Observing System (GCOS) and the GCOS Upper-air Network are obliged to ensure the operation of observation stations included in regional backbone monitoring networks. The Parties to the UNFCCC have to carry out systematic observations of changes in atmospheric precipitation volumes and ensure the creation of databases.

- **Measurement Methods:**

  Collection of data on the quantity of atmospheric precipitation is carried out by the network of meteorological stations. National hydrometeorological services process the data, assessing their quality and consistency and calculating monthly and annual mean values. Special adjustments are made for “wetting” and for “wind losses”. Daily, monthly and annual precipitation quantities are determined. The relationship of the precipitation quantity for a certain period to the perennial standards is calculated as a percentage.

- **National and International Data Availability and Sources:**

  Systematic observation of the quantity of atmospheric precipitation is carried out by the institutions responsible for meteorology or hydrometeorology.

ANNUAL VARIABILITY OF TEMPERATURE (AT LEAST 30 YEARS)

- **Brief Definition:**

  The indicator shows the annual average temperature of the air, its development in a given period of time, and deviations from a long-term average in the country.

- **Unit of Measurement:**

  Degrees Celsius (°C).

- **Purpose:**

  Air temperature is directly linked to the state of the Earth's climate system. The indicator shows trends in the variation of annual average temperature and provides a measure of changes related both to cyclic natural changes in the climate and to anthropogenic impact on global warming.

- The World Meteorological Organization (WMO) Convention facilitates worldwide cooperation in establishing and operating networks of meteorological stations, including measurements of air temperature and hydrological, meteorological and geophysical observations. Countries which are Parties to the UNFCCC have to carry out systematic observations of the climate change parameters, create databases and conduct research related to the climate system.

- Air temperature is observed over long periods of time. The network of hydro-meteorological stations collects data. Temperature is measured eight times a day at the same time at all network stations with the accuracy of 0.2°C. Data treatment is carried out by national hydro-meteorological services, which assess the quality and consistency of the 15 data and calculate various parameters (10-day and weekly mean values, monthly and annual averages, dispersion, etc.). The relationship of the temperature during a given period to the longterm standards is determined in terms of deviation from the standard and is calculated as the difference between the observed value and the basic mean value (1961–1990).

Consumption of ozone depleting substances

- **Brief Definition:**

  This indicator shows the consumption trends for ODSs controlled under the Montreal Protocol on Substance that Deplete the Ozone Layer, thereby allowing inference of the amounts of Ozone Depleting Substances being eliminated as a result of the protocol.

- **Purpose:**

  This indicator depicts the progress towards the phase out the ODSs by the countries which have ratified the Montreal Protocol on Substances that Deplete the Ozone Layer and its Amendments of London (1990), Copenhagen (1992), Montreal (1997) and Beijing (1999).

- The phase-out of ODSs, and their substitution by less harmful substances or new processes, will lead to the recovery of the ozone layer. Stratospheric ozone absorbs most of the biologically damaging ultraviolet radiation (UV-B). Without the filtering action of the ozone layer, more UV-B radiation can penetrate the atmosphere to have adverse effects on human health, animals, plants, micro-organisms, marine life, materials, biogeochemical cycles, and air quality.

- **International Conventions and Agreements:**

  The Vienna Convention for the Protection of the Ozone Layer and its Montreal Protocol on Substances that Deplete the Ozone Layer and the London, Copenhagen, Montreal and Beijing Amendments to the Protocol.

Underlying Definitions and Concepts:

- **Ozone Depleting Substance** (ODS) means any organic substance containing chlorine or bromine, which destroys the stratospheric ozone layer.
- **Controlled substance** means a substance in Annex A, Annex B, Annex C or Annex E of the Montreal Protocol, whether existing alone or in a mixture. It includes the isomers of any such substance, except as specified in the relevant Annex, but excludes any controlled substance or mixture which is in a manufactured product other than a container used for the transportation or storage of that substance.
- **Production** means the amount of listed, controlled substances produced, minus the amount destroyed by technologies to be approved by the Parties to the Montreal Protocol and minus the amount entirely used as feedstock in the manufacture of other chemicals. The amount recycled and reused is not to be considered as "production". **Consumption** is the sum of production plus imports minus exports of controlled substances. We are addressing apparent consumption.
- **Weighted tonnes of ODSs** means the amount of ODSs in tonnes multiplied by their ozone depleting potential.
- **Ozone depleting potential** (ODP) is a relative index of the ability of a substance to cause ozone depletion. The reference level of 1 is assigned as an index to CFC-11 and CFC-12. If a product has an ODP of 0.5, a given weight of the product in the atmosphere would, in time, deplete half the ozone that the same weight of CFC-11 or CFC-12 would deplete. ODPs are calculated from mathematical models which take into account factors such as the stability of the product, the rate of diffusion, the quantity of depleting atoms per molecule, and the effect of ultraviolet light and other radiation on the molecules.

- **Measurement Methods:**

  Weighted Tonnes of ODSs for production are the sum of national annual production (in tonnes) of each controlled substance (as reported to the Ozone Secretariat in accordance with Article 7 of the Montreal Protocol) multiplied by the ozone depleting potential of that substance (as listed in Annexes A, B, C and E of the Montreal Protocol, whose text can be found in the Handbook for the International Treaties for the Protection of the Ozone Layer, 2003 [NB: A new edition is coming out in 2006]). It can be found at: http://ozone.unep.org/,http://www.unep.ch/ozone or http://www.unep.org/ozone. Weighted Tonnes of Ozone Depleting Substances for consumption are obtained through a similar calculation using national annual consumption values (in tonnes).