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**ENVIRONMENTAL MONITORING:**

**GUIDELINES FOR THE APPLICATION OF ENVIRONMENTAL INDICATORS IN  
EASTERN EUROPE, CAUCASUS AND CENTRAL ASIA**

**SUMMARY**

This document contains the Guidelines for the Application of Environmental Indicators in Eastern Europe, Caucasus and Central Asia prepared by the Working Group at its seventh session, held on 27–29 November 2006. The Guidelines includes indicators which are recommended as priority ones from the point of view of both national policies and international comparisons. All indicators are presented in an agreed format to support their practical application in the countries. The Committee is expected to adopt these Guidelines.

**INTRODUCTION**

Environmental indicators are a key tool for environment assessment in the countries of Eastern European, Caucasus and Central Asia (EECCA). Appropriately chosen indicators based on sufficient time-series data can show key trends, help describe causes and effects of environmental conditions and make it possible to track implementation of environmental policies in the EECCA countries and to assess its efficiency.

The EECCA countries currently use a wide variety of environmental indicators when publishing governmental state-of-the-environment reports and compendia of environmental statistics. The involvement of the EECCA countries in the preparation of *Europe's Environment: The Third Assessment Report* (the Kiev Assessment) for the fifth Ministerial Conference "Environment for Europe" (held in Kiev in May 2003) triggered their interest in the development of an agreed set of indicators. Consequently, experts from EECCA countries in the UNECE Working Group on Environmental Monitoring and Assessment, in close cooperation with the European Environment Agency (EEA), selected a core set of environmental indicators for application in EECCA.

To make the core set of the EECCA countries' environmental indicators operational, the Working Group agreed to prepare practical guidelines for their application. These guidelines

cover indicators (see the table below) that were recommended as important from the viewpoint of national and international requirements, as understandable to the public and as supported, to the extent possible, by international methodological guidance. Presence on other international indicator lists was an important additional selection criterion. It relates to:

- (a) Sustainable development indicators of the United Nations Commission on Sustainable Development;
- (b) The indicators from the United Nations Statistics Division (UNSD)/United Nations Environment Programme (UNEP) Questionnaire on Environment Statistics;
- (c) The indicators for the second environmental performance reviews (EPR) under the UNECE review programme;
- (d) The Kiev Assessment indicators and the EEA core set of indicators; and
- (e) World Health Organization (WHO)/Europe proposals for a core set of European environmental health indicators.

The following list of guideline indicators for the EECCA countries demonstrates the relevance of each indicator to other international indicator sets. Depending on their role in the assessment of particular environmental issue, the indicators are classified using the EEA DPSIR framework: Driving forces (D) – Pressures (P) – State (S) – Impact (I) – Responses (R).

The guidelines highlight the importance of the environmental issues for which particular indicators have been designed; refer to international targets; specify requirements for measurements and data collection in the development of each indicator; and provide references to internationally agreed methodologies and recommendations for the development of indicators, as well as to international databases, useful literature and Internet sites.

The guidelines are expected to help in:

- (a) Improving the systems of environmental monitoring and reporting for the purpose of environmental decision-making and public awareness raising;
- (b) Making national environment assessments comparable with those of other UN member states; and
- (c) Facilitating data gathering for future environmental assessment reports.

These guidelines are intended for use primarily by officials in government agencies in the EECCA countries who have responsibility for environmental assessment, reporting and the publication of statistical compendiums and bulletins on environmental issues. They might also be of interest to other parties in the EECCA countries, such as business and industry, academics and non-governmental organizations, as well as to other UNECE countries.

To adapt national systems of environmental monitoring, data collection and environmental reporting to the requirements of these guidelines and the Guidelines for the Preparation of Indicator-based Environment Assessment Reports, the Working Group on Environmental Monitoring and Assessment has prepared a set of recommendations for the Governments of EECCA countries. These recommendations, to be submitted for approval by the sixth Ministerial Conference “Environment for Europe” (10–12 October 2007, Belgrade), address the legal and regulatory basis, institutional arrangements, training of experts, information management, data access and publication as well as international cooperation and environmental information exchange.

Once approved, the guidelines are expected to remain a “living” instrument. Countries should review them periodically to incorporate new methodologies and standards developed by relevant international forums, to add new agreed indicators and to adapt them to practical experience

gained through application.

### Abbreviations used in the text

BOD	biochemical oxygen demand
C	Celsius
CBD	Convention on Biological Diversity
CFC	chlorofluorocarbon
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CLRTAP	Convention on Long-range Transboundary Air Pollution
COD	chemical oxygen demand
D	driving force
ECMT	European Conference of Ministers of Transport
EEA	European Environment Agency
EECCA	Eastern Europe, Caucasus and Central Asia
EMEP	Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe
EU	European Union
Eurostat	European Union Statistical Service
FAO	Food and Agricultural Organization
GCOS	Global Climate Observing System
GDP	gross domestic product
GHG	greenhouse gas(es)
GWP	global warming potential
HBFC	hydrobromofluorocarbon
HCFC	hydrochlorofluorocarbon
HELCOM	Baltic Marine Environment Protection Commission (Helsinki Commission)
HFC	hydrofluorocarbon
I	impact
IAEA	International Atomic Energy Agency
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
ISIC	International Standard Industrial Classification of All Economic Activities
ISO	International Organization for Standardization
IUCN	World Conservation Union
NFR	Nomenclature for Reporting
NMVOC	non-methane volatile organic compound
ODP	ozone-depleting potential
ODS	ozone-depleting substance
OECD	Organisation for Economic Co-operation and Development
P	pressure
PAH	polycyclic aromatic hydrocarbon
PAU	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PFC	perfluorocarbon
PH	acidity (concentration of hydrogen ions)
PM	particulate matter
POP	persistent organic pollutant
PPP	parity of purchasing power
QA/QC	quality assurance/quality control

R	response
S	state
TBFRA	Temperate and Boreal Forest Resources Assessment
TSP	total suspended particulates
UN	United Nations
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNSD	United Nations Statistics Division
UV	ultraviolet
WCMC	World Conservation Monitoring Centre
WEI	water exploitation index
WHO	World Health Organization
WMO	World Meteorological Organization
WSSD	World Summit on Sustainable Development
WWF	World Wildlife Fund

CH <sub>4</sub>	methane
CO	carbon monoxide
CO <sub>2</sub>	carbon dioxide
K <sub>2</sub> O	potassium oxide
N	nitrogen
NH <sub>3</sub>	ammonia
NH <sub>4</sub>	ammonium
NO <sub>x</sub>	nitrogen oxides
N <sub>2</sub> O	nitrous oxide
O <sub>2</sub>	oxygen
O <sub>3</sub>	ozone
P	phosphorus
P <sub>2</sub> O <sub>5</sub>	phosphorus oxide
SF <sub>6</sub>	sulphur hexafluoride
SO <sub>2</sub>	sulphur dioxide
USD	United States dollar

g	gram
ha	hectare
kg	kilogram
km	kilometre
km <sup>2</sup>	square kilometre
ktoe	1,000 tons of oil equivalent
kWh	kilowatt hour
m <sup>3</sup>	cubic metre
mg	milligram
µg	microgram
µm	micrometre
ng	nanogram (10 <sup>-9</sup> g)
p.km	passenger/kilometre
t	ton
t.km	ton-kilometre
toe	ton of oil equivalent

## I. KEY ENVIRONMENTAL INDICATORS FOR EASTERN EUROPE, CAUCASUS AND CENTRAL ASIA

INDICATORS	DPSIR	EPR indicators	UNSD/UNEP environment statistics questionnaire	WHO/Europe environmental health indicators	CSD indicators	"Kiev" indicators	EEA core set of indicators
<b>A. Air pollution and ozone depletion</b>							
1. Emissions of pollutants into the atmospheric air	P	X	X	X		X	X <sup>1/</sup>
2. Ambient air quality in urban areas	S/I	X	X <sup>2/</sup>	X <sup>3/</sup>	X		X <sup>4/</sup>
3. Consumption of ozone-depleting substances	P	X			X	X	X
<b>B. Climate change</b> <sup>5/</sup>							
4. Air temperature	S						X <sup>6/</sup>
5. Atmospheric precipitation	S/I						
6. Greenhouse gas emissions	P/R	X	X		X	X	X
<b>C. Water</b> <sup>7/</sup>							
7. Renewable freshwater resources	S	X	X				X
8. Freshwater abstraction	P	X	X <sup>8/</sup>		X <sup>9/</sup>	X	X
9. Household water use per capita	P	X					X
10. Water losses	R		X				
11. Reuse and recycling of freshwater	R		X				
12. Drinking water quality	I			X			
13. BOD and concentration of ammonium in rivers	S	X	X		X	X	X
14. Nutrients in freshwater	S	X	X			X	X
15. Nutrients in coastal seawaters	S		X				X
16. Polluted (non-treated) wastewaters	P/R	X	X				
<b>D. Biodiversity</b> <sup>10/</sup>							
17. Protected areas	R	X			X	X	X
18. Forest and other wooded land	S	X	X <sup>11/</sup>		X		
19. Threatened and protected species	S/R	X					X
20. Trends in the number and distribution of selected species	S/R				X		X <sup>12/</sup>
<b>E. Land and soil</b> <sup>13/</sup>							

<sup>1/</sup> Subdivided into three indicators: emissions of acidifying substances, emissions of ozone precursors, and emissions of primary particulates and secondary particulate precursors.

<sup>2/</sup> Annual mean concentrations of SO<sub>2</sub>, NO<sub>2</sub> and PM<sub>10</sub> in ambient air in cities and at background sites.

<sup>3/</sup> Population-weighted urban annual average concentration of NO<sub>2</sub>, PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub>. Distribution of daily O<sub>3</sub>.

<sup>4/</sup> Supplemented by the indicator of exceedance of air quality limit values in rural areas.

<sup>5/</sup> The EEA list also includes the indicator of atmospheric greenhouse gas concentrations.

<sup>6/</sup> Global and European temperature.

<sup>7/</sup> The EEA list also includes the following indicators: bathing water quality; chlorophyll in transitional coastal and marine waters. Both the EEA and WHO/Europe lists include the indicator of percentage of national population connected to wastewater treatment.

<sup>8/</sup> Also by surface and groundwater, separately.

<sup>9/</sup> As percentage of renewable freshwater resources only.

<sup>10/</sup> The EEA list also includes three indicators under Fisheries: status of marine fish stocks, aquaculture production and fishing fleet capacity.

<sup>11/</sup> Total area only.

<sup>12/</sup> The species diversity indicator focuses on selected common birds related to farmlands, woodlands and wetlands.

<sup>13/</sup> The EEA list also includes the indicator progress in management of contaminated sites.

INDICATORS	DPSIR	EPR indicators	UNSD/UNEP environment statistics questionnaire	WHO/Europe environmental health indicators	CSD indicators	"Kiev" indicators	EEA core set of indicators
21. Land uptake	I	X <sup>14/</sup>	X <sup>10/</sup>		X <sup>10/</sup>		X <sup>15/</sup>
22. Area affected by soil erosion	S	X	X		X	X	
<b>F. Agriculture</b> <sup>16/</sup>							
23. Fertilizer consumption	P	X			X	X	
24. Pesticide consumption	P	X			X	X	
<b>G. Energy</b> <sup>17/</sup>							
25. Final energy consumption	D	X			X		X
26. Total energy consumption	D	X				X	X
27. Energy intensity	R	X			X	X	X
28. Renewable energy consumption	R				X	X	X
<b>H. Transport</b> <sup>18/</sup>							
29. Passenger transport demand	D/R	X		X	X	X	X
30. Freight transport demand	D	X		X		X	X
31. Composition of road motor vehicle fleet by fuel type	D	X				X	
32. Average age of road motor vehicle fleet	D			X			
<b>I. Waste</b>							
33. Waste generation	D/P/R	X	X <sup>19/</sup>		X <sup>20/</sup>	X	X <sup>21/</sup>
34. Transboundary movements of hazardous wastes	D/R	X		X			
35. Waste reuse and recycling	R	X		X <sup>22/</sup>	X	X	X <sup>23/</sup>
36. Final waste disposal	P/R			X		X	

<sup>14/</sup> Land use.

<sup>15/</sup> By transport infrastructure and urban development only.

<sup>16/</sup> EEA lists the following indicators: gross nutrient balance, area under organic farming.

<sup>17/</sup> EEA also lists the indicator renewable electricity.

<sup>18/</sup> EEA also lists the indicator use of cleaner and alternative fuels.

<sup>19/</sup> Includes waste from agriculture and forestry and from other activities.

<sup>20/</sup> Excluding total waste generation.

<sup>21/</sup> Municipal and packaging waste only.

<sup>22/</sup> Municipal and hazardous waste by volume.

<sup>23/</sup> Recycling and reuse of packaging waste only.

## II. DESCRIPTION OF INDICATORS

### A. Air pollution and ozone depletion

#### 1. EMISSIONS OF POLLUTANTS INTO THE ATMOSPHERIC AIR

##### *General description*

**a) Brief definition:** Emissions of sulphur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), ammonia (NH<sub>3</sub>), particulate matter (PM<sub>10</sub>, PM<sub>2.5</sub> and total suspended particulates (TSP)), carbon monoxide non-methane volatile organic compounds (NMVOCs), persistent organic pollutants (POPs, including polychlorinated biphenyls (PCBs), dioxins/furans and polycyclic aromatic hydrocarbons (PAHs)) and heavy metals (cadmium, lead and mercury) in total volumes and broken down by economic activities as defined by the International Standard Industrial Classification of All Economic Activities (ISIC Rev. 3.1); comparison of the present values with targets (if any) and with emission projections (if available).

**b) Unit of measurement:** Thousands of tons per year or kilograms per year, as appropriate for a particular pollutant. For cross-country comparisons, the indicator may also be presented per km<sup>2</sup> of the country's territory, per capita or per unit of gross domestic product (GDP). GDP is to be presented both in constant prices in USD in parity of purchasing power (PPP) and in constant prices in national currency. In comparisons with targets, percentages are used. This indicator can also be presented in terms of emissions (kg) per unit of production (ton, kWh, etc.).

##### *Relevance for environmental policy*

**a) Purpose:** The indicator provides a measure of existing and expected pressure on the environment in terms of emissions of harmful substances into the atmospheric air and "distance to target" (if any).

**b) Issue:** The above-mentioned pollutants are known for their adverse effects on human health and ecosystems. Some of these pollutants are eroding technical infrastructures as well. Emissions of NO<sub>x</sub> and NMVOC are the main causes of the formation of ground-level ozone, which has adverse effects on human health and ecosystems. The indicator is important not only for assessing pressure on atmospheric air pollution in the country as a whole but also for identifying pressure from particular sectors like energy, transport, industrial processes, agriculture and waste management. On the basis of this indicator, public authorities can adjust the national environmental policy by, for instance, revising emission standards and emission limit values and licenses issued accordingly, strengthening permitting of potentially polluting activities and improving the application of economic instruments. The public in turn should be informed in an understandable way of the status of the problem and the ways of tackling it. Information on pollutant emissions is also necessary for the assessment of transboundary air pollution and for international cooperation to address this problem.

##### **c) International agreements and targets:**

Global and regional level: Under the Stockholm Convention on Persistent Organic Pollutants, both limit values and reporting requirements are set at the global level. The UNECE Convention on Long-range Transboundary Air Pollution (CLRTAP) requires implementation of measures to

prevent, control and reduce emissions of air pollutants and to exchange information on them. The Convention and its eight protocols together set targets for the reduction of specific emissions, prescribe stringent emission limit values for emission sources, propose concrete pollution reduction measures and establish requirements regarding the submission of data on emissions of the above-mentioned pollutants. The Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone sets emission reduction targets for SO<sub>2</sub>, NO<sub>x</sub>, NH<sub>3</sub> and NMVOCs to be reached by 2010. The Protocol on Pollution Release and Transfer Registers to the Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters provides for the collection and presentation of data on emissions of pollutants into the air.

Subregional level: The EECCA Environmental Strategy, approved in 2003 by the Kiev Ministerial Conference “Environment for Europe”, foresees the implementation of legislative, normative, economic, financial, technical and other measures which would lead to the reduction of emissions of pollutants into the air. In the European Union (EU), Directive 2001/81/EC on national emissions ceilings for certain atmospheric pollutants requires the introduction of national emission ceilings for emissions of SO<sub>2</sub>, NO<sub>x</sub>, NMVOC and NH<sub>3</sub> in each member State to be complied with by 2010.

### ***Methodology and guidelines***

**a) Data collection and calculations:** Two basic methods of emission inventory are generally applied: the first, detailed, one is based on direct measurements of emissions, and the second is based on technological calculations (the use of statistics on activities like data on production volumes and fuel and raw materials consumption and of the relevant emission factors). National classifications of emission sources should be harmonized with international standards (see following section). Among individual pollutants, the reporting of emissions of heavy metals and POPs should require particular attention in EECCA countries. Modelling and technological calculations based on statistical data on economic activities should be applied where data are not available.

**b) Internationally agreed methodologies and standards:** CLRTAP and its eight protocols cover the methodology of collection of data on emissions of pollutants into the air. Important internationally agreed standards are included in the Guidelines for Estimating and Reporting Emission Data under CLRTAP and in the *EMEP/CORINAIR Emission Inventory Guidebook*. Calculations of emissions originating from different economic activities must take into account the correlation between the UNECE *nomenclature for reporting* (NFR) source classification system for air emission reporting, the *selected nomenclature for sources of air pollution* (SNAP97) developed by the EEA European Topic Centre on Air Emissions (ETC/AE) and reporting source categories in the Common Reporting Format of the Intergovernmental Panel on Climate Change (IPCC) and the United Nations Framework Convention on Climate Change (UNFCCC).

**Data sources and reporting:** In the EECCA countries, national statistical agencies collect data on emissions into the air from stationary sources using standardized reporting form. Data on emissions from mobile sources are frequently calculated on the basis of fuel consumption by vehicle fleets. Aggregated data are published in annual national environmental and statistical reports. Parties to the Convention on Long-range Transboundary Air Pollution (CLRTAP) report



emissions of the main air pollutants and projections. The emission database is managed by EMEP. EECCA countries report emission data to UNSD in response to the UNSD/UNEP questionnaire on environmental statistics.

### *References at the international level*

- Guidelines for Estimating and Reporting Emission Data under the Convention on Long-range Transboundary Air Pollution. Air Pollution Studies No. 15. United Nations, New York and Geneva, 2003. (ECE/EB.AIR/80)
- EMEP/CORINAIR Emission Inventory Guidebook, 3rd edition. September 2004. (EEA Technical Report 30/2005) <http://reports.eea.eu.int/EMEPCORINAIR4/en>
- Annual European Community CLRTAP Emission Inventory 1990–2003 (EEA Technical Report 6/2005)
- Environmental Pressure Indicators for the EU. Eurostat, 2001.
- Air Emissions Inventory, Air Pollution Monitoring and Modelling in Kazakhstan. In: Environmental Monitoring and Assessment: Eastern Europe, the Caucasus and Central Asia. UNECE, 2003. (CD-ROM)
- Environmental Partnership in the UNECE Region: Environmental Strategy for Countries of Eastern Europe, Caucasus and Central Asia, 2003. (ECE/CEP/105/Rev.1)
- Directive 2001/81/EC of the European Parliament and of the Council of 23 October 2001 on National Emission Ceilings for Certain Atmospheric Pollutants
- <http://www.unece.org/env/lrtap/welcome.html>
- <http://www.emep.int>
- <http://webdab.emep.int/>
- <http://www.ipcc-nggip.iges.or.jp/public/gl/invs4.htm>
- <http://unstats.un.org/unsd/environment/>
- <http://themes.eea.europa.eu/TMS/CSI>
- <http://europa.eu.int/comm/eurostat>

## 2. AMBIENT AIR QUALITY IN URBAN AREAS

### *General description*

**a) Brief definition:** (1) The number or percentage of days during a year with an air pollution level exceeding the established limit values (maximum allowable annual and short-term concentrations (MACs)) in urban areas with regular observations of air quality; (2) percentage of urban population in a country exposed to air pollution above the established limit values; (3) absolute values of concentration of pollutants in the air.

**b) Unit of measurement:** (1) Days or percentage of days during a year with exceeded short-term/daily average limit values; (2) percentage of population living in areas with exceeded limit values; (3) concentration of pollutants ( $\mu\text{g}$ ) in cubic metre ( $\text{m}^3$ ) of air.

## ***Relevance for environmental policy***

**a) 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.

**b) Issue:** Increased concentrations of pollutants in the low layer of the atmosphere can have various adverse impacts on human health, vegetation and materials. Exposure to particulate matter, measured as concentrations of PM<sub>10</sub> or PM<sub>2.5</sub> (particulate matter which passes through a size-selective inlet with a 50% efficiency cut-off at an aerodynamic diameter of 10 µm or 2.5 µm, respectively) in ambient air, represents, together with heavy metals and POPs, one of the largest human health risks from air pollution. Short-term inhalation of high concentrations of suspended particulates PM<sub>10</sub> and PM<sub>2.5</sub> may cause increased symptoms for asthmatics, respiratory symptoms, reduced lung capacity and increased risk of serious diseases. There is considerable evidence of negative impact on human health from carbon monoxide (CO), sulphur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>) and ground-level ozone (O<sub>3</sub>) in ambient air.

### **c) International agreements and targets:**

Regional level: CLRTAP and its eight protocols commit the Parties to reducing and preventing air pollution by SO<sub>2</sub>, NH<sub>3</sub>, NMVOC, O<sub>3</sub>, particulate matter, lead, mercury, cadmium and POPs.

Subregional level: The EECCA Environmental Strategy foresees, in particular, the optimization of standards for ambient air pollution in cities with respect to environmental impacts and to combined health impacts (based on WHO criteria).

In the European Union, Council Directive 96/62/EC on Ambient Air Quality Assessment and Management (Air Quality Framework Directive) has been adopted. The first “daughter directive” (1999/30/EC) sets the limit values for SO<sub>2</sub>, NO<sub>2</sub>, NO<sub>x</sub>, PM<sub>10</sub> and lead. The second daughter directive (2000/69/EC) sets the limit values for benzene and CO. The third daughter directive (2002/3/EC) sets the target values for O<sub>3</sub>, while the fourth daughter directive (2004/107/EC) sets target values for arsenic, cadmium, nickel and benzo(a)pyrene. All limit values and target values except for those for O<sub>3</sub> and CO are set as annual average values. In some cases, shorter-term limit values are set as well. Limit values for the protection of human health for SO<sub>2</sub>, PM<sub>10</sub>, lead and CO were to be complied with by 2005, and those for NO<sub>x</sub> and benzene by 2010. Target values for O<sub>3</sub> are to be complied with by 2010 and those for arsenic, nickel, cadmium and benzo(a)pyrene by 2012. The basic limit values for the protection of human health, as laid down by the above-mentioned directives, are as follows:

- PM<sub>10</sub> (annual average – 40 µg/m<sup>3</sup>, 24-hour limit value – 50 µg/m<sup>3</sup>, not to be exceeded more than 35 times a calendar year)
- SO<sub>2</sub> (hourly limit value – 350 µg/m<sup>3</sup>, not to be exceeded more than 24 times a calendar year; 24-hour limit value – 125 µg/m<sup>3</sup>, not to be exceeded more than 3 times a calendar year)
- NO<sub>2</sub> (annual average – 40 µg/m<sup>3</sup>, hourly limit value – 200 µg/m<sup>3</sup>, not to be exceeded more than 18 times a calendar year)
- Lead (annual average – 0.5 µg/m<sup>3</sup>)
- Benzene (annual average – 5 µg/m<sup>3</sup>)
- CO (maximum daily 8-hour mean – 10 mg/m<sup>3</sup>)

- O<sub>3</sub> (target value – maximum 8-hour mean – 120 µg/m<sup>3</sup>, not to be exceeded more than 25 days a calendar year over 3 years)
- Arsenic (target value – annual average – 6 ng/m<sup>3</sup>)
- Cadmium (target value – annual average – 5 ng/m<sup>3</sup>)
- Nickel (target value – annual average – 20 ng/m<sup>3</sup>)
- Benzo(a)pyrene (target value – 1 ng/m<sup>3</sup>).

### ***Methodology and guidelines***

**a) Data collection and calculations:** An air quality-monitoring network may consist of fixed and/or mobile monitoring 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 monitoring stations in residential areas to get an overview of the general exposure of the country's urban population. National calibration laboratories should be established and quality assurance/quality control (QA/QC) procedures introduced. The urban population is the total number of people living in cities with at least one monitoring station. The indicator should be calculated for exceedance of limit values (MACs) for at least a limited number of priority pollutants such as SO<sub>2</sub>, NO<sub>2</sub>, PM<sub>10</sub> and O<sub>3</sub>.

**b) Internationally agreed methodology and standards:** WHO Air Quality Guidelines for Europe covering 35 pollutants. ISO standards 13.040, Air quality may be applied for monitoring purposes. Many references are available on the most appropriate and up-to-date air monitoring and analysis methods and on proven models estimating ambient air concentrations of air pollutants on the basis of data on emissions.

**Data sources and reporting:** Data on ambient air pollution concentrations are routinely collected in national monitoring networks. General data on air quality in cities 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.

### ***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.
- 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.
- Council Directive 96/62/EC of 27 September 1996 on ambient air quality assessment and management (Air Quality Framework Directive)
- Council Directive 1999/30/EC of 22 April 1999 relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air
- Directive 2000/69/EC of the European Parliament and of the Council of 16 November

- 2000 relating to limit values for benzene and carbon monoxide in ambient air
- Directive 2002/3/EC of the European Parliament and of the Council of 12 February 2002 relating to ozone in ambient air
- 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.
- Council Decision 97/101/EC of 27 January 1997 establishing a reciprocal exchange of information and data from networks and individual stations measuring ambient air pollution within the Member States, as amended by Commission Decision 2001/752/EC.
- 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
- <http://www.unece.org/env/lrtap/welcome.html>
- [http://www.euro.who.int/air/Activities/20020620\\_1](http://www.euro.who.int/air/Activities/20020620_1)
- <http://unstats.un.org/unsd/environment/>
- <http://themes.eea.europa.eu/IMS/CSI>
- <http://europa.eu.int/comm/environment/air/cafe/index.htm>
- <http://europa.eu.int/comm/eurostat/>
- <http://air-climate.eionet.eu.int>

### 3. CONSUMPTION OF OZONE-DEPLETING SUBSTANCES

#### *General description*

**a) Brief definition:** The indicator specifies the total amount of ozone-depleting substances (ODS) produced, sold or consumed in a country.

**b) Unit of measurement:** Tons (Mg) of ODS weighted by their ozone-depleting potential (ODP).

#### *Relevance for environmental policy*

**a) Purpose:** The indicator is a measure of the pressure on the environment of substances that deplete the ozone layer.

**b) Issue:** The ozone layer in the stratosphere is an essential component of the Earth's atmosphere. It protects humans, animals and plants from damaging short wave ultraviolet (UV) radiation. Ozone is destroyed (dissociated) by reactions with certain ODS in the presence of UV radiation. Compounds that cause significant ozone depletion include chlorofluorocarbons (CFCs), carbon tetrachloride, methyl chloroform, halons, hydrochlorofluorocarbons (HCFCs), hydrobromofluorocarbons (HBFCs) and methyl bromide. They are used as solvents, refrigerants, foam-blowing agents, degreasing agents, aerosol propellants, fire extinguishers (halons) and agricultural pesticides (methyl bromide). The extent to which an ODS affects the ozone layer (its ODP) depends on its chemical characteristics. Besides this, certain ODS are also potent greenhouse gases.

**c) International agreements and targets:** The Vienna Convention for the Protection of the Ozone Layer (1985), its Montreal Protocol on Substances That Deplete the Ozone Layer (1987) and the London, Copenhagen, Montreal and Beijing amendments to the Montreal Protocol. The Montreal Protocol sets a target to eliminate the production and use of ODS. The list of substances is set forth in the Protocol and its amendments.

### *Methodology and guidelines*

**a) Data collection and calculations:** Data collection should cover substances in annexes A–C and E of the Montreal Protocol, whether existing alone or in a mixture. It should include the isomers of any ODS, except as specified in the relevant annex, but exclude any controlled ODS or mixture which is in a manufactured product other than a container used for the transport or storage of that substance. “Sale or consumption” is the sum of production plus imports minus exports of the ODS. “Weighted tons of ODS for production” is the sum of national annual production (in tons) of each ODS multiplied by its ODP. ODP is a relative index of the ability of a substance to cause ozone depletion. Data on sales or consumption are obtained through a similar calculation using national annual sale or consumption values (in tons).

**b) Internationally agreed methodology and standards:** The UNEP Ozone Secretariat has developed data reporting forms for reporting under the Montreal Protocol and pursuant to decisions on requests for data by the Meeting of the Parties. These forms cover data reporting on imports, exports, production, amounts destroyed and imports from and/or exports to non-Parties. The UNEP Handbook on Data Reporting under the Montreal Protocol assists the Parties in providing accurate, comprehensive and timely data.

**Data sources and reporting:** Data on production, imports and exports of ODS are generally collected annually by national statistical agencies and/or national focal points responsible for reporting under the Montreal Protocol. EECCA countries have national competent bodies responsible for reporting under the Montreal Protocol and submit national ODS data to the UNEP Ozone Secretariat.

### *References at the international level*

- Vienna Convention on the Protection of the Ozone Layer
- Montreal Protocol on Substances That Deplete the Ozone Layer and its amendments
- Ozone Secretariat, UNEP, Handbook for the International Treaties for the Protection of the Ozone Layer, 2000. (ISBN: 92- 807-1867-3)
- Handbook on Data Reporting under the Montreal Protocol. UNEP and Multilateral Fund for the Implementation of the Montreal Protocol. United Nations, 1999 (ISBN 92-807-1735-9)
- Regulation (EC) No. 2037/2000 of the European Parliament and of the Council on substances that deplete the ozone layer, as amended
- <http://www.unep.org/ozone>
- <http://www.unep.ch/ozone>
- <http://www.unmfs.org>
- <http://www.uneptie.org/ozonaction>
- <http://themes.eea.europa.eu/IMS/CSI>

## **B. Climate change**

### ***4. AIR TEMPERATURE***

#### ***General description***

a) **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 as a whole and in particular regions and municipalities.

b) **Unit of measurement:** Degrees Celsius (°C).

#### ***Relevance for environmental policy***

a) **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.

b) **Issue:** Change in air temperature is evidence of one of climate change's most serious effects, which has been especially noticeable in recent decades. It is observed over a long period of time. There is mounting evidence that the increase of anthropogenic emissions of GHGs is one of the reasons for recently observed rapid increases in average annual temperature. Absolute temperature changes and the rate of change are both important determinants of the possible effects of climate change. These include melting of glaciers, rising sea levels, floods and droughts, changes in biota and many others. Trends and projections of the annual average temperature can be related to the targets. Next to the global average value, the rate and spatial distribution of temperature change are important for determining the capacity of natural ecosystems to adapt to climate change.

c) **International agreements and targets:**

Global level: 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.

Subregional level: The European Council proposed in its 6<sup>th</sup> Environmental Action Programme that the global average temperature increase should be limited to not more than 2°C above "pre-industrial" levels.

#### ***Methodology and guidelines***

a) **Data collection and calculations:** 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

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 long-term 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).

b) **Internationally agreed methodologies and standards:** The best practices and concepts for climate monitoring developed in the framework of the Global Climate Observing System (GCOS); the *Guide to Meteorological Instruments and Methods of Observation* prepared by the Main Geophysical Observatory in coordination with WMO. Climatic standards recommended by WMO are the calculated standards based on 30-year observation data (1961–1990).

**Data sources and reporting:** Temperature is measured systematically by the institutions responsible for meteorology or hydrometeorology in EECCA countries. Data on meteorological observations are published regularly via different mass media. All EECCA countries are members of WMO, and Parties to the UNFCCC prepare reports on the results of air temperature measurements and include this information regularly in their national communications.

#### ***References at the international level***

- WMO Convention (1950)
- UN Framework Convention on Climate Change (1992)
- IPCC Special Report, Climate Change Consequences for the Regions: Vulnerability Assessment. Summary for decision-makers (IPCC, 1997) (ISBN 92-9169-410-4)
- <http://www.wmo.int>
- <http://www.unfccc.int>
- <http://www.ipcc.ch>
- <http://themes.eea.europa.eu/IMS/CSI>

## **5. ATMOSPHERIC PRECIPITATION**

### ***General description***

a) **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.

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

### ***Relevance for environmental policy***

a) **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.

b) **Issue:** Atmospheric precipitation is one of the most important characteristics of climate. Atmospheric precipitation mainly generates renewable freshwater resources (amounts of surface waters and groundwaters) and thus influences the state of all components of the environment (soil, forests, fauna and flora). In addition, the quantity of atmospheric precipitation influences the state of ambient air by regulating its humidity, and it limits the dispersion of suspended particulate matter in lower layers of the atmosphere. The volume, quality and distribution of atmospheric precipitation as well as its seasonal and annual distribution are very significant for agriculture and forestry.

c) **International agreements and targets:** 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.

### ***Methodology and guidelines***

a) **Data collection and calculation:** Collection of data on the quantity of atmospheric precipitation is carried out by the network of meteorological stations. National hydro-meteorological 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.

b) **Internationally agreed methodology and standards:** The best practices and concepts for climate monitoring developed by GCOS. *Guide to Meteorological Instruments and Methods of Observation* prepared by the Main Geophysical Observatory in coordination with WMO.

***Data sources and reporting:*** Systematic observation of the quantity of atmospheric precipitation is carried out by the institutions responsible for meteorology or hydrometeorology in EECCA countries. Data on meteorological observations are published regularly via different mass media. All EECCA countries are members of WMO, and Parties to the UNFCCC prepare reports on the results of atmospheric precipitation observations and include this information regularly in their national communications.

### ***References at the international level***

- WMO Convention (1950)
- United Nations Framework Convention on Climate Change (1992)
- Scientific reference books on climate



- *World Weather Records* volumes on the regions for various decades
- IPCC Special Report, *Climate Change Consequences for the Regions: Vulnerability Assessment*. Summary for decision-makers. IPCC, 1997. ISBN 92-9169-410-4
- <http://www.wmo.ch/>
- <http://www.unfccc.int/>
- <http://www.ipcc.ch/>
- <http://gewex.org/gpcp.html>

## 6. GREENHOUSE GAS EMISSIONS

### *General description*

**a) Brief definition:** (1) Emissions – in total, by sector, per capita and per unit of GDP (in constant prices in USD, in USD in PPP, and in constant prices in the national currency) – of the greenhouse gases (GHG) included in Annex A to the Kyoto Protocol to the UNFCCC: carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF<sub>6</sub>); (2) current trends in anthropogenic GHG emissions in relation to the country targets (the “distance to target” measurement unit helps in comparing EECCA countries with countries covered by the networks of EEA); (3) projected trends in anthropogenic GHG emissions in a country.

**b) Unit of measurement:** Million tons of CO<sub>2</sub> equivalent in total and by economic sector. For cross-country comparisons, the indicator may be presented in thousand tons per square km of the country’s territory and in tons per capita and tons per GDP unit (expressed in constant prices in USD, USD in PPP, or the national currency).

### *Relevance for environmental policy*

**a) Purpose:** The indicator provides a measure of the existing and future pressure on the environment in terms of emissions of GHG into the atmosphere. It shows the extent to which countries have achieved their specified goals and the response to country policies for achieving the emissions target.

**b) Issue:** The main concern relates to the effects of increasing GHG concentrations on global temperature and the earth’s climate, and to the potential consequences for ecosystems, human settlements, agriculture and other socio-economic activities. Emissions of CO<sub>2</sub> and other GHG are still increasing in many countries, despite some progress in decoupling CO<sub>2</sub> emissions from economic growth. The main challenges are to limit emissions of CO<sub>2</sub> and other GHG and to stabilize the concentration of GHG in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. This implies achieving GHG emissions targets set by international agreements or national strategies and strengthening efforts to implement related national and international strategies and to further decouple GHG emissions from economic growth. Future GHG emissions will largely depend on development trends in the economy, on technologies and on social transformations. A country development scenario with a special focus on the priority sectors of the economy that are the major sources of emissions is a specific way to analyse consequences based on various assumptions about future trends and GHG reduction strategies.

### **c) International agreements and targets:**

Global level: The UNFCCC binds the Parties to reduce their emissions, ensure collection of the relevant information, and develop strategies for adjusting to climate change and for cooperation in research and in developing new technologies. The UNFCCC requires all Parties to carry out regular emission inventories. In addition, the Annex 1 countries must regularly submit “national communications” to the Conference of the Parties. The communications should describe the work done by a particular Party to implement the Convention, including projection of GHG emissions for the next 10–20 years.

The Kyoto Protocol to the UNFCCC stipulates that Annex 1 Parties (mainly industrialized countries) shall individually or jointly reduce their aggregate emissions of a “basket” of six GHGs to 5% below 1990 levels by the period 2008–2012. So that this group target can be achieved, each Party has to accomplish its own specific task in the area of emissions reduction. The Russian Federation and Ukraine, for instance, have to stabilize their emissions levels, whereas the EU-15 countries have to reduce their levels by 8%. The World Summit on Sustainable Development (WSSD) held in Johannesburg in 2002 made commitments to an urgently needed and substantial increase in the use of renewable (non-carbon) energy sources as well as the setting up of programmes leading to more sustainable consumption and production patterns, including a reduction in energy use.

#### Subregional level:

The EECCA Environment Strategy foresees, in particular, energy efficiency measures in environmental policies as well as in programmes for mitigating climate change and for achieving the Kyoto Protocol targets.

### ***Methodology and guidelines***

**a) Data collection and calculations:** The contribution of each of the GHG to global warming depends on its ability to absorb heat and its lifetime in the air. Three GHGs – CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O – account for around 98% of the environmental pressure that leads to climate change. In order to aggregate the emissions of different GHGs and to present a single figure for the climate change issue, these are presented in CO<sub>2</sub> equivalent based on the concept of its global warming potential (GWP). GWP is the estimated potential of a greenhouse gas to contribute to global warming in the atmosphere, which is based on its effect over 100 years. For example, the GWP of methane (CH<sub>4</sub>) is 21 and that of nitrous oxide (N<sub>2</sub>O) is 310, which means that the impact of 1 kilogram of methane on global warming is 21 times higher than that of 1 kilogram of carbon dioxide, while that of 1 kilogram of N<sub>2</sub>O is 310 times higher than that of 1 kilogram of CO<sub>2</sub>. The estimate of a country’s GHG emissions can be based on statistical data of state administration bodies regarding activities which affect the GHG concentration in the atmosphere (sources and sinks of GHGs). For instance, annual data on GHG emissions from fuel combustion activities can be estimated based on the annual consumption of fossil fuels. Annual data on methane production in agriculture in relation to gastric fermentation can be evaluated based on the number of animals and the species involved. Conversion (emission) factors connect emissions with statistics on anthropogenic activities. Following is a simplified description of the estimation technique:

$$\text{GHG emissions} = (\text{data on anthropogenic activities}) \times \text{emission factors}$$

Both internationally adopted emission factors developed in the framework of the UNFCCC and national emission factors can be applied.

The GHG emissions values should be estimated for each year based on the assumption that the achievement of the projected emissions values by the year 2010 is a “linear” path – that is, the reduction or stabilization will take place evenly starting from the base year. The difference between the estimated line indicator and the actual indicator for a certain year may have both the “+” (advance) and the “-” (lagging behind) signs.

**b) Internationally agreed methodologies and standards:** Parties to the UNFCCC have adopted reporting guidelines, including a set of tables for the Common Reporting Format which is in line with the *IPCC Guidelines for National Greenhouse Gas Inventories*. Signatories to the Kyoto Protocol adopted Guidelines for national systems for estimation of anthropogenic GHG emissions by sources and removals by sinks. ISO has developed ISO 14064 standards for the quantification, reporting and verification of GHG emissions.

A large number of international models for projecting both short-term and long-term trends in the evolution of GHG emissions in various sectors of the economy are available. IPCC has published three types of scenarios: “without measures”, “with measures” and “with additional measures”. National-level emissions scenarios are developed based on state programmes for socio-economic development, with special focus on the priority sectors of the economy that are the major sources of emissions.

#### ***Data sources and reporting***

The EECCA countries which are Parties to the UNFCCC submit national GHG inventories of anthropogenic emissions by sources and removals by sinks of GHGs not controlled by the Montreal Protocol on Substances That Deplete the Ozone Layer. As a part of their UNFCCC commitments, Annex 1 Parties are required to submit a national communication on a regular basis (every four to five years); other Parties have no obligation regarding regularity. EECCA countries which are Parties to the Kyoto Protocol have established national coordination centres which collect the data for the calculation of emissions and sinks of GHGs, and take care of GHGs emission projections scenarios. EECCA countries report emissions data to the UNSD in response to the UNSD/UNEP Questionnaire on Environmental Statistics.

#### ***References at the international level***

- UN Framework Convention on Climate Change (1992)
- Kyoto Protocol to the UN Framework Convention on Climate Change (1997)
- Revised Guidelines and Principles for National Inventories on GHG (1996)
- Good practice guidance and uncertainty management in national GHG inventories (IPCC, 2000)
- Good practice guidance for land-use, land-use change and forestry (IPCC, 2003)
- IPCC Special Report, Emission Scenarios. Summary for decision-makers (IPCC, 2000) (ISBN 92-9169-313-8)
- The GHG Indicator: UNEP Guidelines for Measuring GHG Emissions for Businesses and Non-commercial Organizations (UNEP, 2000)
- Review of the implementation of commitments and of other provisions of

- National communications: greenhouse gas inventories from Parties included in Annex 1 to the convention. UNFCCC guidelines on reporting and review (FCCC/CP/2002/8, 28 March 2003)
- The GHG Indicator: UNEP Guidelines for Calculating Greenhouse Gas Emissions for Businesses and Non-Commercial Organizations (UNEP, 2000)
- UNFCCC guidelines on reporting and review (document FCCC/CP/2002/8)
- 2006 IPCC Guidelines for National Greenhouse Gas Inventories
- Revised 1996 Intergovernmental Panel on Climate Change (IPCC) guidelines (IPCC, 1997)
- Annual European Community GHG inventory 1990–2003 and inventory report 2005 (EEA Technical Report No. 4/2005)
- Council Decision 2002/358/EC of 25 April 2002 concerning the approval, on behalf of the European Community, of the Kyoto Protocol to the UNFCCC and the joint fulfilment of commitments thereunder
- Decision No. 280/2004/EC of the European Parliament and of the Council of 11 February 2004 concerning a mechanism for monitoring Community greenhouse gas emissions and implementing the Kyoto Protocol
- <http://www.unfccc.int>
- <http://www.ipcc.ch>
- <http://unstats.un.org/unsd/environment/>
- <http://www.globalreporting.org>
- <http://www.ghgprotocol.org>
- <http://cait.wri.org>
- <http://iso.org>
- <http://themes.eea.europa.eu/IMS/CSI>

## **C. Water**

### 7. ***RENEWABLE FRESHWATER RESOURCES***

#### ***General description***

**a) Brief definition:** The total volume of river run-off and groundwater generated under natural conditions, exclusively by precipitation within the country, and the actual flow of rivers and groundwater coming from neighbouring countries.

**b) Unit of measurement:** Million cubic metres/year.

#### ***Relevance for environmental policy***

**a) Purpose:** The development of this indicator over time provides a measure of the state of renewable freshwater resources in a country.

**b) Issue:** Renewable freshwater resources have major environmental and economic value. Their distribution varies widely among and within countries. Pressures on freshwater resources are exerted by overexploitation and by degradation of environmental quality. Relating resources abstraction to renewal of stocks is a central issue in sustainable freshwater resource management.

If a significant share of a country's water comes from transboundary rivers, tensions between countries can arise, especially if water availability in the upstream country is smaller than in the downstream one. Countries are quite interdependent with regard to water resources. Particularly in Central Asia, cooperation between countries sharing rivers such as the Syr Daria and the Amu Daria is crucial for the life of the population, for economic well-being and for political stability in the region. Azerbaijan's reliance on drinking water from the transboundary Kura River is another example.

**c) International agreements and targets:** The Convention on the Protection and Use of Transboundary Watercourses and International Lakes requires that the Parties introduce sustainable water management, including an ecosystem approach and the rational and fair use of transboundary waters.

### *Methodology and guidelines*

**a) Data collection and calculations:** Renewable freshwater (surface and groundwater) resources are replenished by precipitation (less evapo-transpiration) falling on a country's territory that ends up as runoff to rivers and recharge to aquifers (internal flow), and by surface waters and groundwater flowing in from other countries (inflow). Climatic, ecological, economic and other limitations on the availability of these resources for abstraction are reflected in the variable "regular freshwater resources 95 per cent of the time". Data on renewable freshwater resources are usually collected at selected hydrological stations and calculated on the basis of long-term measurements of levels, flow rates and inflows/outflows carried out on rivers and lakes as well as groundwater horizons and countrywide precipitation. The indicator is the major one used to define the water balance of a country.

**b) Internationally agreed methodologies and standards:** The WMO Guidelines on Hydrological Practice; the UNSD/UNEP Questionnaire on Environment Statistics, coordinated with relevant OECD and Eurostat questionnaires.

### *Data sources and reporting*

In many EECCA countries, information concerning renewable freshwater resources is collected by hydro-meteorological services both at the national level and at the levels of main river basins and is published in statistical yearbooks as well as in specialized collections dealing with environmental protection. The information is presented in a more comprehensive format in water cadastre materials. Statistical agencies report data to the UNSD Environment Statistics Database.

### *References at the international level*

- Convention on the Protection and Use of Transboundary Watercourses and International Lakes (1992)
- Raskin, P., Gleick, P.H., Kirshen, P., Pontius, R. G. Jr. and Strzepek, K. *Comprehensive Assessment of the Freshwater Resources of the World*. (Stockholm Environmental Institute, 1997) Document prepared for the fifth session of the UN Commission for Sustainable Development (1997)

- Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (Water Framework Directive)
- <http://www.unece.org/env/water/pdf/waterconr.pdf>
- <http://www.unece.org/env/documents/2000/wat/mp.wat.2000.1.r.pdf>
- [www.wmo.ch](http://www.wmo.ch)
- <http://unstats.un.org/unsd/environment/>
- [http://www.fao.org/ag/agl/aglw/aquastat/water\\_res/waterres\\_tab.htm](http://www.fao.org/ag/agl/aglw/aquastat/water_res/waterres_tab.htm)
- <http://www.euro.who.int/ehindicators/>
- [http://europa.eu.int/comm/environment/water/water-framework/index\\_en.html](http://europa.eu.int/comm/environment/water/water-framework/index_en.html)
- <http://europa.eu.int/comm/eurostat>
- <http://themes.eea.eu.int/IMS/CSI/>

## 8. *FRESHWATER ABSTRACTION*

### *General description*

**a) Brief definition:** The total volume of surface and ground freshwater abstracted annually: total, by economic activity (in accordance with ISIC) and as a percentage of renewable freshwater resources (the country's water exploitation index, or WEI).

**b) Unit of measurement:** Million cubic metres/year for the total volume and the volume by economic activity; percentage for the WEI.

### *Relevance for environmental policy*

**a) Purpose:** The indicator provides, in relation to total resources available for abstraction, a measure of the pressure on the environment in terms of abstraction of freshwater resources. It can reflect the extent of water resource scarcity and the distribution of abstracted water among different economic activities.

**b) Issue:** Freshwater resources are of major environmental and economic importance. Pressures on freshwater resources are exerted by overexploitation and by degradation of the environment. Since water quality is closely linked to water quantity, the relation of freshwater abstraction to renewal of stocks is a central issue in sustainable freshwater resource management. The indicator can show to what extent freshwater resources are already used and any need to adjust supply and demand management policy. Changes in the WEI help to analyse how changes in abstraction affect freshwater resources by increasing pressure on them or making them more sustainable. The WEI threshold that distinguishes non-stressed regions from stressed ones is around 20%. Severe water stress can occur where the WEI exceeds 40%.

### **c) International agreements and targets:**

Regional level: The Convention on the Protection and Use of Transboundary Watercourses and International Lakes.

Subregional level: The EECCA Environmental Strategy requires the preparation and implementation of programmes for integrated water management.

In the European Union, the Water Framework Directive (2000/60/EC) obliges the Member States to promote sustainable use based on long-term protection of available water resources and to ensure a balance between abstraction and recharge of groundwater, with the aim of achieving “good groundwater status” by 2015. Targets are also established via international treaties among riparian countries.

### **Methodology and guidelines**

**a) Data collection and calculations:** Water is abstracted by public or private bodies whose main function is to provide water for various uses (the water supply industry). It can also be directly abstracted from rivers, lakes, wells or springs by industries, farmers, households and others for their own use. The indicator incorporates data on abstraction of freshwater, broken down according to the main activity of the water abstractor as defined by ISIC. The water abstraction indicator calculations are based on the data on quantity of abstracted water reported by water users to the relevant authorities. The quantity of water abstracted is either measured or calculated on the basis of energy consumption for pumps. In some cases it is necessary to apply a calculation method using models for some water users (household and agriculture).

The WEI is the ratio of annual total water abstraction to long-term annual average renewable freshwater resources, expressed as a percentage. The WEI provides a good national-level overview of the pressures on resources in an easily understandable format, and it shows trends over time.

**b) Internationally agreed methodologies and standards:** The UNSD/UNEP Questionnaire on Environment Statistics.

### ***Data sources and reporting***

Many EECCA countries have databases that provide fairly comprehensive time series regarding freshwater abstraction based on reporting in standard form by enterprises and other relevant organizations. These data are collected in water cadastres. Data on freshwater abstraction are published in annual environmental reports and/or in statistical yearbooks. In many countries, information on freshwater abstraction is published in national state-of-the-environment reports. Statistical agencies report data to the UNSD Environment Statistics Database.

### ***References at the international level***

- Convention on the Protection and Use of Transboundary Watercourses and International Lakes, (1992)
- OECD Environmental Data Compendiums
- Europe's Environment: The Third Assessment. (EEA, 2003)
- International Standard Industrial Classification of All Economic Activities. United Nations, Series M, No. 4, Rev. 3.
- Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (Water Framework Directive)
- <http://www.un.org/esa/sustdev/natlinfo/indicators/isd.htm>

- <http://www.unece.org/env/water/pdf/waterconr.pdf>
- <http://www.unece.org/env/documents/2000/wat/mp.wat.2000.1.r.pdf>
- <http://www.fao.org>
- <http://unstats.un.org/unsd/environment/>
- <http://europa.eu.int/comm/eurostat>
- <http://themes.eea.eu.int/IMS/CSI/>
- <http://oecd.org/env/>

## 9. HOUSEHOLD WATER USE PER CAPITA

### *General description*

**a) Brief definition:** The quantity of water used to cover the household and related utility needs of the population (including enterprise employees), calculated per capita.

**b) Unit of measurement:** Cubic metres/year per capita (or litres/day per capita).

### *Relevance for environmental policy*

**a) Purpose:** The indicator provides a measure of the pressure on the environment in terms of water abstraction from different water sources.

**b) Issue:** Adequate quantities of water for meeting basic human needs are a prerequisite for life, health and development. The indicator is one of the major ones defining the level of development of water economy services and the degree of water accessibility to cover all household needs of the population. This indicator helps to identify trends in rational water use in a particular location. The indicator of household water consumption differs by location and depends on many environmental and economic factors.

**c) International agreements and targets:** The Convention on the Protection and Use of Transboundary Watercourses and International Lakes.

### *Methodology and guidelines*

**a) Data collection and calculations:** Household water use capita can be determined based on the measured volume supplied mainly through the public water supply systems. Use of water by the population not supplied by public water supply systems needs to be calculated. Households' water use per capita is calculated by dividing total water consumption in the community by the respective number of inhabitants. The indicator is based on data submitted by associations, enterprises and organizations supplying households with water and by local public administration bodies.

**b) Internationally agreed methodologies and standards:** Not available.

### *Data sources and reporting*

In EECCA countries, data collection on freshwater use are based on annual data reported to state statistical services. In many countries, data on household water use are still frequently collected by the government branch dealing with housing and municipal services. WHO has been



collecting estimates of national average figures from governments as part of its water supply and sanitation monitoring activities.

### *References at the international level*

- Convention on the Protection and Use of Transboundary Watercourses and International Lakes (1992)
- AQUASTAT – FAO global information system on water and agriculture
- Eurostat, *Environment Statistics: Pocketbook*
- <http://www.unece.org/env/water/links/link.htm>
- <http://www.unece.org/env/water/pdf/waterconr.pdf>
- <http://europa.eu.int/comm/eurostat>
- <http://www.fao.org>
- <http://unstats.un.org/unsd/environment/questionnaire2004.htm/>
- <http://themes.eea.eu.int/IMS/CSI/>
- <http://www.euro.who.int/ehindicators/>

## **10. WATER LOSSES**

### *General description*

a) **Brief definition:** The quantity and percentage of freshwater lost during transport (owing to leakage and evaporation) between a point of abstraction and a point of use.

b) **Unit of measurement:** Millions of cubic metres/year, expressed as a percentage.

### *Relevance for environmental policy*

a) **Purpose:** The indicator provides a measure of response to the efficiency of the water management system in a country.

b) **Issue:** Sustainable management of water resources has become a major concern in many countries. The efficiency of water use is of key importance in matching supply with demand. Reducing losses, using more efficient technologies and keeping water transportation systems in good condition are part of the solution. The amount of water lost during transport to users is an indicator of the efficiency of a water management system, including technical conditions affecting water supply pipelines, water pricing and public awareness in a country.

c) **International agreements and targets:** The Convention on the Protection and Use of Transboundary Watercourses and International Lakes and its Protocol on Water and Health.

### *Methodology and guidelines*

a) **Data collection and calculations:** When working with this indicator, the most important issue is to have data on the quantities of freshwater undersupplied to users during transport by water supply industries (the companies collecting, purifying and distributing water through a permanent infrastructure). The indicator is estimated and defined as the absolute and relative

difference between the amount of water abstracted by the water supply industry and the amount delivered to users (households; agriculture, forestry and fishing; manufacturing, the electricity industry and other economic activities). Total losses can be broken down into losses by evaporation and losses by leakage. Losses resulting from illegal tapping or other illegal use of water are excluded. Reports submitted by enterprises are processed first at the regional and then at the country level.

**b) Internationally agreed methodologies and standards:** The UNSD/UNEP Questionnaire on Environment Statistics.

### *Data sources and reporting*

Data are collected based on statistical reporting by countries. In many EECCA countries databases and data at the cadastre level of fairly comprehensive time series exist. EECCA countries report data in their inputs to the UNSD Environment Statistics Database.

### **References at the international level**

- Convention on the Protection and Use of Transboundary Watercourses and International Lakes (1992)
- Protocol on Water and Health to the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (1999)
- International Standard Industrial Classification of All Economic Activities. United Nations, Series M, No. 4, Rev. 3
- AQUASTAT – FAO global information system on water and agriculture
- <http://www.unece.org/env/water/links/link.htm>
- <http://www.unece.org/env/water/pdf/waterconr.pdf>
- <http://europa.eu.int/comm/eurostat>
- <http://unstats.un.org/unsd/environment/>
- <http://themes.eea.eu.int/IMS/CSI/>
- <http://www.euro.who.int/ehindicators/>

## **11. REUSE AND RECYCLING OF FRESH WATERS**

### *General description*

**a) Brief definition:** The share of reused or recycled water in the total volume of water used to cover production needs. The indicator defines the percentage of water saved by applying recycling and reused water supply systems as a national total and broken down by economic activities.

**b) Unit of measurement:** Percentage.

### *Relevance for environmental policy*

**a) Purpose:** The indicator provides a measure of the response to national measures to improve or rationalize water management systems in production sectors.

**b) Issue:** Sustainable management of water resources has become a major concern with regard to sustainable development as a whole. Efficient water use is a key concern. Reducing losses, using more efficient technologies, recycling and reuse are all part of the solution in enterprises. This indicator is very important for public authorities and for the management of enterprises so as to develop production facilities in a targeted manner that ensures efficient water consumption.

**International agreements and targets:** The Convention on the Protection and Use of Transboundary Watercourses and International Lakes and its Protocol on Water and Health.

### *Methodology and guidelines*

**a) Data collection and calculations:** The water use indicator is a ratio of the amount of recycled and reused water to the sum of the quantities of such water and water used to cover production needs. The indicator can be presented using the following formula:

$$\% \text{ rec./reused} = \frac{(Q_{\text{recycled}} + Q_{\text{reused}}) \times 100}{(Q_{\text{recycled}} + Q_{\text{reused}}) + Q_{\text{production}}}$$

where

% rec./reused is the share of recycled and reused water;

$Q_{\text{recycled}}$  is the quantity of recycled water;

$Q_{\text{reused}}$  is the quantity of reused water; and

$Q_{\text{production}}$  is the quantity of water used for production needs.

This indicator is a derivative of quantity ratios (quantity of water used for production needs, quantity of water used in recycled water supply systems, quantity of reused water) reflected in the special format of state statistical reporting.

**c) Internationally agreed methodologies and standards:** The UNSD/UNEP Questionnaire on Environment Statistics.

### *Data sources and reporting*

Data are culled from state statistical reporting by enterprises and other organizations. Many EECCA countries have databases and data at the cadastre level that provide fairly comprehensive time series. Data on this indicator related to particular subsectors of manufacturing industry are published in statistical yearbooks (at the national and subnational levels) as well as in specialized collections dealing with environment issues. EECCA countries report data in their inputs to the UNSD Environment Statistics Database.

### *References at the international level*

- <http://www.unece.org/env/water/links/link.htm>
- <http://www.unece.org/env/water/pdf/waterconr.pdf>
- <http://unstats.un.org/unsd/environment/>
- <http://themes.eea.eu.int/IMS/CSI/>
- <http://www.euro.who.int/ehindicators/>

## 12. DRINKING WATER QUALITY

### *General description*

**a) Brief definition:** Share of samples failing drinking water quality standards in the total number of drinking water samples obtained from different sources (treated water, open reservoirs, springs, wells, etc.)

**b) Unit of measurement:** Percent.

### *Relevance for environmental policy*

**a) Purpose:** The indicator provides a measure of the risk of negative impacts of poor drinking water quality on human health and shows the extent to which the drinking water supply conforms to sanitary requirements and standards.

**b) Issue:** Public health cannot advance without access to an adequate supply of clean drinking water. The quality of drinking water is still an area of concern throughout the EECCA countries, with significant microbiological contamination of supplies and the proportion of samples exceeding the faecal contamination standards ranging from 5% to 30% (WHO). The indicator is a measure of the extent to which drinking water is contaminated by chemical contaminants and microbiological organisms, and thus it can serve as a mechanism for warning of situations that require further in-depth investigation and countermeasures.

### **c) International agreements and targets:**

Regional level: The Protocol on Water and Health to the Convention on the Protection and Use of Transboundary Watercourses and International Lakes. The Parties agreed to take all appropriate measures necessary to achieve:

- Adequate supplies of wholesome drinking water;
- Adequate sanitation of a standard that sufficiently protects human health and the environment; and
- Effective protection of water resources used as sources of drinking water.

Subregional level: The EECCA Environmental Strategy stipulates the preparation of programmes to ensure access to adequate drinking water and sanitation services in line with the Millennium Development Goals and the World Summit on Sustainable Development (WSSD) Plan of Implementation.

### *Methodology and guidelines*

**a) Data collection and calculations:** The indicator is estimated from the available data on the compliance of drinking water with the parameters that are directly linked to human health. The microbiological quality of the drinking water should be expressed in terms of *E. coli* and *Enterococci* levels. Countries may report other microbiological quality criteria, particularly incidence of *Pseudomonas aeruginosa*. A “core group” of 10 chemical quality parameters can be selected. The list of chemical parameters of the EU Drinking Water Directive (98/83/EC), Annex I, Part B can serve as a reference. Turbidity could be included among

the chemical parameters. For each parameter the mathematical expression would be the proportion of drinking water samples analysed that fail to comply with the relevant standards. The data should be collected for a total number of regulatory analyses made by an official monitoring agency or undertaker within the defined spatial unit (a water supply zone or other regional entity defined for regulatory purposes in the country) over a given time period (e.g. one year) (T) and the number of non-compliant samples (E) found in the spatial unit. The “percentage compliance” indicator can be calculated using the formula:

$$\text{Indicator of percentage compliance} = ((T - E)/T) \times 100$$

The number of sampling points in the system of centralized and decentralized drinking water supply along with the frequency of sampling should provide statistical authenticity regarding the number of samples failing the standards. Some EECCA countries might not have the necessary calculation capacity to provide national weighted data. In that case the reporting could be started as a non-weighted system, listing the performance of individual suppliers.

**b) Internationally agreed methodologies and standards:** WHO Guidelines for Drinking-water Quality (3rd ed.). The EC Drinking Water Directive (98/83/EC) sets standards for the 48 most common parameters, based on WHO guidelines.

#### *Data sources and reporting*

In EECCA countries sanitary and epidemiological inspection authorities have long maintained departmental databases on drinking water quality. Some EECCA countries publish data on drinking water quality in annual environmental reports.

#### *References at the international level*

- WHO Guidelines for Drinking-water Quality, 3rd ed. (WHO, 2004)
- Consultation on target setting and progress monitoring of water and wastewater services. Copenhagen, 9–10 May 2005. Report. (WHO/Europe)
- GEMS/WATER Operational Guide, 3rd ed. (WHO, 1992)
- EUROWATERNET. The Environment Agency’s Monitoring and Information. Network for Inland Water Resources. Technical Guidelines for Implementation. Technical Report No. 7. (Copenhagen, 1998)
- Protocol on Water and Health to the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (1999)
- Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption
- <http://www.euro.who.int/document/wsn/protMtgMay05.pdf>
- <http://www.euro.who.int/ehindicators/>
- <http://unstats.un.org/unsd/environment/>
- <http://www.europa.eu.int/comm/eurostat/>
- <http://themes.eea.eu.int/IMS/CSI/>

### 13. **BIOCHEMICAL OXYGEN DEMAND AND CONCENTRATION OF AMMONIUM IN RIVERS**

#### *General description*

**a) Brief definition:** The level of oxygen concentration in water bodies expressed as biochemical oxygen demand (BOD), which is the demand for oxygen resulting from organisms that consume oxidizable organic matter and concentrations of ammonium (NH<sub>4</sub>) in rivers.

**b) Unit of measurement:** The annual average BOD after five or seven days' incubation (BOD<sub>5</sub>/BOD<sub>7</sub>) is expressed in mg of O<sub>2</sub>/litre; the ammonium concentration is expressed in mg of N/litre.

#### *Relevance for environmental policy*

**a) Purpose:** The indicator provides a measure of the state of rivers in terms of biodegradable organic load and ammonium.

**b) Issue:** Large quantities of organic matter (microbes and decaying organic waste) can reduce the chemical and biological quality of river water and result in impaired biodiversity of aquatic communities and microbiological contamination that can affect the quality of drinking and bathing water. Sources of organic matter include discharges from wastewater treatment plants, industrial effluents and agricultural run-off. Organic pollution leads to higher rates of metabolic processes that demand oxygen. This could result in a lack of oxygen (anaerobic conditions). The transformation of nitrogen into reduced forms under anaerobic conditions in turn leads to increased concentrations of ammonium, which is toxic to aquatic life above certain concentrations, depending on water temperature, salinity and pH.

#### **c) International agreements and targets:**

Regional level: The Convention on the Protection and Use of Transboundary Watercourses and International Lakes and its Protocol on Water and Health.

Subregional level: In the European Union, the Water Framework Directive (2000/60/EC) requires the achievement of "good ecological status" or "good ecological potential" for rivers throughout the European Union by 2015.

#### *Methodology and guidelines*

**a) Data collection and calculations:** This indicator illustrates the current situation and trends regarding BOD and concentrations of NH<sub>4</sub> in rivers. The programme of monitoring BOD and concentrations of ammonium should be structured taking into account the spatial and temporal dynamics of the indicator. The number of surveillance points and their location should enable collection of information on BOD background values for the main morphological types of watercourses and values of this indicator in the areas subject to anthropogenic load. Time parameters should correspond to hydrological phases, while the frequency of sampling should reflect the need for statistically authentic information. Efforts should be made to ensure methodological and metrological uniformity in surveillance and data processing; microbiological and chemical-analytical work should be conducted by accredited laboratories with QA/QC systems.

**b) Internationally agreed methodologies and standards:** The method of determining BOD in EECCA countries is in compliance with ISO 5815-1:2003 and ISO 5815-2:2003. The maximum permissible value of BOD<sub>5</sub> pursuant to Directive (78/659/EEC) on the quality of fresh waters needing protection or improvement in order to support fish life is 3 mg/l of O<sub>2</sub> for salmonid waters and 6 mg/l of O<sub>2</sub> for cyprinid waters. In the majority of EECCA countries, the limit value for the concentration of ammonium in rivers is set as 0.39 mg/l. The method of determination of ammonium complies with ISO 7150-1: 1984 and ISO 6778:1984 in many EECCA countries.

### *Data sources and reporting*

EECCA countries have departmental and, in some cases, national databases on the indicator. In some EECCA countries, databases include the results of analysis of BOD and ammonia concentrations in surface water bodies for several decades. Data in these countries are published in annual surface water quality reports. Statistical agencies report data to the UNSD International Environment Statistics Database.

### *References at the international level*

- ISO Water Quality – determination of BOD after five days. ISO 5815. (1989)
- *Standard Methods for the Examination of Water and Wastewater*, 19th ed. (American Public Human Health Association, 1992)
- *GEMS/WATER Operational Guide*, 3rd ed. (WHO, 1992)
- Directive 2000/60/EC of the European Parliament and the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (Water Framework Directive)
- Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control
- Council Directive 91/271/EEC of 21 May 1991 concerning urban wastewater treatment
- Council Directive 75/440/EEC of 16 June 1975 concerning the quality required of surface water intended for the abstraction of drinking water in the Member States
- Council Directive 78/659/EEC of 18 July 1978 on the quality of fresh waters needing protection or improvement in order to support fish life
- <http://www.un.org/esa/sustdev/natlinfo/indicators/isd.htm>
- <http://www.iso.org>
- <http://europa.eu.int/comm/eurostat/>
- <http://www.unece.org/env/water/welcome.html>
- <http://www.icpdr.org/pls/danubis/DANUBIS.navigator>
- <http://www.iksr.org/>
- <http://www.cciw.ca/gems/intro.html>
- <http://unstats.un.org/unsd/environment/>
- <http://themes.eea.eu.int/IMS/CSI/>
- <http://www.euro.who.int/ehindicators/>

## 14. NUTRIENTS IN FRESHWATER

### *General description*

a) **Brief definition:** Concentrations of phosphates and nitrates in rivers, total phosphorus and nitrate in lakes and nitrate in groundwater.

b) **Unit of measurement:** Concentrations of nitrates are expressed as mg of NO<sub>3</sub>/litre, and concentrations of phosphorus and phosphate as mg of P/litre.

### *Relevance for environmental policy*

a) **Purpose:** The indicator provides a measure of the state of freshwater (rivers, lakes and groundwater) in terms of nutrient concentration.

b) **Issue:** Large inputs of nutrients to freshwater bodies from urban areas, industry and agricultural areas can lead to eutrophication of water bodies. This causes ecological changes that can result in a loss of plant and fish species (reduction in ecological status) and have negative impacts on the use of water for human consumption and other purposes. The indicator can be used to illustrate current geographical variations in nutrient concentrations and long-term trends.

### **c) International agreements and targets:**

Regional level: The Convention on the Protection and Use of Transboundary Watercourses and International Lakes and its Protocol on Water and Health refer to reduction of emissions of biogenic substances by industrial, household and diffuse sources.

Subregional level: In the EU the environmental quality of surface waters with respect to eutrophication and nutrient concentrations is an objective of several documents:

- The Drinking Water Directive (98/83/EC) establishes a maximum allowable concentration for nitrate of 50 mg/l.
- The Surface Water for Drinking Directive (75/440/EEC) sets a guideline concentration for nitrate of 25 mg/l.
- The Nitrates Directive (91/676/EEC) requires the identification of groundwater sites/bodies where the annual average nitrate concentration exceeds or could exceed 50 mg NO<sub>3</sub>/l.
- The Urban Waste Water Treatment Directive (91/71/EEC) aims to decrease organic pollution.
- An OECD report of 1980 defines lakes as eutrophic when the annual concentration of phosphorus exceeds 35 mg P/l.

### *Methodology and guidelines*

a) **Data collection and calculations:** A programme for monitoring nutrients in freshwater bodies should be structured taking into account the spatial and temporal dynamics of these ingredients. The number of surveillance points and their location should enable collection of information on the background content of nitrates and phosphates (conditioned by the natural process of decomposition of organic matter) for the main morphological types of watercourses and the



values of this indicator in areas subject to anthropogenic load resulting from spot and diffuse sources. Time parameters should correspond to hydrological phases, while the frequency of sampling should reflect the need for authentic information.

Efforts should be made to ensure methodological and metrological uniformity in surveillance and data processing; microbiological and chemical-analytical work should be conducted by accredited laboratories with QA/QC systems.

**b) Internationally agreed methodologies and standards:** The concentration of nitrates is determined using the ISO 7890-3:1988 method, based on spectrometric measurement of the compound resulting from the reaction of nitrate with sulpho-salicylic acid and its subsequent treatment with alkali. Phosphorus concentrations are determined using the ISO 6878:2004 method, which is in compliance with the corresponding method used by EECCA countries.

### *Data sources and reporting*

EECCA countries have departmental and, in some cases, national databases on the indicator. In some EECCA countries, databases include the results of analysis of nutrients concentrations in surface water bodies for several decades. Data in these countries are published in annual surface water quality reports. Statistical agencies report data to the UNSD Environment Statistics Database.

### **References at the international level**

- Standard Methods for the Examination of Water and Wastewater, 19th ed. (American Public Health Association, 1992)
- GEMS/WATER Operational Guide, 3rd ed. (WHO, 1992)
- Directive 2000/60/EC of the European Parliament and the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (Water Framework Directive)
- Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption
- Council Directive 75/440/EC of 16 June 1975 concerning the quality required of surface waters intended for the abstraction of drinking water in the Member States
- Council Directive 91/271/EEC of 21 May 1991 concerning urban wastewater treatment
- Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources
- <http://europa.eu.int/comm/eurostat/>
- <http://unstats.un.org/unsd/environment/>
- <http://themes.eea.eu.int/IMS/CSI/>
- <http://www.euro.who.int/ehindicators/>
- <http://www.icpdr.org/pls/danubis/DANUBIS.navigator>
- <http://www.iksr.org/>

## 15. NUTRIENTS IN COASTAL SEAWATERS

### *General description*

**a) Brief definition:** The presence in coastal seawaters of nutrients (biogenic substances) used by plants and autotrophic bacteria to maintain vital activity, and affecting the biological productivity and ecological condition of coastal waters.

**b) Unit of measurement:** Concentrations of major biogenic substances (nitrates and phosphates) are expressed in micrograms/litre.

### *Relevance for environmental policy*

**a) Purpose:** The indicator provides a measure of the state of coastal seawaters in terms of nutrient concentrations.

**b) Issue:** Nitrogen and phosphorus enrichment can result in a chain of undesirable effects, starting with excessive growth of plankton algae, which increases the amount of organic matter settling to the bottom. This development may be exacerbated by changes in the species composition and functioning of the pelagic food web (e.g. the growth of small flagellates rather than larger diatoms), which leads to lower grazing by copepods and increased sedimentation. The consequent increase in oxygen consumption can, in areas with stratified water masses, lead to oxygen depletion, changes in community structure and death of the benthic fauna. Eutrophication can also increase the risk of algal blooms, some of them consisting of harmful species that cause the death of benthic fauna and wild and caged fish and may lead to shellfish poisoning of humans. Increased growth and dominance of fast-growing filamentous macroalgae in shallow sheltered areas is another effect of nutrient overload which can change coastal ecosystems, increase the risk of local oxygen depletion and reduce biodiversity and the availability of nurseries for fish.

### **c) International agreements and targets:**

The Convention on the Protection of the Marine Environment of the Baltic Sea (Helsinki, 1974); the Convention on the Protection of the Mediterranean Sea against Pollution (Barcelona, 1976); the Convention on the Protection of the Black Sea against Pollution (Bucharest, 1992); the Framework Convention on the Protection of the Marine Environment of the Caspian Sea (Tehran, 2003).

### *Methodology and guidelines*

**a) Data collection and calculations:** A basic monitoring programme should specify biogenic substances and a core list of measured indicators. The number of sampling points and their spatial location should enable the collection of information on the content of biogenic substances throughout the gradient of loads – from background water landing sea areas to coastal seawater areas exposed to substantive anthropogenic (predominantly agricultural and household) loads. Time parameters should take into account the time mutability of the content of biogenic substances. Methodological and metrological uniformity of surveillance and data processing should be a goal; microbiological and chemical-analytical activities should be conducted by accredited laboratories with measurement quality control systems.

**b) Internationally agreed methodologies and standards:** The concentration of nitrates is determined using the ISO 7890-3:1988 method, based on spectrometric measurement of levels of the compound resulting from the reaction of nitrate with sulpho-salicylic acid and its subsequent treatment with alkali. Phosphorus concentrations are determined using the ISO 6878:2004 method, which is in compliance with the corresponding method used by EECCA countries.

#### *Data sources and reporting*

EECCA countries have departmental and, in some cases, national databases on biogenic substances contained in coastal seawaters. Several EECCA coastal countries publish data on concentration of nutrients in seawater, including coastal waters, in annual reports on seawater quality.

#### **References at the international level**

- GEMS/WATER Operational Guide, 3rd ed. (WHO, 1992)
- Directive 2000/60/EC of the European Parliament and the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (Water Framework Directive), as amended by Decision 2455/2001/EC of the European Parliament and the Council establishing the list of priority substances in the field of water policy
- <http://www.unep.org>
- <http://www.iso.org>
- <http://www.helcom.fi/>
- <http://www.blacksea-commission.net/>
- <http://www.grida.no/caspian/>
- <http://themes.eea.eu.int/IMS/CSI/>

## **16. POLLUTED (NON-TREATED) WASTEWATERS**

### *General description*

**a) Brief definition:** The indicator defines the share of non-treated wastewaters that were discharged into water bodies in the total volume of wastewaters generated in the country in a given year.

**b) Unit of measurement:** Percent.

### *Relevance for environmental policy*

**a) Purpose:** The indicator defines the level and nature of the pressure on natural water, makes it possible to obtain information necessary for developing nature conservation arrangements, and helps assess measures taken to increase the efficiency of the wastewater management system.

**b) Issue:** Wastewaters exert significant pressure on the water environment because of loads of organic matter and nutrients as well as hazardous substances. The inability to ensure treatment of the total amount of wastewater delivered to treatment plants, owing to their insufficient capacity or inefficient use, is one of the substantive factors of anthropogenic load on aqueous ecosystems.

### **c) International agreements and targets:**

Regional level: The Convention on the Protection and Use of Transboundary Watercourses and International Lakes and its Protocol on Water and Health.

Subregional level: The EECCA Environmental Strategy calls for increasing the volume of collected and treated wastewaters.

In the European Union, the Directive on Urban Waste Water Treatment (91/271/EEC) aims to protect the environment from the adverse effects of urban wastewater discharges. It prescribes the level of treatment required before discharge and requires Member States to provide all agglomerations of more than 2,000 inhabitants with collecting systems. It also requires all wastewater collected to be appropriately treated. It has to be fully implemented in the EU-15 countries by 2005 and in the 10 new Member States by 2008–2015.

### ***Methodology and guidelines***

**a) Data collection and calculations:** Monitoring of discharges from wastewater treatment plants should provide for obtaining representative information on the quantity of wastewater not treated at wastewater treatment plants. When conducting primary metering, the users should provide for the required frequency of sampling at water outlet points. Environmental authorities and hygiene services should exercise well-established control over the quality and authenticity of primary measurements. Processing of source data and its inclusion in informational databases should be done using updated information technologies. Major difficulties in obtaining representative data on wastewaters not treated by wastewater treatment plants are confined to low frequency of primary sampling and lack of necessary equipment to measure wastewater quantity and quality.

**b) Internationally agreed methodologies and standards:** The UNSD/UNEP Questionnaire on Environment Statistics.

### ***Data sources and reporting***

Companies and organizations in EECCA countries have to report on their wastewater discharges to authorized state inspection authorities using the standard forms. EECCA countries have departmental and national databases concerning quantities of wastewater not treated (or not sufficiently treated) at wastewater treatment plants. Information is entered into the State water cadastre. Information on volumes of wastewaters and on concentrations of pollutants therein is published in annual environmental reports and in statistical yearbooks. EECCA countries report data in their inputs to the UNSD/UNEP Questionnaire on Environment Statistics.

### ***References at the international level***

- *Standard Methods for the Examination of Water and Wastewater*, 19th ed. (American Public Human Health Association, 1992)
- *GEMS/WATER Operational Guide*, 3rd ed. (WHO, 1992)
- Directive 2000/60/EC of the European Parliament and the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (Water Framework Directive)
- Council Directive 91/271/EEC of 21 May 1991 concerning urban wastewater treatment

- <http://www.unece.org/env/water/welcome.html>
- <http://www.unhabitat.org>
- <http://www.europa.eu.int/comm/eurostat/>
- <http://unstats.un.org/unsd/environment/>
- <http://www.euro.who.int/ehindicators/>

## **D. Biodiversity**

### **17. PROTECTED AREAS**

#### ***General description***

**a) Brief definition:** The indicator shows the areas of land, water surfaces and adjacent air layer protected in compliance with the national legislation. It includes the area of highly protected territories and their share in the total area of the country. Additional indicators can be developed for the categories of natural territories which have a special World Conservation Union (IUCN) status and for the national categories of protected areas to demonstrate their respective extent and share in the total area of the country.

**b) Unit of measurement:** Total area in km<sup>2</sup> and as a percentage of the total country territory as well as by IUCN category.

#### ***Relevance for environmental policy***

**a) Purpose:** The indicator provides a measure of the response to the degradation of ecosystems and the loss of biodiversity in a country. It demonstrates the extent to which areas important for conserving biodiversity, cultural heritage, scientific research (including baseline monitoring of processes in the ecosystems), recreation, natural resource maintenance and other environmental values are protected from incompatible uses.

**b) Issue:** Sustainable development depends on a sound environment, which in turn depends on ecosystem diversity. Protected areas, especially the full range of IUCN Protected Area Categories, are essential for conserving biodiversity and contributing to sustainable development.

#### **c) International agreements and targets:**

Global and regional levels: The Convention on Biological Diversity aims at the establishment (by 2010 for terrestrial areas and by 2012 for marine areas) and maintenance of comprehensive, effectively managed and ecologically representative national and regional systems of protected areas. Recommendation 16 of the Fourth World Congress on National Parks and Protected Areas (Caracas, 1992) establishes a target of 10% protected areas for each biome (major ecosystem type). The European environment ministers in Kiev in 2003 called for the establishment of a pan-European ecological network by 2015.

Subregional level: The EECCA Environment Strategy calls for the increase of the share of protected areas as well as appropriate material and financial support for them.

At the EU level, the target is to have a Natura 2000 ecological network of special protected areas completed on land by 2005 and on marine sites by 2008, and management objectives for all sites

agreed and instigated by 2010. In the European Union, Council Directive 92/43/EEC on the conservation of natural habitats and wild fauna and flora lists habitat types to be protected in the Member States.

### ***Methodology and guidelines***

**a) Data collection and calculations:** It is necessary to have maps of designated areas and inventories of all protected areas of the country showing their location, size, date of establishment and protection regime in accordance with national legislation and relevant international requirements. For inter-country comparisons, protected areas could also be grouped by the IUCN categories. Monitoring is done on an annual basis.

**b) Internationally agreed methodologies and standards:** IUCN defines six management categories of protected area falling into two groups. ***Totally protected areas*** are maintained in a natural state and are closed to extractive uses. They include Category I, Strict Nature Reserve/Wilderness Area; Category II, National Park; and Category III, National Monument. ***Partially protected areas*** are managed for specific uses (e.g. recreation) or to provide optimal conditions for certain species or communities. They include Category IV, Habitat/Species Management Area; Category V, Protected Landscape/Seascape; and Category VI, Managed Resource Protected Area. This methodology is increasingly used for land ecosystems, less so for marine ecosystems, and least for inland water ecosystems. Inland water ecosystems are usually lumped with land in a terrestrial classification. The methodology for this indicator has not been standardized.

### ***Data sources and reporting***

EECCA ministries of environment generally collect this data. Data on protected areas (total number, area, location and date of creation) by national category are published in annual environmental reports, in national reports on biodiversity status and in statistical yearbooks in some EECCA countries. In cooperation with the UNEP World Conservation Monitoring Centre, IUCN's World Commission on Protected Areas compiles the UN List of Protected Areas, which provides the name, IUCN category, location, size and year of establishment of all protected areas meeting the IUCN definition, regardless of size and whether or not they have been assigned an IUCN category for all countries. This information is also included in the World Database on Protected Areas. Good examples are the European Nature Information System, managed by the European Topic Centre on Biological Diversity (ETC/BD in Paris) for the European Environment Agency (EEA) and the European Environment Information and Observation Network (EIONET), which covers, in particular, data on habitats and sites compiled in the framework of Natura 2000 (the EU Habitats and Birds Directives).

### ***References at the international level***

- UN Convention on Biological Diversity
- Guidelines for Protected Area Management Categories. CNPPA with the assistance of WCMC. International Union for the Conservation of Nature and Natural Resources (IUCN), Gland, Switzerland; Cambridge, UK, 1994. 261 p. ISBN 2-8317-0201-1
- Parks for Life: Report of the Fourth World Congress on National Parks and Protected Areas (IUCN, 1995)

- 2003 United Nations List of Protected Areas. (IUCN and UNEP/WCMC 2003)
- Ecosystems and Human Well-being: A framework for assessment. Millennium Ecosystem Assessment (2003) (ISBN 1-55963-403-0)
- Benefits Beyond Boundaries: Proceedings of the Fifth IUCN World Parks Congress (IUCN, 2005)
- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora
- Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds
- <http://www.un.org/esa/sustdev/natlinfo/indicators/isd.htm>
- <http://www.biodiv.org/>
- [www.wcmc.org.uk/parks/index.htm](http://www.wcmc.org.uk/parks/index.htm)
- [www.iucn.org/themes/wcpa/index.html](http://www.iucn.org/themes/wcpa/index.html)
- [www.wcmc.org.uk/protected\\_areas/data/un\\_97\\_list.html](http://www.wcmc.org.uk/protected_areas/data/un_97_list.html)
- <http://eunis.eea.eu.int/sites.jsp>
- <http://www.world-national-parks.net/>
- <http://themes.eea.eu.int/IMS/CSI/>
- <http://nature.eionet.eu.int>

## **18. FORESTS AND OTHER WOODED LAND**

### ***General description***

**a) Brief definition:** The indicator shows the total area of forests and other wooded lands, the ratio of this area to the country's total area, and the share of different categories of forests and other wooded lands.

**b) Unit of measurement:** Km<sup>2</sup> or thousand ha for the total; percentage for the share of forests and wooded land, and for the share of different categories.

### ***Relevance for environmental policy***

**a) Purpose:** The indicator provides a measure of the state of forest and other wooded lands in a country and shows the trends in use for environmental purposes.

**b) Issue:** Forests are among the most diverse and widespread ecosystems on earth and have many functions. They provide timber and other products; deliver recreation benefits and ecosystem services, including regulation of soil and water regimes; are reservoirs for biodiversity; and act as carbon dioxide sinks. Overexploitation, fragmentation, environmental degradation and conversion into other types of land use threaten many forest resources. The impact of human activities on natural forest growth and regeneration is cause for concern. The indicator gives insights into quantitative and qualitative aspects of forest resources and presents averages that may nevertheless conceal important variations among forest and other wooded lands.

### **c) International agreements and targets:**

Global and regional levels: Convention on International Trade in Endangered Species of Fauna and Flora (CITES); Convention on the Conservation of Wetlands of International Importance

(Ramsar Convention); Convention on Biological Diversity; Convention on Climate Change; Convention to Combat Desertification. The United Nations Conference on Environment and Development adopted the Non-Legally Binding Authoritative Statement of Principles for a Global Consensus on the Management, Conservation and Sustainable Development of All Types of Forests (the Forest Principles).

Subregional level: The EECCA Environment Strategy underlines the importance of implementing reforestation projects, as well as the need to improve systems to protect forests from overlogging, illegal cutting and forest fires and to restore systems for regular forest management.

### ***Methodology and guidelines***

**a) Data collection and calculations:** In data collection and calculations, relevant definitions established by FAO for its Global Forestry Resources Assessments and by the Ministerial Conference on the Protection of Forests in Europe (MCPFE) should be used. These relate to definitions of *forest and other wooded land* as well as definitions of forest and other wooded land whose primary function is designated as *protection of soil and water, conservation of biodiversity and social services* (recreation, tourism, education and/or conservation of cultural sites). Other relevant definitions include *primary forest/other wooded land* (forest/other wooded land of native species, where there are no clearly visible indications of human activities and the ecological processes are not significantly disturbed), *protective plantation* (stands of introduced species established for provision of environmental services, such as soil and water protection, pest control and conservation of habitats of biological diversity; areas of native species characterized by few species, straight tree lines and even-aged stands) and *semi-natural forest/other wooded land* (areas under intensive management where native species are used and deliberate efforts are made to increase/optimize the proportion of desirable species, thus leading to changes in the structure and composition of the forest). The data are generally contained in national forest inventories and obtained by sampling ground surveys, cadastral surveys, remote sensing or a combination of these. The frequency of evaluation is generally five years.

**c) Internationally agreed methodology and standards:** The UNECE/FAO Global Forestry Resource Assessment; the MCPFE guiding principles for use of the Pan-European Indicators for Sustainable Forest Management. The EU has introduced a detailed procedure for monitoring of forests (see Regulation No. 21/52/2003).

### ***Data sources and reporting***

In EECCA countries, forestry ministries or agencies collect the relevant data and submit it to the FAOSTAT global multilingual database and the electronic database of the Expert Committee on Temperate and Boreal Forest Resources (TBFRA) of FAO/UNECE. Data on the area of forests and their state are published in several EECCA countries in annual environmental reports, in national statistical yearbooks or in specialized yearbooks.

### ***References at the international level***

- UN Convention on Biological Diversity
- Temperate and Boreal Forest Resources Assessment of 2000 UNECE/FAO. Terms and definitions. UN. New York and Geneva, July 1997



- Forestry Resources of Europe, CIS, North America, Australia, Japan, and New Zealand (of industrialized countries of temperate/boreal zones). UNECE/FAO contribution to the Global Forest Resource Assessment of 2000. Keynote speech. UN. New York and Geneva, 2000. (ECE/TIM/SP/17)
- Global Forest Resource Assessment: Updated version, 2005. Technical description of national reporting tables in the framework of OJIP-2005. Forest Resource Assessment Program. Working paper No.81. FAO. Rome, 2004
- MCPFE Liaison Unit VIENNA. Background information for improved Pan-European indicators for sustainable forest management - MCPFE expert level meeting 7 – 8 October 2002, Vienna, Austria
- Sustainable Forest Management Systems. Application of the pan-European criteria for sustainable forest management (Portuguese Standard, NP4406 2003) MCPFE, 2003
- International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests
- Regulation (EC) No 2152/2003 of the European Parliament and of the Council of 17 November 2003 concerning monitoring of forests and environmental interaction in the Community
- <http://www.un.org/esa/sustdev/natlinfo/indicators/isd.htm>
- <http://www.unece.org/trade/timber/fra/welcome.htm>
- <http://faostat.fao.org/faostat/collections?subset=forestry>
- <http://www.mcpfe.org/>
- <http://www.icp-forests.org/Index.htm>
- <http://www.iisd.ca/forestry/unff/unff5/>

## **19. THREATENED AND PROTECTED SPECIES**

### ***General description***

**a) Brief definition:** This indicator presents numbers of populations and species in particular groups of species, in total and by species group that are threatened at the national and global levels and under protection in the country.

**b) Unit of measurement:** Number of species; number of adult individuals; percentage for trends.

### ***Relevance for environmental policy***

**a) Purpose:** The indicator provides a measure of the state of biodiversity in terms of the number of threatened species and the relative effectiveness of national response measures to maintain national-level and global biodiversity.

**b) Issue:** Biodiversity has intrinsic value, and biodiversity maintenance is essential for human life and sustainable development. Many species-level biological resources are currently at risk of modification, damage or loss. For many years, IUCN and other international organizations have been monitoring the extent and rate of biodiversity degradation by assigning species to categories of threat through detailed assessment of information against a set of objective, standard quantitative criteria. IUCN has developed a “red list” of globally threatened species.

The 2006 edition lists a total of 16,118 species. Countries are developing red lists of species that are threatened at the national level, including rare species, and are establishing appropriate protection regimes for these species. Some of the globally threatened species present in EECCA may not be classified as threatened at the national level. Nevertheless, countries have an important responsibility to care for these species even though they are not yet threatened on their territories. To what extent national policies on nature and biodiversity reflect this responsibility is shown by the information that the indicator provides on the total number of globally threatened species present and protected in the country.

**c) International agreements and targets:**

Global and regional levels: This indicator is relevant to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention), which lists species that must be protected. The Convention on Biological Diversity aims to reduce the rate of biodiversity loss by the year 2010. The ministers of environment of the European States participating in the process of the Pan-European Biological and Landscape Diversity Strategy in 2003 reinforced their objective to halt the loss of biological diversity at all levels by the year 2010. The target implies not only that species extinction must be stopped but also that the status of threatened species must be improved.

Subregional level: In the EU, Directives on the conservation of wild birds and on the conservation of natural habitats and wild fauna and flora list relevant species under legal protection.

***Methodology and guidelines***

**a) Data collection and calculations:** Lists of each group of threatened and protected species established in the country, and by IUCN for globally threatened species, serve as a basis for data collection. There may be differences between the number of threatened species and the number of species under protection, as the latter may include rare species and species protected under relevant multilateral environmental agreements or because of their presence on the *IUCN Red List of Threatened Species*. It is useful to have a breakdown for the latter species when presenting the resulting data. The number of species should be counted by species group (animals: invertebrates, freshwater fishes, reptiles, amphibians, birds and mammals; vascular plants, aquatic plants, mosses, lichens and fungi). Taxonomic problems and the inadequacy of the IUCN list may hinder proper maintenance of general accounting for invertebrates. Estimates for each species group should be done at least every five years.

**b) Internationally agreed methodologies and standards:** The *IUCN Red List* is the world's most comprehensive inventory of the global conservation status of plant and animal species. Classification into the categories for species threatened with extinction (Vulnerable, Endangered, and Critically Endangered) is done using a set of five quantitative criteria that form the heart of the system.

***Data sources and reporting***

At the national level in EECCA, data are available from ministries of environment, agencies dealing with protected areas and statistical agencies. In the majority of EECCA countries,

information on threatened species is collected in “red books”, which include data on the abundance and state of rare and/or protected species of wild fauna and flora and conservation measures regarding them. Red books should be published at least once every 10 years. In addition, subnational red books are being published in several EECCA countries. The UNEP-WCMC Species Database provides detailed information on species of conservation importance. UNEP-WCMC maintains the CITES Trade Database. The European Nature Information System managed by ETC/BD covers data on species compiled in the framework of Natura 2000 and other relevant instruments.

### *References at the international level*

- UN Convention on Biological Diversity
- 2004 IUCN Red List of Threatened Species: A Global Species Assessment. Edited by Jonathan E.M. Baillie, Craig Hilton-Taylor and Simon N. Stuart. ISBN: 2-8317-0826-5
- Categories and criteria of the World Red Book of the International Union for Conservation of Nature (IUCN)
- Global Biodiversity: Status of Earth's Living Resources. Compiled by World Conservation Monitoring Centre in collaboration with The Natural History Museum, London, and in association with IUCN, UNEP, WWF, and WRI. Chapman & Hall, London, 1992 - 585 p.
- World Atlas of Biodiversity. UNEP-WCMC; Publisher University of California Press, 2002. - 340 p. ISBN: 0-520-23668-8
- European Red List of Globally Threatened Animals and Plants, 1991 (E/ECE/1249 - ECE/ENVWA/20) (Sales No. 91.II.E.34)
- Code of Practice for the Conservation of Threatened Animals and Plants and Other Species of International Significance, 1992 (ECE/ENVWA/25-Sales No.92.II.E.16)
- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora
- Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds
- <http://www.redlist.org/>
- <http://www.iucn.org/themes/ssc/>
- <http://www.unep-wcmc.org/>
- <http://themes.eea.eu.int/IMS/CSI/>
- <http://www.cms.int/>
- <http://www.cites.org/>
- <http://themes.eea.europa.eu/IMS/CSI>

## **20. TRENDS IN THE NUMBER AND DISTRIBUTION OF SELECTED SPECIES**

### *General description*

**a) Brief definition:** Changes in the number of various selected species in a given area (country, region or designated area).

**b) Unit of measurement:** Number of mature individuals or other relevant indicator of abundance in a given area; percentage for trends.

## *Relevance for environmental policy*

**a) Purpose:** The indicator provides a measure of the state of populations of selected species and response measures to maintain biodiversity.

**b) Issue:** Many multilateral environmental agreements recognize that biodiversity has an intrinsic value and that biodiversity maintenance is essential for human life and sustainable development. Because of high economic interest, many biological resources at the gene, species and ecosystem levels are currently at risk of modification, damage or loss. The indicator shows the situation for populations of representatives of fauna and flora that belong to groups of species that are of major resource relevance and are important from the point of view of biodiversity conservation (“selected species”). The indicator will help decision makers to balance economic interests with biodiversity protection (especially when issuing hunting and forest harvest licenses), and to maintain balance in ecosystems.

### **International agreements and targets:**

Global and regional levels: The Convention on Biodiversity (CBD), the Bonn Convention, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Berne Convention. The CBD aims to reduce the rate of biodiversity loss by the year 2010. The ministers of environment of the European States participating in the process of the Pan-European Biological and Landscape Diversity Strategy in 2003 reinforced their objective to halt the loss of biological diversity at all levels by the year 2010.

Subregional level: The EECCA Environment Strategy calls for the preparation and implementation of national strategies and action plans in the field of biodiversity protection.

In the EU, Directives on the conservation of wild birds and on the conservation of natural habitats and wild fauna and flora are also relevant.

### *Methodology and guidelines*

**a) Data collection and calculations:** The following categories of species might be considered “selected species” when developing a monitoring programme:

(a) **Keystone species:** Taxons whose impact on the ecosystem or community studied is disproportionately large relative to their abundance. The loss of these species will significantly affect the population sizes of other species in the ecosystem, potentially leading to further species loss (“cascade effect”).

(b) **Species of international significance:** Examples are species for which a country accounts for a significant proportion of the global or European range or population.

(c) **“Flagship” species:** These are taxons of particular intrinsic (cultural and historical) appeal to the citizens of the country as a whole or its regions.

(d) **Endemic species:** Any area contributes to global biodiversity by the overall number of different species within it and by the proportion of species that do not occur anywhere else (are endemic to the area). Conservation of endemic species, particularly those sharing a discrete geographic area, can be an effective way to maintain global biodiversity levels.

Information on species abundance should be collected through the consistent long-term application of an appropriate survey technique that is widely accepted by the scientific community. Retrospective population data can be obtained through review of published

literature, including previous field study reports, to find material that is appropriate for comparison with the methodologies currently in use. While it is usually impossible to count every individual within a population or area, knowledge of habitat requirements and species population density in sample areas, coupled with data on climate, altitude, soil type and/or vegetation cover, can be used to estimate population size in the area of interest. In many countries, a geographic information system (GIS) is commonly used to analyse the spatial data. It is important to verify population size predictions through fieldwork.

Trends in numbers of species are obviously determined on the basis of total cyclic oscillations which reflect all conditions relating to the existence, protection and rational use of biological resources. This indicator is determined separately for each species.

For species for which in the country there are only assessments of absolute or relative quantities in territorial observation units (in administrative territorial units, particular protected areas or national parks), the reference point for each territorial observation unit is the assessment of the quantity in the year in which the monitoring was introduced.

**b) Internationally agreed methodologies and standards:** WCMC/UNEP and World Wide Fund for Nature (WWF) have designed and implemented a system (the Living Planet Index) to generate indicators on biodiversity change over time, principally at the global and continental levels. EEA is currently considering abundance variation trends over years for farmland, woodland, park and garden birds as well as distribution variation trends over 20–25 years for butterflies.

### *Data sources and reporting*

Completeness of the basic data on species is different in particular countries depending on their conditions and national priorities. Some data that may be suitable as a basis for this indicator are collected by central environmental institutions, state statistics bodies, academic institutions and nature conservation associations. To cite two international-level examples: BirdLife International maintains a database on farmland birds and on trends involving woodland, park and garden birds, and Dutch Butterfly Conservation maintains a database on trends involving butterflies.

### *References at the international level*

- UN Convention on Biological Diversity
- Code of Practice for the Conservation of Threatened Animals and Plants and Other Species of International Significance (1992) (ECE/ENVWA/25-Sales No.92.II.E.16)
- Birds in Europe: Population Estimates, Trends and Conservation Status. BirdLife International. BirdLife Conservation Series No 12. (London, 2004)
- EBCC Atlas of European Breeding Birds: Their Distribution and Abundance. Hagemeyer, EJM and Blair MJ (eds). (London: T and AD Poyser, 1997)
- Biotope use and trends of European butterflies. van Swaay, C., Warren, M. & Loïs G. Journal of Insect Conservation (2006) 10:189-209
- Delbaere, B. An inventory of biodiversity indicators in Europe 2002. EEA Technical Report. (2003)
- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora
- Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds

- <http://www.un.org/esa/sustdev/natlinfo/indicators/isd.htm>
- <http://www.unep-wcmc.org/>
- <http://www.cms.int/>
- <http://www.cites.org/>
- <http://themes.eea.eu.int/IMS/CSI/>
- <http://www.iucn.org/themes/ssc/>
- <http://www.birdlife.net/>
- <http://www.ebcc.info/>
- <http://www.rspb.org.uk/>
- <http://www.environment.detr.gov.uk/sustainable/>
- <http://www.vlinderstichting.nl/>

## **E. Land**

### **21. LAND UPTAKE**

#### ***General description***

**a) Brief definition:** Land uptake by transport infrastructure and urban development and by landfills, waste dumps, tailing pits and refuse heaps in a country.

**b) Unit of measurement:** Km<sup>2</sup> or hectares; percentage of the total territory of the country; and the contributions of the various land-cover categories to land uptake as a percentage of the total territory.

#### ***Relevance for environmental policy***

**a) Purpose:** The indicator provides a measure of the impact on the environment and shows trends in the encroachment of artificial land developments on natural and semi-natural land.

**b) Issue:** Land uptake by transport infrastructure and urban development and by landfills, waste dumps, tailing pits and refuse heaps has the highest impact on the environment due to sealing of soil as well as disturbances resulting from transport, noise, resource use, waste dumping and pollution. Transport networks add to the fragmentation and degradation of the natural landscape. The intensity and patterns of urban sprawl are the result of three main factors: socio-economic development, demand for housing and extension of transport networks. A high percentage of land used for waste dumps, landfills, tailing pits and refuse heaps for legal or illegal waste disposal is an indicator of unsustainable development.

**c) International agreements and targets:** None.

#### ***Methodology and guidelines***

**a) Data collection and calculations:** Results are presented as the average change, as a percentage of the country's total area and as a percentage of the various types of land cover used by transport infrastructure, urban development and landfills, waste dumps, tailing pits and refuse

heaps in a country. Land use by urban and related infrastructures is generally calculated using statistical data. In a few EECCA countries these data are supplemented by satellite images. Difficulties often arise in accounting for land used illegally for waste dumps, landfills, tailing pits and refuse heaps. The period of reporting is 10 years.

**b) Internationally agreed methodologies and standards:** FAO is working on the harmonization of classification systems and databases to improve national and international land-use information. This includes the development of definitions and protocols, a computerized land-use database structure, and a broadly accepted structure of land-use classifications.

### *Data sources and reporting*

Data on land use in EECCA countries are generally available from government authorities responsible for cadastres and land-use planning and environmental protection and from statistical agencies and local authorities. Data on land uptake off productive function are published in annual environmental reports and/or in statistical yearbooks in a number of countries. Statistical agencies report data to the UNSD Environment Statistics Database. FAO also collects data from its member countries.

### *References at the international level*

- <http://www.un.org/esa/sustdev/natlinfo/indicators/isd.htm>
- <http://www.fao.org>
- [http://themes.eea.eu.int/Environmental\\_issues/waste/indicators](http://themes.eea.eu.int/Environmental_issues/waste/indicators)
- <http://themes.eea.eu.int/IMS/CSI>
- <http://unstats.un.org/unsd/environment/>
- [http://epa.gov/ncea/ROE\\_Indicators/](http://epa.gov/ncea/ROE_Indicators/)

## **22. AREA AFFECTED BY SOIL EROSION**

### *General description*

**a) Brief definition:** Total land area and share of agricultural land affected by degradation through wind and water erosion.

**b) Measurement unit:** Area (km<sup>2</sup>) and percentage of agricultural land area affected.

### *Relevance for environmental policy*

**a) Purpose:** The indicator provides a measure of the state of land in terms of the degree to which it is affected by wind and water soil erosion.

**b) Issue:** Soil erosion can be caused by natural soil and landscape characteristics (steepness of hills, types of soil, amount of precipitation) which are difficult to change, as well as by land use, which can be easily mitigated by terracing, creation of wind barriers (including forest plantations) and changes in factors such as the variety, thickness and age of vegetation. Land erosion is a natural phenomenon, which, however, tends to be greatly accelerated by human

activity. In most cases, erosion results from unsustainable agricultural land use, large-scale farming and over-grazing, and inappropriate irrigation and water management. Agricultural management systems are a primary factor affecting the quality of soil. In turn, erosion is an exemplary indicator of negative effects caused by unacceptable agricultural practices, which lead to declines in soil fertility and often to irreversible soil damage. The soil erosion indicator estimates the total territory of eroded soil, the nature of erosion and erosion dynamics (where long time series are available), and it enables the planning of counter-erosion activities.

**c) International agreements and targets:** United Nations Convention to Combat Desertification (New York, 1994). The soil erosion indicator reflects the progress achieved at the national level in fulfilling the requirements of Article 10 of the Convention. While no specific targets have been defined, the goal should be to reduce the area and percentage of land affected by erosion and/or reduce the severity of erosion.

### *Methodology and guidelines*

**a) Data collection and calculations:** Data are collected separately for total land area (excluding area under inland or tidal water bodies) and agricultural land (including land under scattered farm buildings, yards and their annexes, and permanently uncultivated land, such as uncultivated patches, banks, footpaths, ditches, headlands and shoulders). Wind and water erosion (sheet, rill and gully) of soil can be measured as a net loss and applied to one of four categories: light, moderate, strong and extreme. Alternatively, erosion can be measured visually or derived on the basis of reduced productivity. These alternatives can also be applied to the same four categories, which are mutually exclusive. The four categories should be supplemented by the total area affected. The soil erosion indicator does not take into account many important types of soil degradation, such as hardening, over-grazing, secondary salt pollution, and loss of fertility and biodiversity. It also does not take into account the effects of road construction and tourism. The soil erosion indicator should be assessed at least every five years.

**b) Internationally agreed methodologies and standards:** UNECE has adopted the Standard International Statistical Classification for Land Use. The Global Assessment of Soil Degradation, developed by UNEP and FAO, provides definitions categorizing the extent of soil erosion. There is also a methodology for the creation of global and national soil databases (Soils and Terrain Digital Databases – SOTER). The Committee on Science and Technology of the United Nations Convention to Combat Desertification is currently developing relevant international standards. Wind and water erosion methodologies developed in the United States (Universal Soil Loss Equation) and some other countries may be also helpful.

### *Data sources and reporting*

At the national level in EECCA, data are collected by government bodies responsible for land cadastres, land-use planning and environmental protection as well as by statistical agencies. Data on land affected by erosion are published in annual state-of-the-environment reports and/or in statistical yearbooks in some countries. EECCA countries report data to the UNSD Environment Statistics Database. FAO also collects data from its member countries.

### *References at the international level*

- United Nations Convention to Combat Desertification



- *Assessment and Reporting on Soil Erosion*. Technical report No. 94. (EEA, 2002)
- *Down to the Earth: Soil Degradation and Sustainable Development in Europe. A Challenge for the Twenty-First Century*. Environmental Issues Series No. 16. (EEA/UNEP, 2000)
- Towards a strategy for soil protection. (EC, 2002)
- Assessment and reporting on soil erosion. (EEA, 2002)
- Grimm, M. et al. *Soil Erosion Risk in Europe*. (2002)
- <http://www.un.org/esa/sustdev/natlinfo/indicators/isd.htm>
- <http://www.fao.org/gtos/tems/index.jsp>
- <http://www.unccd.ch>
- <http://unstats.un.org/unsd/environment/>

## **F. Agriculture**

### **23. FERTILIZER CONSUMPTION**

#### *General description*

**a) Brief description:** Amount of mineral and organic fertilizers used per unit of arable land and land under permanent crops.

**b) Measurement unit:** Kilogram per hectare for mineral fertilizers and tons per hectare for organic fertilizers.

#### *Relevance for environmental policy*

**a) Purpose:** The indicator makes it possible to assess the fertilizer pressure on the environment (the accumulation of nutrients in the soil, the resulting pollution of surface and groundwater, and the movement of nutrients through trophic chains and other parts of the environment).

**b) Issue:** The use of mineral and organic fertilizers in agriculture to increase cropping power increases environmental hazards, such as water and soil pollution, and has negative effects on other environmental components, interfering with the natural balance of soil microflora. High levels of nitrate and nitrite in drinking water are a hazard to human health. The actual environmental effects will depend on pollution abatement methods, soil and plant types, and meteorological conditions. Time-series analysis of fertilizer consumption enables monitoring of its effect on the environment and preparation of strategies to mitigate the negative impacts of fertilizers on the environment.

**c) International agreements and targets:** EU Directive 91/676/EEC on water pollution by nitrates establishes requirements covering the use of nitrogen and phosphate. The placing on the market of fertilizers is regulated by regulation 2003/2003. The Baltic Marine Environment Protection Commission (HELCOM) has developed recommendations for its Parties in this regard.

#### *Methodology and guidelines*

**a) Data collection and calculations:** It is necessary to collect data on mineral fertilizer sales and fertilizers' basic characteristics. The indicator is assessed annually. Data on the quantities of

fertilizers used (sales to the final consumer) are converted into the three basic nutrient components (N, K<sub>2</sub>O, P<sub>2</sub>O<sub>5</sub>) and aggregated. Basic data on fertilizer nutrient content can be obtained directly from producers or through chemical analysis. (The content must be indicated clearly on labels and in all commercial documents.) Arable land and land under permanent crops are defined according to cadastre information.

**b) Internationally agreed methodologies and standards:** ISO standards (17020 for sampling and 17025 for testing).

### ***Data sources and reporting***

In EECCA countries, data on the use of mineral and organic fertilizers are collected by the ministries dealing with agriculture and the environment, and by statistical agencies. In several EECCA countries, national statistical agencies and their subnational departments have long-term databases on the use of fertilizers at the national and subnational levels. Data on national consumption of mineral and organic fertilizers are published in annual statistical yearbooks in several countries. FAO Member States report data to the FAOSTAT database. Collection of data on organic fertilizers such as compost, manure and bone meal is not being carried out in EECCA countries. Information on the consumption of fertilizers outside the agricultural sector is not being collected.

### ***References at the international level***

- Environmental Indicators for Agriculture. Vol. 3: Methods and Results. (OECD, 2001)
- Wascher, D.W. (ed.). Agri-Environmental Indicators for Sustainable Agriculture in Europe. ECNC Technical Reports series. (European Centre for Nature Conservation, 2000)
- *Towards Sustainable Agriculture – A Pilot Set of Indicators*. Research Report. (MAFF, 2000)
- FAOSTAT database, annual updates.
- Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources
- Regulation (EC) No. 2003/2003 of the European Parliament and of the Council of 13 October 2003 relating to fertilizers
- <http://www.un.org/esa/sustdev/natlinfo/indicators/isd.htm>
- <http://faostat.fao.org>
- <http://europa.eu.int/comm/eurostat/>
- <http://www.fertilizer.org/>

## **24. PESTICIDE CONSUMPTION**

### ***General description***

**a) Brief description:** Use of pesticides per unit of agricultural land.

**b) Measurement unit:** Kilogram per hectare.

### ***Relevance for environmental policy***

**a) Purpose:** The indicator provides a measure of the pressure on the environment in terms of intensity of pesticide consumption.

**b) Issue:** The use of pesticides (herbicides, fungicides, insecticides, etc.) mainly for crop protection increases environmental hazards (soil pollution and negative effects on other parts of the environment). Pesticides can be persistent, mobile and toxic in soil, water and air, and they can affect humans and wildlife either directly when used or indirectly through the food chain. Some pesticides can accumulate in the soil and in biota, and their residues may reach surface water and groundwater through leaching. Only detailed information on the use of pesticides makes it possible to assess the resulting environmental hazards for various regions, separate territories and crops, which are influenced by geography and other local conditions, such as the types of crops cultivated, the timing of application and the material used. Strategies can then be devised to offset negative effects.

### **c) International agreements and targets:**

Global and regional levels: The 2001 Convention on POPs and the Protocol on POPs to the Convention on Long-range Transboundary Air Pollution (CLRTAP) control the use of pesticides. Some pesticides are banned by international trade agreements.

Subregional level: Since 1993 the EU has been implementing a programme to establish harmonized maximum residue levels, which restrict the levels of pesticide residues in foodstuffs sold in the European Union. The placing on the market of plant protection products is regulated by Directive 91/414/EEC.

### ***Methodology and guidelines***

**a) Data collection and calculations:** Data calculation is based on the amount of pesticide sales (sales volume). Data are continuously fed into national databases on pesticide consumption. Pesticide consumption is assessed annually. At the national level, government authorities aggregate pesticide consumption data by pesticide groups: insecticides, herbicides, fungicides and so on. Ideally, pesticide databases should describe pesticide characteristics, such as active components, to be able to relate to their toxicity and environmental behaviour. An analysis of pesticides' effect on the environment that is based solely on the amount of active components present cannot be considered complete. It is important to take into account factors such as broadcast methods, the climate, the season, and the types of soil and cultivated crop.

**b) Internationally agreed methodologies and standards:** OECD collects data on the amount of active component, while the European Commission is preparing a regulation to collect detailed information on pesticide use in Member States.

### **Data sources and reporting**

In EECCA, ministries of agriculture and state statistical agencies collect data on pesticide consumption. FAO Member States report some data on total national pesticide consumption to the FAOSTAT database. Eurostat maintains a database of member countries' data.

### ***References at the international level***

- FAOSTAT database, annual updates.
- Council Directive 76/895/EEC of 23 November 1976 relating to the fixing of maximum levels for pesticide residues in and on fruits and vegetables
- Council Directive 86/362/EEC of 24 July 1986 on the fixing of maximum levels for pesticide residues in and on cereals products
- Council Directive 86/363/EEC of 24 July 1986 on the fixing of maximum levels for pesticide residues in and on foodstuffs of animal origin
- Council Directive 90/642/EEC of 29 November 1990 on the fixing of maximum levels for pesticide residues in and on products of plant origin, including fruits and vegetables.
- Council Directive 91/414/EEC of 15 July 1991 concerning the placing of plant protection products on the market
- Regulation (EC) No. 396/2005 of the European Parliament and of the Council of 23 February 2005 on maximum residue levels of pesticides in or on food and feed of plant and animal origin
- *Environmental Indicators for Agriculture. Vol. 3: Methods and Results.* (OECD, 2001)
- Wascher, D.W. (ed.). *Agri-Environmental Indicators for Sustainable Agriculture in Europe.* ECNC Technical Reports series. (European Centre for Nature Conservation, 2000)
- U.S. Department of Agriculture, Agricultural Marketing Service. Pesticide Data Program
- <http://www.un.org/esa/sustdev/natlinfo/indicators/isd.htm>
- <http://www.fao.org/>
- <http://europa.eu.int/comm/eurostat/>
- <http://www.pops.int/>
- <http://www.pesticideinfo.org/Index.html>
- <http://www.epa.gov/tri/>

## **G. Energy**

### **25. FINAL ENERGY CONSUMPTION**

#### ***General description***

**a) Brief definition:** Energy consumption, represented by energy supplied to the final consumer for all energy uses – both the total and the amount used by major users (transport, industry, services, agriculture and households).

**b) Unit of measurement:** Thousand tons of oil equivalent (ktoe) for total consumption and for consumption by major consumers; percentage for the shares of particular consumers.

#### ***Relevance for environmental policy***

**a) Purpose:** Final energy consumption represents a driving forces indicator and shows trends in final energy consumption. The trend in final energy consumption (total and by user) provides a broad indication of progress in reducing energy consumption and associated environmental impacts by the different end users (transport, industry, services and households). It can be used to help monitor and assess the success of key policies that attempt to influence energy consumption and energy efficiency.

**b) Issue:** Energy is a key factor of industrial development and safeguarding vital services for life. However, current energy consumption practices have considerable negative impacts on the environment. Energy-related problems raise awareness due to their impact on the quality of the environment through pollution of air, waters and soil. Hence better integration of environmental and energy-efficiency issues into environmental, economic and social policies is an important task for countries. The policy objective is to work out and implement particular measures in certain sectors of the economy to increase the efficiency of energy consumption (or reduce energy intensity), and thereby reduce negative environmental impacts. Thus, for instance, industry-related strategies should include rational, achievable and reasonable efficiency standards and also financial incentives. Activities in the household sector focus mainly on the application of energy efficiency standards to construction of new housing, energy pricing reform and public awareness campaigns.

**c) International agreements and targets:**

Global and regional levels: UNFCCC and its Kyoto Protocol call for curbing total GHG emissions, the major share of which is CO<sub>2</sub> emissions caused by combustion of fossil fuels. The Kyoto Protocol establishes limits on total GHG emissions for industrially developed countries and economies in transition. CLRTAP requires the implementation of concrete measures to reduce emissions of pollutants into the air, including those originating in fuel combustion.

Subregional level: The EECCA Environment Strategy calls, in particular, for the development and dissemination of alternative energy technologies with the aim of giving a greater share of the energy mix to renewable energies; for the improvement of energy efficiency; and for greater reliance on advanced energy technologies, including cleaner fossil fuels technologies.

The EU Directive on energy end-use efficiency and energy services (2006/32/EC) aims at boosting the cost-effective and efficient use of energy in the European Union. According to this Directive, each Member State should each year save 1% more energy than in the previous year through increased energy efficiency, which, it is hoped, will lead to annual energy savings of around 6% by 2012.

***Methodology and guidelines***

**a) Data collection and calculations:** Final energy consumption is calculated as the sum of final energy consumption from all sectors. Final energy consumption includes consumption of transformed energy (electric power, public heating, petroleum products, coke, etc.) and primary fuels such as natural gas and renewable energy sources (solar energy, biomass, etc.). Final energy consumption in *industry* includes consumption in all industrial sectors except the “energy sector”. Final energy consumption in *transport* includes consumption in all types of transportation (rail, road, public transport in cities, pipeline and air transport and inland and maritime navigation). Final energy consumption in *households* includes quantities consumed by households, excluding the consumption of motor fuels for personal transport. Household consumption includes all use of electricity and use of fuels for space and water heating. Final energy consumption in *services* includes consumption by public administration and private services. Final energy consumption in *agriculture* consists of quantities consumed by agriculture, including engines used for agricultural transportation. Final energy consumption in fisheries consists of quantities consumed by the fishing industry, excluding fishing on the high seas. The relative contribution of a specific sector can be measured by the ratio of final energy

consumption from that specific sector to the total final energy consumption calculated for a calendar year.

**b) Internationally agreed methodologies and standards:** IAEA, in cooperation with the United Nations Department of Economic and Social Affairs (UNDESA), IEA, Eurostat and EEA's Energy Indicators for Sustainable Development (EISD) with corresponding methodologies and guidelines in 2005.

### *Data sources and reporting*

In the EECCA countries, national energy balances are prepared by the government bodies responsible for economic affairs or in state statistical offices. Data on energy consumption in total and by sector are published in national energy balances and in statistical yearbooks. UNSD updates and maintains an Energy Statistics Database. IEA supports the most comprehensive databases on energy balances and assessments, which are primarily based on national data or on data collected by reliable regional agencies.

### *References at the international level*

- United Nations, *Energy Statistics – Definitions, Units of Measure and Conversion Factors*. Series F, No. 44.
- United Nations, Commission of the European Communities, International Monetary Fund, OECD and World Bank. *System of National Accounts 1993 (SNA 1993)*. Series F, No. 2, Rev. 4.
- United Nations. *Handbook of the International Comparison Programme*. Studies in Methods, Series F, No. 62.
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- OECD/IEA, *Energy Statistics of OECD Countries and Energy Statistics of Non-OECD Countries* (issued annually) Part I: Methodology.
- IAEA, UNDESA, IEA, Eurostat and EEA. *Energy Indicators for Sustainable Development: Guidelines and Methodologies*. (IAEA, 2005)
- IEA, *Key World Energy Statistics* (2003).
- Eurostat: Energy balances.
- Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC.
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- <http://www-pub.iaea.org/>
- <http://unstats.un.org/>
- <http://www.worldbank.org>
- [http://europa.eu.int/estatref/info/sdds/en/sirene/energy\\_base.htm](http://europa.eu.int/estatref/info/sdds/en/sirene/energy_base.htm)
- <http://forum.europa.eu.int/irc/dsis/coded/info/data/coded/en/Theme9.htm>
- <http://themes.eea.eu.int/IMS/CSI/>
- <http://www.iea.org>

## 26. *TOTAL ENERGY CONSUMPTION*

### *General description*

**a) Brief definition:** Energy resources, total and by fuel (solid, oil, gas, nuclear and renewable sources, including hydropower), consumed annually in a country.

**b) Unit of measurement:** Ktoe for total and by fuel, and percentages for shares of different types of fuel.

### *Relevance for environmental policy*

**a) Purpose:** Total energy consumption, total and by fuel, is a driving forces indicator describing the development of the energy sector and the corresponding levels of energy consumption.

**b) Issue:** Energy is a key factor in industrial development and the provision of essential services. Traditionally, energy has been considered a key element of economic progress. However, current energy production and consumption practices are having major negative impacts on the environment. These impacts are fuel-specific: for instance, the use of coal as a fuel has a major impact due to extremely high levels of pollutant emissions, whereas natural gas is one of the most environmentally appropriate fossil fuels. However, production and transportation of natural gas appear to be a huge source of GHG emissions (methane). Renewable energy sources have less negative environmental impact. Long-term objectives include continuous increases in energy efficiency that are higher than increases in energy consumption, as well as switching to consumption of environmentally appropriate renewable energy resources. The indicator reflects primary energy supply and serves as a unit of measurement for power inputs in the economy. It is widely used to measure the use of various fuels.

### **c) International agreements and targets:**

Global and regional levels: The UNFCCC and its Kyoto Protocol call for curbing total GHG emissions, the major share of which is CO<sub>2</sub> emissions caused by combustion of fossil fuels. The Kyoto Protocol establishes limits and targets for total GHG emissions for countries included in Annex 1. CLRTAP requires the implementation of concrete measures aimed at the reduction of emissions of pollutants into the air, including those originating in fuel combustion.

Subregional level: The EECCA Environment Strategy calls, in particular, for the development and dissemination of alternative energy technologies to increase the share of renewable energies in the energy mix, for improving energy efficiency and for greater reliance on advanced energy technologies, including cleaner fossil fuel technologies.

The EU Thematic Strategy on Air Pollution calls for using cleaner fuels and increasing energy efficiency.

### *Methodology and guidelines*

**a) Data collection and calculations:** Total energy consumption is a key element of energy balances and relates to “revealed” consumption. Measuring it requires the use of data on revealed rather than actual consumption, and it is calculated based on a formula taking into account production, exports, imports, storage bins and changes in fuel stocks. Production (or primary production) means production of solid fuels (coal, lignite and derivatives), oil (crude oil and

petroleum products), gas (natural and derived), nuclear energy and energy from renewable sources (solar energy, energy from biomass and waste, and geothermal, hydropower and wind energy). International trade in energy products is based on the “general trade” system, in which all goods delivered into the country or shipped out of it are registered as export or import goods. Data on changes in stocks mean data on changes in stocks with producers, importers and/or industrial consumers as of the beginning and end of the year. Bins are usually related to the fuel delivered to vessels and aircrafts for international sea and air shipping, irrespective of whether or not they belong to the state. Data on exports, imports, bins and changes in stocks of resources include data on both primary and secondary products (fuel products, such as petrol and lubricants produced from primary fuels). Balance calculation based on the data on total consumption of fuels is carried out according to the following scheme:

For each fuel type, measure consumption volume using the following formula:

$$\text{primary production} + \text{imports} - \text{exports} - \text{bin} \pm \text{changes in stocks}$$

Then, using the conversion multiplier factor for each fuel type, convert the obtained volume values into common energy units. Adding up all consumption values for each fuel type results in the total energy consumption (gross domestic energy consumption).

The relative contribution of a specific fuel is measured using the ratio of energy consumption originating from that fuel to the total gross inland energy consumption calculated for a calendar year, and the result is expressed as a percentage.

**b) Internationally agreed methodologies and standards:** IAEA, in cooperation with UNDESA, IEA, Eurostat and EEA, in 2005 published Energy Indicators for Sustainable Development (EISD) along with corresponding methodologies and guidelines.

### ***Data sources and reporting***

In EECCA countries, government bodies responsible for economic affairs or statistical offices prepare national energy balances. Data on fuel types and consumption of various fuels are available from national statistical agencies; some of the data are also published in national statistical yearbooks. UNSD maintains a statistical database on energy based on reports by various countries, including EECCA countries. The most comprehensive database on energy balances is maintained by IEA and includes national data as well as data and estimates collected by other international bodies.

### ***References at the international level***

- United Nations, *Energy Statistics – Definitions, Units of Measure and Conversion Factors*. Series F, No. 44.
- United Nations, Commission of the European Communities, International Monetary Fund, OECD and World Bank. *System of National Accounts 1993 (SNA 1993)*. Series F, No. 2, Rev. 4.
- United Nations. *Handbook of the International Comparison Programme*. Studies in Methods, Series F, No. 62.
- World Bank, *World Development Indicators* (issued annually).



- OECD/IEA, *Energy Statistics of OECD Countries and Energy Statistics of Non-OECD Countries* (issued annually) Part I: Methodology.
- IAEA, UNDESA, IEA, Eurostat and EEA. *Energy Indicators for Sustainable Development: Guidelines and Methodologies*. (IAEA, Vienna, 2005)
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- Eurostat: Energy balances.
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- [http://europa.eu.int/estatref/info/sdds/en/sirene/energy\\_base.htm](http://europa.eu.int/estatref/info/sdds/en/sirene/energy_base.htm)
- <http://forum.europa.eu.int/irc/dsis/coded/info/data/coded/en/Theme9.htm>
- <http://themes.eea.eu.int/IMS/CSI/>
- <http://www.iea.org>

## 27. ENERGY INTENSITY

### *General description*

- a) Brief definition:** Ratio between the final consumption of energy (or total energy consumption) and the GDP calculated for a calendar year at constant prices.
- b) Unit of measurement:** Ktoe per unit of GDP in USD. For internal use, the GDP should be expressed in the national currency.

### *Relevance for environmental policy*

- a) Purpose:** Energy intensity is one of the key indicators of sustainable development. Its dynamics characterize the level of efficiency of energy consumption in a country.
- b) Issue:** Energy is a key factor in economic progress. However, current energy production and consumption practices are having major negative impacts on the environment. Energy intensity indicates the general correlation between energy consumption and economic development and provides a basis for approximate assessment of energy consumption and its environmental impact as a result of economic growth. Energy intensity depends both on the structure of the economy (high- and low-energy-consuming sectors) and on geographical factors (countries in cold climate zones may consume 20% more energy per capita than other countries for heating purposes, whereas countries in hot climates may consume some 5% extra energy per capita for air conditioning). The policy objective is to improve energy efficiency and weaken the correlation between economic growth and energy consumption (decoupling economic growth from energy consumption), particularly the consumption of fossil fuels.

### **c) International agreements and targets:**

Global and regional levels: There are no particular targets for energy intensity. The UNFCCC and its Kyoto Protocol call for curbing total GHG emissions, the major share of which is CO<sub>2</sub> emissions caused by burning of fossil fuels. The Kyoto Protocol establishes limits and targets for total GHG emissions for countries included in Annex 1. CLRTAP requires the implementation

of concrete measures aimed at the reduction of emissions of pollutants into the air, including those originating in fuel combustion.

Subregional level: The EECCA Environment Strategy calls for better integration of energy efficiency issues into environmental, economic and social policies and for the development and dissemination of alternative energy technologies in order to improve energy efficiency.

The indicative target for final energy consumption intensity in the European Union, set in 1998, is a 1% annual improvement in the intensity of final energy consumption. According to the Directive on energy end-use efficiency and energy services, each Member State should each year save 1% more energy than in the previous year through increased energy efficiency, which, it is hoped, will lead to annual energy savings of around 6% by 2012.

### ***Methodology and calculations***

**a) Data collection and calculations:** Energy intensity of GDP in terms of final energy consumption is calculated by dividing final energy consumption (indicator 25) by GDP. Energy intensity of GDP in terms of total energy consumption is calculated by dividing total energy consumption (indicator 26) by GDP. The GDP figures are taken at constant prices to avoid the impact of inflation and are presented with an indication of the base year (2000). GDP is measured in constant prices in USD, in USD in PPP and in the local currency. Data on total and final energy consumption are derived in the way described for individual indicators.

**b) Internationally agreed methodologies and standards:** IAEA, in cooperation with UNDESA, IEA, Eurostat and EEA, in 2005 published Energy Indicators for Sustainable Development (EISD), along with corresponding methodologies and guidelines.

### ***Data sources and reporting***

In some EECCA countries, data on the energy intensity of GDP are available from government bodies responsible for economic affairs or in statistical offices. UNSD updates and maintains an Energy Statistics Database and a National Accounts Statistics Database. IMF's International Financial Statistics Database and the World Bank's Database of World Development Indicators provide nominal and real GDP for most countries. IEA supports the most comprehensive databases on energy balances, which are primarily based on national data or on data and estimates collected by reliable regional agencies.

### ***References at the international level***

- United Nations, *Energy Statistics – Definitions, Units of Measure and Conversion Factors*. Series F, No. 44.
- United Nations, Commission of the European Communities, International Monetary Fund, OECD and World Bank. *System of National Accounts 1993 (SNA 1993)*. Series F, No. 2, Rev. 4.
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- IAEA, UNDESA, IEA, Eurostat and EEA. *Energy Indicators for Sustainable Development: Guidelines and Methodologies*. (IAEA, 2005)
- IEA, *Key World Energy Statistics* (2003).
- Thematic Strategy on Air Pollution (COM(2005)446).
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- Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC.
- <http://www.un.org/esa/sustdev/natlinfo/indicators/indisd/indisd-mg2001.pdf/>
- <http://www-pub.iaea.org/>
- <http://unstats.un.org/>
- <http://www.worldbank.org>
- [http://europa.eu.int/estatref/info/sdds/en/sirene/energy\\_base.htm](http://europa.eu.int/estatref/info/sdds/en/sirene/energy_base.htm)
- <http://forum.europa.eu.int/irc/dsis/coded/info/data/coded/en/Theme9.htm>
- <http://themes.eea.eu.int/IMS/CSI/>
- <http://www.iea.org>.

## 28. RENEWABLE ENERGY CONSUMPTION

### *General description*

**a) Brief definition:** The share of renewable energy consumption in a country's total energy consumption for a calendar year. Renewable energy is energy obtained from renewable (i.e. non-fossil) sources. Major forms include wind, solar, geothermal, wave, tidal, hydropower, biomass, landfill gas, sewage treatment plant gas and biogas energy.

**b) Unit of measurement:** Percent.

### *Relevance for environmental policy*

**a) Purpose: Renewable energy consumption**, characterized by the share of renewable energy in total national energy consumption, represents the response aimed at the reduction of the environmental impact of energy consumption.

**b) Issue:** The dependence of the economy on non-renewable energy resources (fossil fuels) cannot be viewed as steady in the long run, since natural fossil fuel resources are limited, whereas renewable resources can ensure a continuous energy supply. Renewable energy sources can be viewed as the best option for reducing the negative environmental impacts of energy production and consumption. The related policy objective is to achieve a safe energy supply by gradual replacement of fossil fuels with renewable energy sources.

### **c) International agreements and targets:**

Global level: Chapter 4 of Agenda 21 calls for improving efficiency in the use of energy sources and for a transition to the environmentally friendly use of renewable resources.

Subregional level: The EECCA Environment Strategy calls, in particular, for the mobilization of domestic and foreign investments for the development of renewable energy sources and the

development and dissemination of alternative energy technologies in order to increase the share of renewable energies in the energy mix.

In the European Union, the European Commission's White Paper "Energy for the Future: Renewable Sources of Energy" and the 1998 Council Resolution on renewable energy provide a framework for Member States' actions to develop renewable energy and set an indicative target of increasing the share of renewable energy in EU-15 total energy consumption to 12% by 2010. For the 10 new Member States which joined the EU in 2004, the target is 7.5%.

### ***Methodology and guidelines***

**a) Data collection and calculations:** Measuring renewable energy consumption relates to total energy consumption (see indicator 26). Calculation is based on a formula taking into account production, exports, imports and changes in fuel stocks. Both data on consumption of energy produced from renewable energy sources and data on total energy consumption are required. Both types of data may be available in national energy balances of many countries, as well as from various international information sources on energy.

**b) Internationally agreed methodologies and standards:** IAEA, in cooperation with UNDESA, IEA, Eurostat and EEA, in 2005 published Energy Indicators for Sustainable Development (EISD), along with corresponding methodologies and guidelines.

### ***Data sources and reporting***

National data and assessments on renewable energy resources are collected by government bodies responsible for economic affairs and/or by statistical agencies and are published in the national statistical yearbooks of some EECCA countries. UNSD and IEA collect data and assessments based on information from national and international sources.

### ***References at the international level***

- United Nations, *Energy Statistics – Definitions, Units of Measure and Conversion Factors*. Series F, No. 44.
- OECD/IEA. Energy Statistics of OECD Countries and Energy Statistics of non-OECD countries. (issued annually) Part I: Methodology.
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- [http://europa.eu.int/estatref/info/sdds/en/sirene/energy\\_base.htm](http://europa.eu.int/estatref/info/sdds/en/sirene/energy_base.htm)
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- <http://themes.eea.eu.int/IMS/CSI/>
- <http://www.iea.org>

## H. Transport

### 29. *PASSENGER TRANSPORT DEMAND*

#### *General description*

**a) Brief definition:** This indicator is presented in two ways:

(i) The number of kilometres travelled by persons in a given year by all modes of public transport (taxis, buses, trolleybuses, trams, underground, trains, inland water transport, maritime transport and airplanes) and by private transport.

(ii) A breakdown of total passenger transport demand by mode (the share of each mode in total transport demand).

**b) Unit of measurement:**

(i) Thousand passenger-kilometres (pkm)

(ii) Percentage

#### *Relevance for environmental policy*

**a) Purpose:** Passenger transport demand is a driving force indicator. It is of prime importance in regulating passenger turnover and developing various types of transport. Breaking down passenger transport demand by mode helps to assess the effectiveness of response measures.

**b) Issue:** Travel is an essential part of the economic and social life of a country. Continuous growth of demand for transport, especially road transport, raises concern regarding the long-term sustainability of current trends. This problem is aggravated by the high age and energy intensity and poor environmental parameters of vehicle fleets and the poor state of road infrastructure. Maintaining current trends in the transport sectors of the EECCA countries would lead to sharp increases in environmental and health problems related to air pollution, noise pollution and enormous land uptake. The relevance of the modal split policy for the environmental impact of passenger transport stems from differences in the “environmental performance” (resource consumption, emissions, noise, accidents, etc.) of different modes of transport. Electricity-driven modes of transport are more “clean” than the other modes. Policies are expected to be implemented in EECCA countries which support a shift towards less environmentally damaging means of transport and reduce the need for travel.

**c) International agreements and targets:**

Regional level: The Transport, Health and Environment Pan-European Programme (THE PEP), adopted by the High-level Meeting of UNECE and WHO Europe in 2002, requires as one of its priorities the implementation of measures supporting redistribution of passenger transport in favour of modes which comply with the need to protect health and the environment, including measures to develop high-quality integrated public transport systems and limit demand for and intensity of car use.

Subregional level: The EECCA Environment Strategy calls for the development and implementation of national transport strategies for sustainable development using less energy-

intensive modes of transport and the introduction of incentives for environmentally sustainable transport, including public transport.

In the EU, the European Commission's white paper "European Transport Policy for 2010: Time to Decide" proposes an action plan for substantially improving the quality and efficiency of transport. The Thematic Strategy on Urban Development from 2006 calls for the use of "cleaner" modes of transport and for improving population mobility.

### ***Methodology and guidelines***

**a) Data collection and calculations:** Current statistics should make it possible to calculate the passenger transport demand for the majority of modes. Data on passenger carriage are collected from enterprises, agencies and private individuals involved in the transport business. The reporting time in passenger carriage depends on the type of transport: one can use the time when the ticket is acquired (rail, car, municipal electrically driven transport) or the time of departure (maritime, inland water and air transport). In passenger carriage statistics the time of arrival is, practically speaking, used only for air transport. Passenger turnover is assessed by multiplying the total number of passengers for each transport mode by the distance of carriage; this is done separately for each mode of transport. All data should be based on movements on national territory, regardless of the nationality of the vehicle.

**b) Internationally agreed methodologies and standards:** Eurostat/European Conference of Ministers of Transport (ECMT)/UNECE Common Questionnaire on Transport Statistics (passenger transport performance).

### ***Data sources and reporting***

In several EECCA countries, data on passenger transport demand and modes of transportation (intra-city, urban, etc.) are published regularly in statistical yearbooks. Some EECCA countries report relevant data via the Common Questionnaire on Transport Statistics circulated by Eurostat, UNECE and ECMT.

### ***References at the international level***

- United Nations, Commission of the European Communities, International Monetary Fund, OECD and World Bank. System of National Accounts 1993 (SNA 1993). Series F, No. 2, Rev. 4
- UNECE, *Annual Bulletin of Transport Statistics for Europe and North America*.
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- <http://europa.eu.int/comm/eurostat>
- <http://themes.eea.eu.int/IMS/CSI/>
- <http://www.cemt.org/>

### 30. *FREIGHT TRANSPORT DEMAND*

#### *General description*

**a) Brief definition:** The indicator includes three elements: (a) the volume of freight transported to the corresponding stage distance during a year by each mode of freight transport; (b) the volume of freight transport per unit of GDP; and (c) the modal split share of freight transport (the share of particular modes of transport in total freight transport).

**b) Unit of measurement:**

For (a), thousand ton-kilometres (tkm); for (b), tkm per unit of GDP in USD and in the national currency; and for (c), percentage.

#### *Relevance for environmental policy*

**a) Purpose:** Freight transport demand is a driving force indicator and shows the volume of cargo conveyance in a country.

**b) Issue:** Travel is an essential part of the economic and social life of a country. Continuous growth of demand for transport, especially road transport, raises concern regarding the long-term sustainability of current trends. This problem is aggravated by the high age and energy intensity and poor environmental parameters of vehicle fleets and the poor state of road infrastructure. The relevance of the modal split policy for the environmental impact of freight transport stems from differences in the “environmental performance” (with regard to resource consumption, GHG emissions, pollutant and noise emissions, accidents, etc.) of different transport modes. Shifting freight from road to water and rail is an important strategic element in future transport policy.

**c) International agreements and targets:**

Regional level: The Transport, Health and Environment Pan-European Programme (THE PEP), adopted by the High-level Meeting of UNECE and WHO Europe in 2002, requires as one of its priorities the implementation of measures supporting redistribution of freight transport in favour of modes which comply with the need to protect health and the environment, including measures to develop high-quality integrated public transport systems and limit demand for and intensity of car use.

Subregional level: The EECCA Environment Strategy calls for the development and implementation of national transport strategies for sustainable development so as to use less energy-intensive modes of transport and the introduction of incentives for environmentally sustainable transport, including public transport.

In the European Union, the European Commission's white paper "European Transport Policy for 2010: Time to Decide" proposes an Action Plan for substantially improving the quality and efficiency of freight transport in Europe.

### ***Methodology and guidelines***

**a) Data collection and calculations:** Total inland transport should include transport by road, rail, pipelines and inland waterways. Calculations relating to transport by rail and inland waterways should be based on movements on national territory, regardless of the nationality of the vehicle or vessel. Calculations relating to road transport should be based on all movements of vehicles registered in the reporting country. The unit of surveillance in freight conveyance statistics is the shipment (a batch delivered on the basis of a freight conveyance contract). Participants in the compilation of summary data on freight conveyances include enterprises, agencies and private individuals involved in the transportation business. Freight turnover is defined as the sum of the products of the mass of freight conveyed in tons multiplied by the distance of conveyance in kilometres. The indicator *freight transport demand per unit of GDP* is defined as the ratio between freight transport demand in tkm and GDP in constant 2000 prices (in both the national currency and the USD equivalent). The indicator *modal split* is presented as the share of a particular mode of transport in total freight transport demand (i.e. the modal split share for freight transport).

**b) Internationally agreed methodologies and standards:** The Eurostat/ECMT/UNECE Common Questionnaire on Transport Statistics (passenger transport performance).

### ***Data sources and reporting***

In a number of EECCA countries, data on freight transport demand by mode and on different types of load are published regularly in statistical yearbooks. Some EECCA countries report relevant data via the Eurostat/ECMT/UNECE Common Questionnaire on Transport Statistics. GDP is published in the UNSD National Accounts Statistics Database. IMF's International Financial Statistics database and the World Bank's database of world development indicators provide data on nominal and real GDP for most countries.

### ***References at the international level***

- United Nations, Commission of the European Communities, International Monetary Fund, OECD and World Bank. System of National Accounts 1993 (SNA 1993). Series F, No. 2, Rev. 4
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- European Commission, *European Transport Policy for 2010: Time to Decide*. White paper (COM (2001) 370)
- Eurostat, Pocketbook “Energy, transport and environment indicators” (2005)
- <http://www.unece.org/trans/main/wp6/wp6.html>
- <http://www.unece.org/trans/main/wp6/transstatpub.html#trans>
- <http://europa.eu.int/comm/eurostat>
- <http://themes.eea.eu.int/IMS/CSI/>
- <http://www.cemt.org/>

### 31. COMPOSITION OF THE ROAD MOTOR VEHICLE FLEET BY FUEL TYPE

#### *General description*

**a) Brief definition:** The indicator defines the breakdown of the road motor vehicle fleet by fuel type.

**b) Unit of measurement:** The number of motor vehicles by fuel type and each category’s share in the total road motor vehicle fleet.

#### *Relevance for environmental policy*

**a) Purpose:** This is a driving force indicator which shows tendencies in the transport sector’s development and is also an indirect indicator of fuel consumption. The indicator helps to understand developments in the composition of the road motor vehicle fleet by fuel type, which in turn explains observed trends in transport’s impact on the environment.

**b) Issue:** The current transport system poses significant and growing threats to the environment and human health. Continuous growth of demand for transport, especially road transport, raises questions about the long-term sustainability of current trends. This problem is strengthened by the high age and energy intensity and poor environmental parameters of the vehicle fleet and poor status of road infrastructure. Transport policies increasingly recognize the need to improve the shares of transport modes that use environmentally friendly fuels, primarily electric and biofuel vehicles. The promotion of low- and zero-sulphur fuels will lead to decreases in pollutant emissions from road vehicles. To decrease environmental pollution of the environment, promotion of biofuels must also be taken seriously.

#### **c) International agreements and targets:**

Regional level: The Transport, Health and Environment Pan-European Programme (THE PEP) requires the adoption of national fuel quality standards in the EECCA countries and the implementation of necessary changes in taxation.

Subregional level: The EECCA Environment Strategy calls, among other things, for the development and implementation of national transport strategies for sustainable development using less energy-intensive modes of transport and for the introduction of incentives for environmentally sustainable transport.

In the EU, current legislation requires the reduction of the sulphur content of fuels to 50 mg/kg (low-sulphur fuels) by 2005 and its further reduction below 10 mg/kg (zero-sulphur fuels) by 2009. The legislation also requires that by 2005 and 2010 biofuels constitute 2% and 5.75% respectively of EU fuel consumption.

### ***Methodology and guidelines***

**a) Data collection and calculations:** Data should cover the stock of road motor vehicles, namely, all road vehicles registered in a country on a given date and licensed to use roads open to public traffic. Data should be collected separately for each category of road motor vehicles: passenger cars, motor coaches, buses and trolleybuses, and trucks. For each category, vehicles may be classified according to the type of energy used by the motor. The main types are gasoline (petrol), diesel, gas (liquefied petroleum gases and natural gas), electricity, biofuel (e.g. biodiesel) and other sources (e.g. alcohols, mixtures of alcohols with other fuels or hydrogen). The electricity and biofuel groups should also be presented as percentages of the total for each vehicle category. The shares may be compared with a baseline year demonstrating trends in fleet composition.

**b) Internationally agreed methodologies and standards:** The methodology developed jointly by UNECE, ECMT and Eurostat for the Common Questionnaire on Transport Statistics.

### ***Data sources and reporting***

In a number of EECCA countries, data on number of vehicles of different categories, including passenger cars, trucks and buses, as well as respective fuel consumption (mainly petrol and diesel fuel) are published regularly in statistical yearbooks. ministries of Transport in a few EECCA countries collect and report data to UNECE annually.

### ***References at the international level***

- UNECE, *Annual Bulletin of Transport Statistics for Europe and North America*
- United Nations, *Glossary for Transport Statistics*, 3rd ed. (2003)
- Directive 98/70/EC of the European Parliament and of the Council of 13 October 1998 relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EC, as amended
- Directive 2003/17/EC of the European Parliament and of the Council of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport
- <http://www.unece.org/trans/main/wp6/wp6.html>
- <http://europa.eu.int/comm/eurostat>

## **32. AVERAGE AGE OF THE ROAD MOTOR VEHICLE FLEET**

### ***General description***

**a) Brief definition:** The indicator defines the average age of the road motor vehicle fleet.

**b) Unit of measurement:** The number of motor vehicles by age and percentage of each age group in each category of road vehicle fleet.

### ***Relevance for environmental policy***

**a) Purpose:** The average age of the vehicle fleet is a driving force indicator and shows the technical status of the fleet through its age.

**b) Issue:** Transport is an important source of emissions of pollutants and GHGs as well as of other negative impacts on human health and the environment. These effects increase with vehicle age. Outdated vehicle equipment is a serious problem in the EECCA countries. A key priority of state policy for the development of transport systems in EECCA countries should be to improve vehicle fleet composition by replacing older, more polluting vehicles with newer, cleaner ones.

**c) International agreements and targets:**

Regional level: The Transport, Health and Environment Pan-European Programme (THE PEP) requires the introduction of systems for controlling the use of vehicles with a long period of use in EECCA countries, the implementation of necessary changes in taxation and the establishment of national vehicle certification systems. The “younger” categories of cars comply with UNECE/EURO standards, limiting emissions of pollutants into the air.

Subregional level: The Environment Strategy for EECCA Countries includes the development and implementation of national transport strategies for sustainable development.

In the EU, the Directive on end-of-life vehicles provides that vehicles sold after 2005 should, depending on their weight, be either at least 85% reusable and/or recyclable or at least 95% reusable and/or recoverable.

***Methodology and guidelines***

**a) Data collection and calculations:** Data should cover the stock of road motor vehicles, namely, all road vehicles registered on a given date in a country and licensed to use roads open to public traffic. A road vehicle’s age is the length of time since the first registration of the vehicle, irrespective of the registering country. Data should be presented for each of the five categories of road motor vehicles: passenger cars, motor coaches, buses and trolleys, trucks and road tractors. For each category, the number of vehicles should be broken down by age as follows:  $\leq 2$  years,  $\leq 5$  years,  $\leq 10$  years and  $> 10$  years. Each individual age category may be also presented as a percentage of the total by each vehicle category. The shares may be compared with a baseline year demonstrating trends in the fleet composition.

**b) Internationally agreed methodologies and standards:** The methodology developed jointly by UNECE, ECMT and Eurostat for the Common Questionnaire on Transport Statistics.

***Data sources and reporting***

Data on the average age of vehicles are available from various specialized sources. Ministries of transport in a few EECCA countries collect and report data to UNECE annually.

***References at the international level***

- UNECE, *Annual Bulletin of Transport Statistics for Europe and North America*
- United Nations, *Glossary for Transport Statistics*, 3rd ed. (2003)
- Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of-life vehicles
- <http://www.unece.org/trans/main/wp6/wp6.html>
- [http://www.unece.org/trans/main/Vehicle\\_Regulations](http://www.unece.org/trans/main/Vehicle_Regulations)
- <http://europa.eu.int/comm/eurostat>

## I. Waste

### 32. WASTE GENERATION

#### *General description*

**a) Brief definition:** The amount of generated waste in a country – in total, per unit of GDP, by sector (industrial and municipal solid waste) and by negative impact (hazardous waste).

**b) Measurement unit:** Million metric tons per year. Total waste intensity should be presented in kilograms per unit of GDP at constant prices (in both USD and the national currency), and municipal waste intensity should be expressed in kg per capita or in m<sup>3</sup> per capita. This indicator can also be presented in terms of waste (kg) generated per unit of production (ton, kWh, etc.).

#### *Relevance for environmental policy*

**a) Purpose:** The main purpose is to provide a measure of the pressure on the environment of the total amount of generated waste and waste by category (hazardous, industrial and municipal solid waste). The waste intensity represents a driving force indicator and shows response to anthropogenic activities. Waste generated per unit of GDP (total waste intensity) will show whether there has been any decoupling of waste generation from economic growth. Municipal waste generation per capita allows comparisons of countries. For each indicator, the two time series should be shown together (i.e. on total waste generation and on development of GDP, on municipal waste generation and on the number of population) to get the full benefit of the indicator. Changes in the value of this indicator enable assessment of the effectiveness of environmental policy.

**b) Issue:** Sound and efficient use of natural resources is an important part of sustainable development. Waste represents a considerable loss of resources in the form of materials and energy. The treatment and disposal of the generated waste may cause environmental pollution and expose humans to harmful substances and infectious organisms. Waste generation is closely linked to the level of economic activity in a country and reflects society's production and consumption patterns. A reduction in the volume of waste generated is an indication of the economy's move towards less material-intensive production and consumption patterns.

#### **c) International agreements and targets:**

Regional level: Parties to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal agreed to take all practicable steps to ensure minimization of the generation of hazardous and other waste (including municipal waste). Agenda 21's chapter 20 on general objectives includes the target of "preventing or minimizing the generation of hazardous wastes as part of an overall integrated cleaner production approach" (20.7).

Subregional level: The EECCA Environment Strategy calls for the development of inter-sector waste management action plans and of economic mechanisms to facilitate implementation of cleaner technologies and waste prevention and minimization.

In the EU, the waste framework directive provides for increased efforts to prevent and reduce waste generation, recover wastes and develop new techniques for final disposal of waste.

### ***Methodology and guidelines***

**a) Data collection and calculations:** The precise definition of what constitutes waste varies. According to the Basel Convention, wastes are substances or objects which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law. Principally, waste can be considered materials that are not primary products (products produced for the market), for which the generator has no further use related to production, transformation or consumption, and which the generator discards, or intends to or is required to discard. It excludes residuals directly recycled or reused on the site of generation and pollutants that are directly discharged into ambient water or air as wastewater or air emission. Waste statistics should group waste according to main economic activities and should use the ISIC. *Industrial waste* covers waste generated primarily by mining and quarrying, by manufacturing industries and by energy production and construction. Waste from industrial activities that is removed by municipal waste collection should be reported under the respective sector of generation. *Municipal solid waste* includes all municipal waste collected plus the estimated amount of municipal waste from areas not served by a municipal waste collection service. In general it covers waste originating from households as well as similar waste from commerce and trade, small businesses, office buildings and institutions (schools, hospitals, government buildings) and also waste from the cleaning of roads and open air baskets. Data on municipal solid waste generation are usually gathered through surveys of municipalities, which are responsible for waste collection and disposal, or from transport companies that collect waste, or from landfill or incineration sites. Waste collection companies and landfills should apply coefficients or factors for recalculations from m<sup>3</sup> to tons.

The amount reported under “total waste generation” should be equal to the sum of the waste amounts reported as industrial waste, waste generated by other economic activities (e.g. agriculture and forestry) and municipal solid waste. *Hazardous waste* includes those of the above-mentioned categories which should be controlled according to the Basel Convention (Article 1 and Annex I).

**b) Internationally agreed methodologies and standards:** The UNSD/UNEP Questionnaire on Environment Statistics provides a methodology for calculating waste generation by sector. The Basel Convention has established an internationally agreed methodology for calculating the amount of hazardous waste generated. In the EU, waste statistics (including waste generation and waste disposal (final disposal and recovery)) are dealt with by a specialized regulation (2150/2002).

### ***Data sources and reporting***

In the EECCA countries, data on the generation of industrial waste are usually collected by authorities responsible for the environment or by state statistical agencies (using a special statistical form 2TP), while data on municipal waste generation are collected by state statistical agencies. In many EECCA countries, data on waste generation are published in national state-of-the-environment reports and statistical yearbooks. EECCA countries report data on internationally agreed types of hazardous waste to the Secretariat of the Basel Convention and

waste generation data to UNSD in their response to the UNSD/UNEP Questionnaire on Environment Statistics.

### *References at the international level*

- UNSD/UNEP 2006 Questionnaire on Environment Statistics (waste section)
- Basel Convention for the Control of Transboundary Movement of Hazardous Wastes and Their Disposal
- United Nations. International Standard Industrial Classification of All Economic Activities. Series M, No. 4, Rev. 3.
- *Europe's Environment: The Third Assessment*. (EEA, 2003) (Kiev Assessment)
- Regulation (EC) No. 2150/2002 of the European Parliament and of the Council of 25 November 2005 on waste statistics
- Directive 2006/12/EC of the European Parliament and of the Council of 5 April 2006 on waste
- <http://www.un.org/esa/sustdev/natlinfo/indicators/isd.htm>
- <http://unstats.un.org/unsd/environment/>
- <http://www.basel.int/>
- <http://themes.eea.eu.int/IMS/CSI>
- <http://waste.eionet.eu.int/>
- <http://www.etc-waste.int/>
- <http://europa.eu.int/comm/eurostat/>

## 34. TRANSBOUNDARY MOVEMENTS OF HAZARDOUS WASTES

### *General description*

**a) Brief definition:** The total amount of hazardous waste, as defined by the Basel Convention (Article 2), exported and imported by a country.

**b) Unit of measurement:** Metric tons per year.

### *Relevance for environmental policy*

**a) Purpose:** The transboundary movement of hazardous waste represents a driving force indicator. Trends in a country's export of hazardous waste show its response to the need to minimize the generation of hazardous waste and to reuse or recycle it domestically.

**b) Issue:** Toxic, explosive, oxidizing, corrosive, flammable, irritant, teratogenic, mutagenic, carcinogenic, ecotoxic and infectious waste are recognized as hazardous waste. The uncontrolled movement and dumping of this waste can cause severe health problems and can poison water and land for decades. Reuse and recycling of hazardous waste reduces the need for its transboundary movement and prevents risks to human health and the environment. In some instances transboundary movement is required for environmentally sound waste recovery and disposal. Transboundary hazardous waste movement may also be justified when waste is going to be used as a secondary raw material or for energy generation. Complete data on the export and import of hazardous waste help to control its safe movement and disposal.

**c) International agreements and targets:** Transboundary movement of hazardous waste is regulated by the Basel Convention through requirements for prior notifications and consents (Article 6). The Conference of the Parties to the Basel Convention, at its second meeting, banned transboundary movement of hazardous waste from Annex VII countries (EU, OECD and Liechtenstein) to non-Annex VII countries (resolution II/12). The third meeting of the Conference of the Parties amended the above resolution (resolution III/1). The Basel Convention does not provide any internationally agreed targets for the containment and reduction of transboundary movement of hazardous waste.

### ***Methodology and guidelines***

**a) Data collection and calculations:** The amount of exported and imported hazardous waste is regulated through prior notification at the side of export and written consent at the side of import as required by Article 6 of the Basel Convention. Data should be recorded on the amount, category and nature of each type of waste (whether hazardous or other waste according to Annex II to the Convention) subject to transboundary movement. Data should be available on a continuous basis through the application at the national level of notification and monitoring procedures for transboundary waste movement. The difficulty of establishing whether a particular waste is hazardous leads to problems in using waste information as an indicator of sustainable development. A special technical working group created under the Basel Convention was entrusted with determining which types of waste should be considered hazardous under the convention (Decision III/1 of the third meeting of the Conference of the Parties). The same working group categorized waste into types which should be considered as waste under all and any circumstances and other types which are not subject to the Convention (Annexes VIII and IX to the Convention). Illegal trade in hazardous waste poses additional problems.

**b) Internationally agreed methodology and standards:** Article 5 of the Basel Convention requires that Parties establish competent bodies responsible for administering notifications and issuing consents as well as establishing focal points which collect all relevant information on any transboundary movement of hazardous or other wastes (amount, properties, origin, methods of disposal, etc.). The seventh meeting of the Conference of the Parties to the Basel Convention adopted a decision on harmonization of lists of wastes and related procedures. In the EU, waste statistics (including on waste generation and waste disposal) are dealt with by a specialized regulation (2150/2002).

### ***Data sources and reporting***

Data on transboundary movement of hazardous wastes are collected by customs offices and by environmental protection authorities in frontier areas. The most reliable and complete information can be obtained from Basel Convention focal points or competent authorities, which are responsible for reporting to the Convention secretariat. This information is reviewed and compiled by the secretariat and is presented in an annual report which includes statistical tables and graphic representations of the data.

### ***References at the international level***

- Manual: Questionnaire on “Transmission of Information”. (Basel Convention for the Control of Transboundary Movement of Hazardous Wastes and Their Disposal).
- Regulation (EC) No. 2150/2002 of the European Parliament and of the Council of 25

November 2005 on waste statistics

- <http://www.basel.int/>
- <http://unstats.un.org/unsd/environment/>
- <http://waste.eionet.eu.int/>
- [http://themes.eea.eu.int/Environmental\\_issues/waste/indicators](http://themes.eea.eu.int/Environmental_issues/waste/indicators)
- <http://www.oecd.org/env/>
- <http://reports.eea.eu.int>
- <http://europa.eu.int/comm/eurostat/>
- <http://www.environmentalindicators.com>

## 35. WASTE REUSE AND RECYCLING

### *General description*

**a) Brief definition:** Waste reused or recycled as a share of the total waste in a country – in total, by sector (industrial and municipal solid waste) and by negative impact (hazardous waste).

**b) Unit of measurement:** Percentage.

### *Relevance for environmental policy*

**a) Purpose:** Waste reuse and recycling represents a response type indicator and shows the proportion of total waste, or of the specific category of waste, that is recycled.

**b) Issue:** Waste reuse and recycling is an important component of sustainable use of resources in general and sustainable solid waste management in particular. As the population continues to grow, the amount of land available for waste disposal is reduced, and waste has to be transported longer distances. When waste reuse and recycling are stimulated, landfill capacity is conserved and solid waste management expenditures are reduced. Increased reuse and recycling leads to a reduction in the environmental impacts of waste final disposal, such as methane and carbon dioxide gas emissions from landfill sites, and preserves natural resources. Reuse and recycling also tend to increase the population's income through employment in the waste reuse and recycling sector.

### **c) International agreements and targets:**

The EECCA Environment Strategy calls for the development of inter-sector waste management action plans and government support for waste treatment facilities.

In the EU, the Directive on packaging and packaging waste requires member countries to reuse and recycle a minimum of 55% and a maximum of 80% of packaging waste by 2008. The waste framework directive provides for increased efforts to prevent and reduce waste generation, recover wastes and develop new techniques for final disposal of waste. EU targets for recycling and re-use also cover end-of-life vehicles and waste from electrical and electronic equipment.

### *Methodology and guidelines*

**a) Data collection and calculations:** "Reuse and recycling" is defined as any reprocessing of waste material in a production process that diverts it from the waste stream, except reuse as fuel



(energy recovery). Reprocessing (whether into the same type of product or for different purposes) should be included. Reuse and recycling in industrial plants (i.e. at the place of generation) should be excluded. Assessment of reused and recycled waste requires precise assessment of total waste and the specific category of waste (industrial, municipal or hazardous). The indicator of waste reuse and recycling is derived by dividing the quantity of total and specific-category waste reused and recycled by the total quantity of waste and specific-category waste generated and expressing the result as a percentage. In addition, for municipal waste the proportion of reused and recycled waste may be presented as a percentage of reused and recycled components, such as metals, plastic, paper, glass, textiles or organic materials.

**b) Internationally agreed methodology and standards:** The UNSD/UNEP Questionnaire on Environment Statistics provides a methodology for calculating waste reuse and recycling. In the EU, waste statistics, including waste generation and waste disposal, are covered by a specialized regulation (2150/2002).

### *Data sources and reporting*

In EECCA, data on reuse and recycling of waste are collected by ministries responsible for urban affairs and the environment and by state statistical agencies.

### **References at the international level**

- European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste
- Regulation (EC) No 2150/2002 of the European Parliament and of the Council of 25 November 2005 on waste statistics
- Directive 2006/12/EC of the European Parliament and of the Council of 5 April 2006 on waste
- Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles
- Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE)
- <http://www.un.org/esa/sustdev/natlinfo/indicators/isd.htm>
- <http://unstats.un.org/unsd/environment/datacollect.htm>
- <http://europa.eu.int/comm/eurostat/>
- <http://waste.eionet.eu.int/>
- [http://themes.eea.eu.int/Environmental\\_issues/waste/indicators](http://themes.eea.eu.int/Environmental_issues/waste/indicators)

## **36. FINAL WASTE DISPOSAL**

### *General description*

**a) Brief definition:** The share of the total amount of waste generated – in total, broken down by sector (industrial and solid municipal waste) and broken down by negative impact (hazardous waste) – that is finally disposed of by (a) incineration (without energy recovery or use as a fuel) or (b) landfilling on a controlled site.

**b) Measurement unit:** Percentage.

### ***Relevance for environmental policy***

**a) Purpose:** The indicator provides a measure of the pressure on the environment and the response to the efficiency of the waste management system.

**b) Issue:** The way a country manages its waste has significant long-term implications for public health, the economy and the natural environment. Therefore it is essential to promote an environmentally sound waste treatment and disposal programme. Generally, adequate waste management indicates that the authorities are aware of the health and environmental risks and that they support or impose suitable measures to prevent or reduce waste. Reducing the amount of waste that needs to be disposed of reduces the demand for raw materials, leading to a reduction in resource extraction. For waste that is not suitable for reuse or recycling, incineration is often considered the next-best option (provided that the incineration plants comply with legislation for emission standards and that energy from waste incineration is recovered), as it reduces the overall volume of waste. If reuse, recycling and incineration are excluded, waste should be landfilled on a controlled site, with suitable technical control in line with national legislation. Controlled landfilling requires adherence to a permit system and technical control procedures in compliance with the national legislation in force. Other final disposal methods may include permanent storage.

### **c) International agreements and targets:**

The EECCA Environment Strategy calls for the development of inter-sector waste management action plans.

In the EU, there are two basic directives on final disposal of waste: the Directive on the landfill of waste and the Directive on the incineration of waste. The waste framework directive provides for increased efforts to prevent and reduce waste generation, recover wastes and develop new techniques for final disposal of waste.

### ***Methodology and guidelines***

**a) Data collection and calculations:** To measure the proportion of waste disposed of by different methods, a combination of several methods can be used. To avoid double counting, it is important to be aware of where in the waste flow the data are collected. Municipalities or industries should have data available on waste they manage. Also, waste management and disposal facilities such as incineration plants and landfills should be aware of the amounts they are processing. Waste collection companies are another potential source of data. However, data can be scattered, and their collection and compilation for indicator purposes can be time-consuming. Calculation of the waste incineration rate should consider only waste incinerated through the registered waste management system. Households or industries incinerating their own waste should not be included. Calculation of the landfill rate usually does not consider waste disposed of at illegal dumps.

**b) Internationally agreed methodologies and standards:** The UNSD/UNEP Questionnaire on Environment Statistics provides a methodology for calculating final disposal.

### ***Data sources and reporting***

In EECCA countries, data on final disposal of waste are collected by ministries responsible for urban affairs and environment and by state statistical agencies. Data on the generation and disposal of industrial waste are usually collected by the authorities responsible for the environment, while data on municipal waste generation and disposal are collected by state statistical agencies. Special statistical forms are used. Data on waste generation and disposal are published in national state-of-the-environment reports in some countries.

### ***References at the international level***

- UNSD/UNEP 2006 Questionnaire on Environment Statistics (waste section)
- United Nations. International Standard Industrial Classification of All Economic Activities. Series M No. 4, Rev. 3.
- *Europe's Environment: The Third Assessment* (EEA, 2003) (Kiev Assessment)
- Regulation (EC) No 2150/2002 of the European Parliament and of the Council of 25 November 2005 on waste statistics
- Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste
- Directive 2000/76/EC of the European Parliament and of the Council of 4 December 2000 on the incineration of waste
- Directive 2006/12/EC of the European Parliament and of the Council of 5 April 2006 on waste
- <http://www.un.org/esa/sustdev/natlinfo/indicators/isd.htm>
- <http://unstats.un.org/unsd/environment/questionnaire2006.htm>
- <http://www.basel.int/>
- [http://themes.eea.eu.int/Environmental\\_issues/waste/indicators](http://themes.eea.eu.int/Environmental_issues/waste/indicators)
- <http://themes.eea.eu.int/IMS/CSI>
- <http://waste.eionet.eu.int/>
- <http://www.etc-waste.int/>
- <http://europa.eu.int/comm/eurostat/>.