Group 1. Environmental consequences of transport

Indicator 1 - Energy consumption

Objective Reduce consumption of fossil energy by transport.

Definition Final energy consumption by transport mode (road, air, marine bunkers, rail, inland navigation) expressed in million tonnes of crude oil equivalent (mtoe).

Sub indicators
Final energy consumption by road transport
Final energy consumption by air transport
Final energy consumption by inland navigation
Final energy consumption by rail
Final energy consumption by marine bunkers

Concepts Final energy consumption is the actual energy used by transport mode corrected for losses in production and pipelines.

Final energy consumption for road transport is energy used for passenger and freight transport. Road transport includes transport by cars, vans and lorries, buses, taxis, motorcycles and mopeds.

Final energy consumption for air transport is energy used for domestic and international air transport.

Final energy consumption for inland navigation is energy used for domestic sea transport, e.g. for transport between two national ports. Fishing is not included.

Final energy consumption for rail is energy used for inland passenger and freight rail transport.

Final energy consumption by marine bunkers is energy used in international bunkering.

The final energy is expressed in e.g. PJ-Joule (10^{15} Joule) or the unit mtoe crude oil equivalents, where 1 unit mtoe = 41,868 PJ.

Methodology The final energy consumption for the various modes of transport can be compiled based on information from the supplying companies, e.g. the information from the oil companies about their sales for different purposes of use.

Problems related to methodology Often data concerning energy consumption by mode of transport is not present or comparable and alternatives have to be set up. In the European Odyssee database (4), an alternative to energy consumption is the so-called unit consumption of petrol for transport by vehicle x per equivalent car. This relates to total consumption of petrol to a stock of e.g. motorcycles, measured in terms of a number of equivalent cars.

The conversion of the actual stock of vehicle category x (e.g. motorcycles) into a stock of equivalent cars is based on a coefficient reflecting the difference in the average yearly consumption between each type of vehicle and the car. If, for instance, a motorcycle consumes on average 0,2 toe/year and a car 1 toe/year, one motorcycle is equal to 0,2 equivalent cars.

These coefficients can e.g. be determined from information about vehicle characteristics, distance travelled and specific consumption in transport statistics (litre/100 km).

There is an inherent inaccuracy in the final energy consumption for the various transport modes when based on information from the supplying companies. One reason is that sale and consumption do not always match for a given period, and another is that a minor part of the sale of energy is used for non-transport purposes.

If information on energy consumption is based on records from the supplying companies, the use of black market oil is for obvious reasons not included. This is in some countries of a significant size and must be estimated.

Relevant literature

1. Are we moving in the right direction? EEA 2000
2. Indicators tracking transport and environment integration in the EU EEA 2001
3. Transport and Environment statistics for the Transport and Environment Reporting Mechanism (TERM) for the European Union. Eurostat.
4. Data for the EU and reports can be found on the ODYSSEE homepage: (European Project and Database on Energy Efficiency Indicators) http://www.odyssee-indicators.org/odyssee.html
5. Energy Efficiency in Denmark: An analysis based on the ODYSSEE Data base from the SAVE project "Cross Country Comparison on Energy Efficiency Indicators, Phase 6", Dec. 2000, published by The Danish Energy Agency
6. EEA fact sheet, cf. http://themes.eea.eu.int/Sectors_and_activities/transport/indicators/consequences/transport_consumption/index_html

Indicator 2 - Air emissions

Objective

Meet the EU target under the Kyoto Protocol of the United Nations Framework Convention on Climate Change. (CO_2, N_20, CH_4)

Meet EU and/or international (long range-transboundary air pollution Convention) emission reduction targets. ($N0_x$, NMVOCs, SO_2, PM_{10})

Definition

Annual air emissions of Carbondioxide (CO_2), Nitrous oxides (N_20) and Methane (CH_4) – with a focus on transport.

Annual air emissions of ozone precursors, Nitrogen oxides ($N0_x$), Non-methane volatile organic compounds (NMVOCs), Sulphur dioxide (SO_2) and fine particles (PM_{10}).

Sub-indicators

Air emissions of CO_2, N_20 and CH_4 for:
Road transport
Rail transport
Air traffic
Inland navigation

Air emissions of $N0_x$, NMVOCs, SO_2 and PM_{10} for:
Road transport
Rail transport
Air traffic
Inland navigation

Concepts

Emissions are masses of materials emitted to the air as the result of an activity.

The emissions for the above materials are calculated in accordance with the international CORINAIR system (CO-ordination of Information on AIR emissions), which is a common European system for reporting air emissions. The CORINAIR system covers not only the transport sector but is a general emission reporting system. Other major sectors are the energy sector and the industry sector.

The CORINAIR calculation principle is to calculate the emissions as the volume of activities multiplied by corresponding emission factors.

- An activity is a specific process generating emissions.
- An emission factor is the mass of emissions per activity unit for a specific activity. (e.g. emissions of gram of CO_2 per litre combusted petrol used by the given activity)

For the materials, emissions from road transport are air emissions for sector 7 in CORINAIR. This sector consists of the sub sectors in SNAP-codes:

- 701 passenger cars,
- 702 light duty vehicles < 3,5 tonnes,
- 703 heavy duty vehicles and busses > 3,5 tonnes,
- 704 mopeds and motorcycles < 50 cm^3,
- 705 motorcycles > 50 cm^3,
- 706 gasoline evaporation from vehicles,
- 707 automobile tyre and brake wear.

Emissions from rail transport are emissions according to sub-sector
- 802 shunting locs, rail cars and locomotives.

Emissions from air traffic are emissions according to sub-sector
- 805 air traffic.

Air traffic: Domestic and international, airport and cruise traffic.

Emissions from inland navigation are emissions according to sub-sectors
- 803: Inland waterways
- 804: Maritime activities

Inland waterways include sailing boats with auxiliary engines, motorboats/work boats, personal watercrafts and inland goods carrying vessels.

Maritime activities include national fishing and ships sailing from one inland port to another inland port (national sea traffic) and marine bunkers for international sea traffic.

Methodology

Information on activities to carry out the CORINAIR inventory may be obtained from the national Transport and Energy Statistics, and information about the emission factors.

The most consistent emission factors should be used and could be either measured values or default factors proposed by the CORINAIR methodology.

Problems

There is no agreement on which emission calculation model and emission reporting system that is the most appropriate. The COPERT model (COmputer Programme to calculate Emissions from Road Transport) and the CORINAIR-system is only one of several possibilities.

Basic data for the parameters in the chosen calculation model are not always available. In that case default or assumed values have to be used.

Relevant literature

1. Are we moving in the right direction? EEA 2000
2. Indicators tracking transport and environment integration in the EU EEA 2001
3. Transport and Environment statistics for the Transport and Environment Reporting Mechanism (TERM) for the European Union. Eurostat.
4. EMEP/CORINAIR Emission Inventory G Technical report No.30 Guide-book 3rd edition. (This report contains a comprehensive description of the sectors in the CORINAIR system and the SNAP-codes for all the sub-sectors.). Website: http://reports.eea.eu.int/technical_report_2001_3/en
5. The Danish CORINAIR inventories, Technical report no 287. Website http://www.dmu.dk/1_viden/2_Publikationer/3_fagrapporter/rapporter/fr287.pdf (contains the same definitions as in 1.)
6. EU-Council Directive 70/220/EEC concerning decreasing emissions from mobile sources (as e.g. passenger cars).
7. Directive 96/44/EU adapting to technical progress Council Directive 70/220/EEC on the approximation of the laws of the Member States relating to measures to be taken against air pollution by emissions from motor vehicles.
8. EU-Parliament and Council Directive concerning national emissions limitations: KOM (99) 0125-99/0067
9. ReportER, Toll to Report Emissions Register data (under contract to EEA): Website: http://www.spirit.sk/products/corinair/e_reporter.html
10. EEAs homepages (inclusive fact sheets): http://reports.eea.eu.int/ENVISSUENo12/en/page007.html
11. http://themes.eea.eu.int/Sectors_and_activities/transport/indicators/consequences/GHG/index_html
12. http://themes.eea.eu.int/Sectors_and_activities/transport/indicators/consequences/air_pollutants/Emissions_of_air_pollutants_TERM_2001.doc.pdf
13. Lithuanian homepage: www.lt.eionet.eu.int

Indicator 3 - Exceedances of air quality standards

Objective Meet EU air quality standards.

Definition Exceedances of EU air quality standards.

Percentage of the population exposed to exceedances of EU air quality standards.

Sub-indicators Exceedances of EU air quality standards for:
Benzene (C_6H_{12}), Carbon monoxide (CO), Lead (Pb), Nitrogen dioxide (NO_2), Ozone (O_3) and Particulate matter (PM_{10}).

Percentages of population exposed to exceedances of proposed EU urban air quality standards for:
Benzene (C_6H_{12}), Carbon monoxide (CO), Lead (Pb), Nitrogen dioxide (NO_2), Ozone (O_3) and Particulate matter (PM_{10}).

Concepts Exceedances of EU air quality standards are (according to the Auto-oil programme ll for pollutants):

Pollutant	Averaging Period	Air quality standards and objectives
C_6H_{12}	Calendar year	5 μg/ m^3
CO	8 hours	10 mg/ m^3
Pb	Calendar year	0,5 μg/ m^3
NO_2	Calendar year	40 μg/ m^3
	1 hour	200 μg/ m^3 not to be exceeded more than 8 (18) times a calendar year
O_3	Daily 8-hour max.	120 μg/ m^3 not to be exceeded more than 20 days per calendar year
PM_{10}	24 hours	50 μg/ m^3 not to be exceeded more than 7 (35) times a calendar year
	Calendar year	20μg/ m^3 (40 μg/ m^3)

Source: Are we moving in the right direction?

Methodology Statistics on exceedances of limit values can be obtained using a model in the Auto-Oil II programme. The input to the model is concentrations of the pollutants measured by e.g. urban measurement stations in main urban areas. Those measurements are co-ordinated by EEA under the AirBase, (air quality information system of the EEA). AirBase contains a database with information submitted by participating countries from across Europe. This information comprises air quality data for a selection of stations and a number of components, and background information on air quality monitoring networks and stations. The two preceding EU databases APIS (Air Pollution Information System; air quality data) and GIRAFE (background information on air quality networks and stations) are now included in and replaced by the AirView (AIR quality Visualisation Instrument for Europe on the Web) web-application, which facilitates free access to all information contained in AirBase.

Problems related to definitions For the time being, there is no distinct method to calculate the percentages of the urban population exposed to exceedances of air quality standards. However, some studies have been made by EEA, ETC/ACC (The European Topic Centre on Air and Climate Change, established by EEA in 2001) by combining population data with calculated values (4).

Relevant literature

1. Are we moving in the right direction? EEA 2000
2. Indicators tracking transport and environment integration in the EU EEA 2001
3. Transport and Environment statistics for the Transport and Environment Reporting Mechanism (TERM) for the European Union. Eurostat.
4. European Environment Agency, European Topic Centre on Air and Climate change's website; http://etc-acc.eionet.eu.int/

   This centre is built on experiences from the former EEA, ETC-AQ which no longer exists.
5. The AirView website: http://etc-acc.eionet.eu.int/databases/airview.html
6. EEA fact sheet, cf. http://themes.eea.eu.int/Sectors_and_activities/transport/indicators/consequences/air_quality/Air_Quality_TERM_2001.pdf

Indicator 4 - Traffic noise: Exposure and annoyance

Objective Reduce number of people that are exposed to and annoyed by high traffic noise levels (i.e. noise levels which endanger health and quality of life).

Definition Percentage of population exposed to transport noise.

Percentage of population highly annoyed by transport noise of the various modes.

Sub-indicators Percentage of population exposed to transport noise from:

Road traffic.
Rail traffic.
Air traffic.

Percentage of population annoyed by transport noise from:

Road traffic.
Rail traffic.
Air traffic.

Concepts Exposure is classified to four noise dB-levels (45-55 dB, 55-65 dB, 65-75 dB, 75+ dB), where the decibel level is the so-called Ldn-Day-night level, which gives a penalty of 10 dB for night-time noise.

There is no clear definition of noise annoyance.

Methodology Data for exposure by transport noise may be obtained from National Road, Rail and Air authorities.

There are only few pilot studies and rough estimates which have been conducted by the Member States concerning noise annoyance, e.g. EEA has conducted some pilot studies (1).

Problems A lot of methodological problems concerning knowledge and lack of data are connected to an adequate assessment of noise exposure as well as noise annoyance (1).

Relevant literature

1. Are we moving in the right direction? EEA 2000
2. Indicators tracking transport and environment integration in the EU EEA 2001
3. EEA fact sheet, cf.
   http://themes.eea.eu.int/Sectors_and_activities/transport/indicators/consequences/noise_exposure/Noise_TERM_2001.doc.pdf

Indicator 5 - Proximity of transport infrastructure to designated nature areas/Fragmentation

Objective

Preserve biodiversity and ensure connectivity between nature areas.

Preserve biodiversity and protect designated nature areas.

Definition

Size of non-fragmented areas i.e. parcels not fragmented by transport infrastructure.

Size of non-fragmented forest areas.

Special bird areas and wetlands, which have a major transport infrastructure within 5 km of their centre.

Sub-indicators

Average size of land parcels not fragmented by transport infrastructure.

Average size of forest areas not fragmented by transport infrastructure.

Number of special bird areas (SPAs) and wetland areas (Ramsar Wetlands) designated for nature protection, which have a major transport infrastructure within 5 km of their centre.

Concepts

Special bird areas (SPA) are nature areas designated by EC Birds Directive.

Ramsar wetlands are nature areas designated in the global Ramsar Convention for the protection of wetlands.

Average size of land parcels/forest areas not fragmented by transport infrastructure is defined as the average size of contiguous land/forest units, measured in square-km, which are not cut through by major transport infrastructure.

Major transport infrastructure is defined as motorways, national and principal roads, railways, airports and seaports.

Methodology

This indicator is compiled by the international organisations EEA (European Environment Agency) and ETC-LC (European Topic Centre on Land Cover).

Relevant literature

1. Are we moving in the right direction? EEA 2000
2. Indicators tracking transport and environment integration in the EU EEA 2001
3. Council Directive 79/409/EEC on the conservation of wild birds – consolidated version 31.05.95 (Annex I)
4. The Ramsar Convention on Wetlands' website: http://www.ramsar.org/
5. EEA fact sheet, cf.

   http://themes.eea.eu.int/Sectors_and_activities/transport/indicators/consequences/fragmentation/Fragmentation_TERM_2001.doc.pdf

   http://themes.eea.eu.int/Sectors_and_activities/transport/indicators/consequences/proximity/Proximity_to_designated_sites_TERM_2001.doc.pdf

Indicator 6 - Land-take

Objective Minimise land-take per transport unit.

Definition Annual land-take by transport mode. (Direct and indirect land-take).
Land-take efficiency: The ratio between land used and the infrastructure's traffic carrying capacity.

Sub-indicators Annual land-take by transport infrastructure:

Roads

Railways

Canals

Airports

Concepts Land-take is direct land-take (e.g. area covered by the transport infrastructure) and indirect land-take (e.g. land-take associated by security areas, parking, stations, and service areas etc.)

Land-take efficiency is the ratio between land used for transport purposes and the traffic carrying capacity (e.g. hectares/ passenger km. for roads) of the infrastructure.

Annual land-take is measured in hectares or in percent of the total country area.

Methodology Only limited data exist for land-take by transport infrastructure in the Member States.

Data on the length of roads, number of lanes and estimates of the average width of roads by type of road can be used for estimation of the land-take.

Only few estimates for land-take efficiency in the Member States are made.

Relevant literature

1. Are we moving in the right direction? EEA 2000
2. Indicators tracking transport and environment integration in the EU EEA 2001
3. EEA fact sheet, cf.
   http://themes.eea.eu.int/Sectors_and_activities/transport/indicators/consequences/land_take/Land_take_TERM_2001.doc.pdf

Indicator 7 - Traffic accident fatalities

Objective Reduce substantially the annual number of transport fatalities and injuries.

Definition Number of persons killed each year in transport accidents by mode.

Sub indicators Number of persons killed in a year by

Road

Rail

Air

Sea

The fatality rate is obtained by dividing the number of fatalities per transport mode by the corresponding number of passenger-km (generally expressed as the number of deaths per billion passenger-km).

Indicators for injured persons are added from 2001.

The traffic modes air and sea are so far not considered in detail.

It is the policy of the EU Commission to reduce the number of fatalities in road traffic to a maximum of 27,000 by 2010 (8).

7.1 Road traffic accidents

Concepts A road injury accident is an accident involving at least one road vehicle in motion on a public road or private road to which the public has right of access, resulting in at least one injured or killed person (7).

Road vehicles are vehicles running on wheels and intended for use on roads (6).

Casualties are either

- Killed (fatalities): Any person killed immediately or dying within 30 days as a result of an injury accident (7). Suicide, criminal or natural death is not considered a result of a traffic accident.
- Injured: Any person not killed, but who sustained an injury as result of an injury accident, normally needing medical treatment (7).

Methodology Two separate data sources are available for casualties in connection with road traffic accidents

- Records from the police
- Records from the health sector

In Lithuania as in many other countries (including Denmark) statistics on road traffic accidents are based on police records.

If a country applies a diverting definition of a killed person, conversion coefficients should be estimated so that comparisons on the basis of the 30-day-definition can be made.

Problems related to the methodology In general data coming from the police records are reliable as regards fatalities, but injured persons are underrated in the police records. In Denmark an ad hoc survey (1996 (2)) has proved that compared with records from the health sector (casualty departments), the police records only accounted for 21 per cent of the total number of persons injured in road traffic accidents. In general the fatalities are well covered

when the indicator is based on police records but there is a severe underestimation as regards injured persons.

Further, there is no agreed methodology for reporting on injuries and hence datasets are not comparable across Member States (1, p. 43). Even the applied definitions of severe casualties may vary among the European countries.

This may be the reason for giving the highest priority to the fatality indicator.

7.2 Rail accidents

Concepts

A railway operating accident is an accident occurring on main lines or service tracks operated by the railway, associated with railway stock movements on open tracks or on station premises and resulting in death of a person or a serious injury, or in extensive damage to stock, track or other installations, or extensive disruptions to traffic. Accidents in workshops, warehouses and depots are excluded. UIC (13)

- Persons killed (fatalities): Death of person instantaneous or within 30 days as a result of an accident, excluding suicides, criminal or natural death. UIC (13).
- Persons injured: Any person not killed as a result of a rail accident but who sustained a serious injury involving incapacity to work for more than 14 days, inclusive of the day of the accident, excluding attempted suicide. UIC (13)

Methodology

Data on rail traffic accidents are in general recorded by the network supplier and at least for the principal railway lines reported to UIC.

Problems related to the methodology

Three types of victims are generally considered: Passengers, employees and others. All should be reported. As for road traffic accidents it applies also for rail that there is no agreed methodology for reporting on injuries.

Both statistics on road traffic accidents and statistics on rail traffic accidents will according to the definitions include accidents at level crossings between roads and railways. In order to avoid double counting comparing road and rail accidents, accidents in level crossings should be reported separately.

The number of deaths caused by rail traffic is relatively small and far below the number of fatalities in road transport. Therefore the annual rail fatality rate is highly dependent on the occurrence of major accidents in the year of observation. For that reason the rail fatality rate should rather be calculated for a longer period than a year.

Relevant literature

1. Are we moving in the right direction? EEA 2000
2. Indicators tracking transport and environment integration in the EU EEA 2001
3. Transport and Environment statistics for the Transport and Environment Reporting Mechanism (TERM) for the European Union. Eurostat.
4. Council Decision 93/704/EC on the creation of a Community database on road accidents.
5. Færdselsuheld 2000 (Road traffic accidents), Statistics Denmark 2001.
6. Glossary for Transport statistics. Eurostat/ECMT/UNECE
7. TRANS/WP.6/2001/8. Draft Glossary on road traffic accidents
8. Council Decision 93/704/EC on the creation of a Community database on road accidents.
9. Færdselsuheld 2000 (Road traffic accidents), Statistics Denmark 2001.
10. Glossary for Transport statistics. Eurostat/ECMT/UNECE
11. TRANS/WP.6/2001/8. Draft Glossary on road traffic accidents

12. Transport 2000, Statistics Denmark 2000
13. Railway Operating Accidents, Table A91 of UIC questionnaire
14. EEA fact sheet, cf.
http://themes.eea.eu.int/Sectors_and_activities/transport/indicators/consequences/accidents/Transport_accident_fatalities_TERM_2001.doc.pdf
15. White Paper: European transport policy for 2010: time to decide
COM (2001) 370, September 2001