Group 6. Technology and utilisation efficiency

Indicator 20 - Energy and CO_2 intensity

Objective

Reduce energy use per transport unit (passenger-km or tonne-km).
Reduce CO_2 - emissions per transport unit.

Definition

Energy intensity of passenger and freight transport, i.e. energy consumption per unit of transport activity (MJ/ passenger-km and MJ/ tonne-km) by mode.

Fuel efficiency of new cars and of the total car fleet, i.e. fuel use per km. (litre/100 km)

Specific CO_2 emissions for passenger and freight transport (emissions per passenger-km and tonne-km[1])

Sub-indicators

MJ per passenger-km by transport mode (passenger transport).
MJ per tonne-km by transport mode (freight transport).

Fuel efficiency: Fuel use per km (litre per 100 km).

Concepts

The indicators are ratios between energy use and passenger-km/tonne-km for respectively passenger and freight transport, cf. indicator 1, 8 and 9.

The energy use by mode can be expressed in joules or in crude-oil equivalents.

The calculation factors are:

1 koe = 41,868 MJ
1 toe = 41,868 GJ
1 Mtoe = 41,868 PJ
1 kWh = 3,6 MJ

The fuel efficiency for the total car fleet and for all new cars is the quantity of petrol/diesel used for driving 100 km. (litre /100 km).

New cars are defined as new registered cars, e.g. cars registered for the first time. The types of cars considered are petrol and diesel driven cars (used by private households or by companies).

The total car fleet is all cars (used by private households or by companies), regardless of age.

Problems related to concepts

The energy consumption related to passenger transport depends on the need of people to be transported. The amount of energy needed to fulfil the demand of passenger transport depends on three factors: The number of passengers per trip, the actual number of kilometres each passenger needs to be transported and transport mode (car, bus etc.).

The total demand for passenger transport can be calculated by adding up every passenger's transport – measured as the total amount of kilometres for each passenger's transportation in a given year. However, there is often a lack of such detailed data, and as a substitute can be used an estimate of the passenger demand by multiplying the number of kilometres performed by each mode (bus, car, etc.) with the average number of passengers.

The same considerations can be made for freight transport.

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[1] See the more precise definitions of the various transport modes for passenger and freight transport in indicator 21.

Methodology

Cf. indicators 1, 8 and 9.

Data for fuel efficiency can be produced from the transport statistics if it is based on a car-register with sufficient data for the fuel use for the distribution of cars or there exists fuel-consumption data for each car.

The energy use for passenger/freight transport by mode can be found in the energy statistics.

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. European data and reports can e.g. be found on the ODYSSEE homepage: (European Project and Database on Energy Efficiency Indicators) http://www.odyssee-indicators.org/odyssee.html
4. EEA fact sheet, cf. http://themes.eea.eu.int/Sectors_and_activities/transport/indicators/technology/efficiency/Energy_efficiency_and_specific_CO2_emissions_TERM_2001.pdf

Cf. literature for indicators 1, 8 and 9.

Indicator 21 - Specific emissions

Objective Reduce emissions per transport unit (passenger-km or tonne-km).

Definition Emissions of air pollutants per transport unit distinguishing between type (freight or passenger), mode and vehicle category.

Sub-indicators

Passenger transport:

Emissions per passenger-km of CO, PM, VOC, NO_x

Freight transport:

Emissions per tonne-km of CO, PM, VOC, NO_x

Methodology Emissions per transport mode can e.g. be found in the CORINAIR database. (See indicator 2 for more details).

The passenger-km/ton-km for transport mode can be found in transport statistics (cf. indicators 8 & 9 for more details).

Problems As for indicator 20 it applies also here that – if data are available – it is better to use a bottom-up approach rather than simply dividing aggregated emissions by performance. Cf. also indicators 2, 8 and 9.

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/technology/emissions/Specific_emissions_TERM_2001.doc.pdf

Cf. literature for indicators 2, 8 and 9.

Indicator 22 - Occupancy rates of passenger vehicles

Objective Improve the efficiency of passenger transport by increasing vehicle occupancy rates.

Definition Occupancy rate is the average number of passengers in a vehicle (cars, buses, trains, aircraft).

Sub- indicators
Occupancy rate for cars
Occupancy rate for buses
Occupancy rate for trains
Occupancy rate for aircraft

Concepts The occupancy rate is calculated as ratio between the transport performance (passenger-kilometres) and the supplied vehicle-km.

A vehicle-kilometre is a unit of measure representing movement of a vehicle over one kilometre (4).

Methodology For a bus or a railway vehicle the passenger-kilometres may be obtained from ad hoc surveys on embarking and disembarking passengers per stop of the vehicle or from data on ticket-sales.

For passenger cars the sources may be observation from the roadside of the number of passengers in the vehicles or data from household surveys on persons per car journey.

For air transport the data may be obtained from the airports. The draft Council Regulation on statistics on air transport (5) requests information on passengers and number of flights.

Problems The calculation of occupancy rates requires parallel concepts and definitions of passenger-kilometres and vehicle-kilometres. If one is based on national vehicles on national territory and the other has another basis there is a severe problem.

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. Glossary for Transport statistics. Eurostat/ECMT/UNECE
5. Proposal for a Council Regulation (EC) on statistical returns in respect of carriage of passengers, freight and mail by air (95/C 325/08)
6. EEA fact sheet, cf. http://themes.eea.eu.int/Sectors_and_activities/transport/indicators/technology/occupancy/Occupancy_rates_TERM_2001.pdf

Indicator 23 - Load factors

Objective Increase vehicle load factors in order to reduce the growth in freight transport vehicle-km.

Definition The load factor is the ratio of the average load to total vehicle freight capacity (vans, lorries, train wagons, ships).

Empty haulage is calculated as the percentage of vehicle-kilometres run empty.

Sub-indicators
Load factor for vans
Load factor for lorries/semi-trailers
Load factor for train wagons
Load factor for ships
Empty haulage for lorries

23.1 Load factor

Methodology The load factor is the ratio of the average load to total vehicle freight capacity (EEA). The calculation of the load factor requires information on the freight capacity of the means of transport in question.

For road vehicles the load capacity is the maximum permissible load weight of the vehicle according to national law of the country of registration of the vehicle. As the various countries apply different rules for the capacity, the load weight may vary for the same vehicle. That may affect comparisons between countries. To avoid any misinterpretation of the definition one should stick to the classification made by the country of registration. The data relevant for the calculation of the indicator are submitted to Eurostat according to Council Regulation on road goods statistics (5)

The capacity data necessary for the calculation of the indicator for rail transport is not requested by the draft Council Regulation on rail statistics (6). The railway operators may however be able to estimate the load capacity on basis of the average capacity of the wagons hauled.

For ships the freight capacity is equal to the deadweight, DWT, that is the difference in tonnes between the displacement of a ship on summer load-line in water with a specific gravity of 1,025 and the total weight of the ship, i.e. the displacement in tonnes of a ship without cargo, fuel, lubricating oil, ballast water, fresh water and drinking water in the tanks, usable supplies as well as passengers, crew and their possessions (4). Note that part of the freight transported by sea is carried by ferries that also transport passenger cars with accompanying drivers. Here, the capacity is normally adjusted, the passenger cars more than the lorries. DWT is for the time being an optional variable in the Council Regulation on sea transport (4)

Problems The calculation of the load factor using the actually transported volume of goods as the denominator gives only one picture of reality. In distributing journeys the average load will on average be only half of the loaded volume so the actual transport performance will only be half as big as the load factor indicates. And many short journeys with low load factor may outbalance a high performance of a longer journey. For that reason a load factor may also be calculated as the ratio between the transport performance in tonnes-kilometres and the possible supply of tonnes-kilometres by the vehicles involved.

It is recommended that both measures of capacity are applied for calculations of the use of capacity.

EEA notes that the relevant data may not always be available. Instead the ratio of tonne-kilometres to performed vehicle-kilometres can be applied. In that case the development in the calculated load factor may deviate from the real one because of e.g. change in the share of empty runs.

23.2 Empty haulage

Methodology

Empty haulage is calculated as the percentage of vehicle-kilometres run empty. It can be calculated for road vehicles as well as for rail vehicles.

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 Directive 95/64/EC of 8 December 1995 on statistical returns in respect of carriage of goods and passengers by sea
5. Council Regulation (EC) No 1172/98 of 25 May 1998 on statistical returns in respect of the carriage of goods by road
6. Proposal for a Regulation of the European Parliament and of the Council on rail transport statistics (2001/C 180 E/07)
7. Glossary for Transport statistics. Eurostat/ECMT/UNECE
8. EEA fact sheet, cf. http://themes.eea.eu.int/Sectors_and_activities/transport/indicators/technology/load/Load_factors_TERM_2001.doc.pdf

Indicator 24 - Uptake of cleaner fuels

Objective Switch to more environmentally friendly fuels (e.g. phase out leaded petrol).

Definition Market share of cleaner fuels (unleaded petrol and low-sulphur fuel) and alternative fuels (electricity, liquefied petroleum gas (LPG), natural gas, alcohol mixtures, hydrogen and bio-fuels).

Sub-indicators Market share of:

Cleaner fuels:
Unleaded petrol and low sulphur fuel

Alternative fuels:
Electricity
Liquefied petroleum gas (LPG)
Natural gas
Alcohol mixtures
Hydrogen
Bio fuel

Concepts Market share of unleaded petrol: The percentage of the total petrol sales sold as unleaded petrol.

Market share of the alternative fuels: The percentage of consumption (expressed in energy units) of each type of alternative fuels related to the total volume of cleaner fuels and alternative fuels for transport.

Transport: Road transport, rail transport, air transport, inland navigation and inland waterways.

Methodology Information about the market share for unleaded fuels may be obtained from the supplying companies, e.g. the oil companies.

The market shares of alternative fuels may be obtained from information for the supplying companies.

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 Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EEC
5. EEA fact sheet, cf. http://themes.eea.eu.int/Sectors_and_activities/transport/indicators/technology/clean_fuel/Uptake_of_cleaner_and_alternative_fuels_TERM_2001.doc.pdf

Indicator 25 - Size and average age of vehicle fleet

Objectives Improve the fleet composition by replacing older, more polluting vehicles with newer, cleaner ones.

Definition Vehicle fleet size and average age (road, rail, air vehicles)

Sub-indicators Passenger car fleet

Size
Average age

EEA has not defined indicators for rail vehicles and aircraft

Concepts Passenger car is a road motor vehicle other than a motorcycle, intended for the carriage of passengers and designed to seat no more than nine persons (including the driver). Cars include taxis and may also include pick-ups. (1)

Problems related to the concepts According to the Glossary (1) vehicles designed to transport both passengers and goods should be classified either among the passenger road vehicles or among the goods road vehicles, depending on their primary purpose. The level of information on the primary use of the vehicle may vary among countries and impact the statistics.

Methodology Data on cars can be obtained from the vehicle registers. If age data are not available they can be modelled using long time-series of stocks and flows and balancing using a Weibull distribution to represent the failure (end of life) rate.

Problems related to the methodology The statistics require an updated and reliable vehicle register with information of the first day (year) of registration.

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. Glossary for Transport statistics. Eurostat/ECMT/UNECE
5. EEA fact sheet, cf. http://themes.eea.eu.int/Sectors_and_activities/transport/indicators/technology/age/Average_age_of_the_vehicle_fleet___TERM_2001.pdf

Indicator 26 - Compliance with emission standards

Objective Improve compliance with emission standards.

Sub-indicators Share of the vehicle fleet that complies with EU emission standards (EURO I and EURO II).

Share of aeroplane fleet that complies with ICAO noise standards.

Concepts Share of the private and commercial petrol and diesel driven car fleet fitted with catalytic converters.

Share of the private and commercial air fleet that complies with the ICAO-noise standards (Chapters I - IV).

Chapter II is a noise standard to jet powered aircrafts designed before Oct. 1997. (E.g. Boeing 727 and Douglas DC-9).

Chapter III contains a stricter standard than that in chapter II. Boeing 767 and Airbus A319 are examples of "Chapter III" aircraft types.

In June 2001, a new even more logical standard, chapter IV was adopted based on recommendations made by the fifth meeting of the Committee on Aviation Environmental Protection (CAEP/5). Commencing 1 January 2006, the new standard will apply to newly certificated aeroplanes and to chapter III aeroplanes for which re-certification to chapter IV is requested.

Methodology The data concerning the total car fleet can be constructed if the transport statistics are based on a car register containing information about catalytic converters for the individual cars.

The data concerning the total air fleet can be found, if an air-worthiness register, with information about the noise standards for the air fleet is applied.

Problems Often statistics about cars fitted with catalytic converters and information about noise standards for the air fleet is missing and estimates has to be made.

A possible estimate for the share of the car fleet fitted with catalytic converters can be made by assuming that all cars registered for the first time after catalytic converters were made mandatory by law, 1993 for the EU member states, is fitted with catalytic converters.

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. The International Civil Aviation organisation's homepage: http://www.icao.int/
   http://www.icao.int/icao/en/env/noise.htm
5. EEA fact sheet, cf.
   http://themes.eea.eu.int/Sectors_and_activities/transport/indicators/technology/fleet/index_html