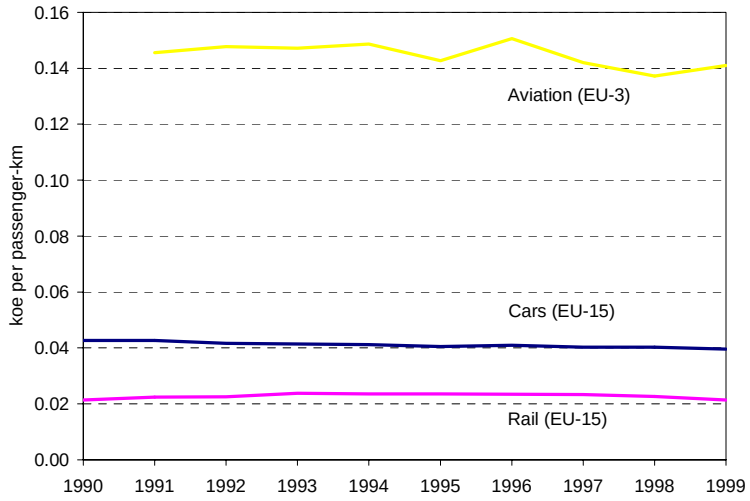
Indicator fact sheet

TERM 2002 27 EU — Overall energy efficiency and specific CO_2 emissions for passenger and freight transport (per passenger-km and per tonne-km and by mode)

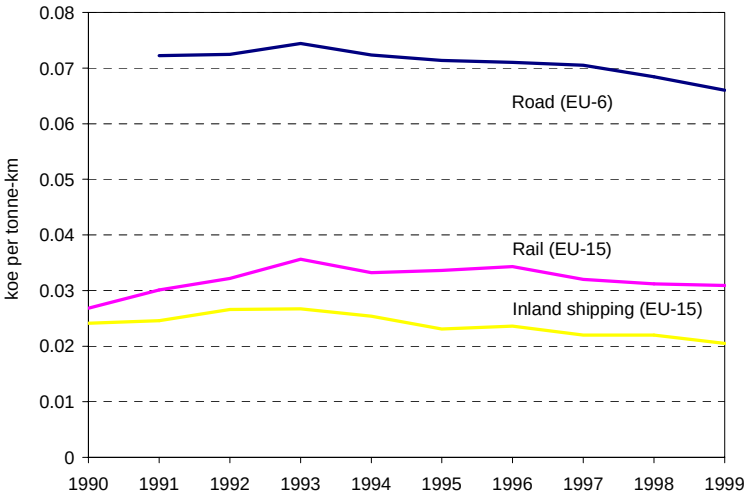
😐 **The energy efficiency of passenger cars has improved over the past decade, partly due to the voluntary agreement with the car industry to reduce CO_2 emissions from new cars, but also due to a shift from petrol to diesel cars. Trucks also slightly improved their energy efficiency over the past decade, but they consume significantly more energy per tonne-kilometre than rail or ship transport. The energy efficiency of rail has remained stable in recent decades; that of ships improved a little. Despite improvements during the 1990s, aviation continues to be the least energy efficient mode.**

Figure 1: Energy efficiency of car, rail and air passenger transport, 1990–99



Source: Odyssee, 2002.

Figure 2: Energy efficiency of road, rail and inland waterway freight transport, 1990–99



Source: Odyssee, 2002.

Results and assessment

Policy relevance

The European climate change programme (European Commission, 2000a), the sustainable development strategy (European Commission, 2001a) and the sixth environmental action programme (European Commission, 2001b) all point out climate change as a priority area for action. Since transport is one of the biggest energy consumers, it is therefore a priority area for energy efficiency improvement and thus CO_2 emission reductions (European Commission, 2002a).

Energy efficiency improvements can be achieved by limiting fuel consumption per vehicle-kilometre (improving energy efficiency), increasing occupancy rates and load factors (reducing emissions per passenger-kilometre or tonne-kilometre), or by using high-quality (or alternative) fuels (limiting CO_2 emissions per unit of fuel uptake). Specific targets for transport energy efficiency (or specific CO_2 emission reductions) are, however, not set.

Policy context

Along the lines with the European climate change programme, the sustainable development strategy and the sixth environmental action programme (6EAP), the basic pillars to improve energy efficiency of transport are:

- shifting to less energy consuming modes (like rail and water);
- reduction of congestion; and
- promotion of alternative fuels (like biofuels).

Only the 6EAP includes the strategy to research and exploit engine technologies offering higher (energy and emission) efficiency. It also states the need for special attention in this respect to the aviation sector.

The Commission's action plan to improve energy efficiency in the European Community (European Commission, 2000b) addresses improving energy efficiency. The action plan proposes, among other measures, enhancing the integration of energy efficiency considerations into other non-energy policy and programme areas (like the transport sector) and measures for re-focusing and reinforcing existing successful Community energy-efficiency measures. Measures to enhance the integration of energy efficiency into non-energy policy programme areas include incentives for optimal occupancy of vehicles, promotion of new and alternative infrastructure and, subsequently, modal shifting and modal integration, management alternatives to air transport, completion of the internal market in rail transport and changing behaviour regarding mobility. With respect to re-focusing and reinforcing successful current energy-efficiency policies and measures, the action plan emphasises the need to fully implement and monitor the voluntary agreements with the car manufacturing industry, and to provide additional incentives to accelerate the rate of compliance, through further action on vehicle fuel economy and improved pricing.

Against the background of the Kyoto Protocol, the EU has adopted a strategy to cut the average CO_2 emissions of new cars sold in the EU by around one third. This strategy consists of three elements.

1. Agreements with car manufacturers to reduce new car CO_2 emissions mainly by technological innovation. The three commitments with the European (ACEA), Japanese (JAMA) and Korean (KAMA) car manufacturers associations contain the same quantified CO_2 emission objective for the average new passenger car sold in the European Union, i.e. 140 g CO_2/km (to be achieved by 2009 by JAMA and KAMA and by 2008 by ACEA).
2. A fiscal framework for measures to reduce CO_2 emissions from new cars.
3. Improving consumer information on the energy efficiency of new cars (car labelling directive — 1999/44/EC).

This strategy is monitored annually (see Box 1). The overall final objective is to achieve an average specific CO_2 emission figure for new passenger cars of 120 g CO_2/km by 2005, and 2010 at the latest.

Additionally, two research programmes need mentioning: Thermie and SAVE.

- The Thermie programme (European Commission, 1994) of the Commission aimed to promote more efficient energy technology. The programme, now closed, had a budget of about EUR 700 million. The Thermie programme now forms part of the specific programme on research, technological development and demonstration on energy, environment and sustainable development for 1998–2002 (European Commission, 1999b). Priorities in this programme are given to an integrated approach to improving energy efficiency in transport, among others.
- The SAVE programme was adopted by the Council in 1996 for a five-year period (European Commission, 1999c). It now forms part of the energy framework programme for 1998–2002 (European Commission, 2000c). It has several priorities for the transport sector. These include measures to increase the use of energy-efficient transport in European cities for both passengers and freight, including the optimal occupancy of vehicles (both public and private), promotion of new and alternative infrastructure, management alternatives to air transport and changing behaviour. For 2000–02, emphasis is placed on information dissemination and reducing the use of private cars, encouraging collective transport modes and seriously considering how to reduce the need for transport.

Environmental context

Transport accounts for almost one third of final energy consumption (see TERM 2002 01 EU — Energy consumption) and around a quarter of total CO_2 emissions (see TERM 2002 02 EU — Transport emissions of greenhouse gases). Energy efficiency improvements in transport can therefore result in enormous reduction in energy consumption and CO_2 emission.

The average energy efficiency of passenger and freight transport is determined by the fleet composition (number and type of vehicles), vehicle utilisation (occupancy rates and load factors) and driving characteristics (speeds, distances).

NB: For goods transport, energy use per tonne-kilometre also depends on the characteristics of the goods transported by the modes (heavier or less heavier goods). Part of the difference in energy use per tonne-kilometre can therefore also be explained by differences in goods transported.

Assessment

The energy efficiency (oil equivalents per passenger-kilometre) of passenger car transport has improved by 7 %. The improvement in passenger cars' energy efficiency results partly from the voluntary agreements with the car manufacturing industries, as pointed in the third annual report on the effectiveness of the Community's strategy to reduce CO_2 emissions from passenger cars (European Commission, 2002b).

The changes in energy efficiency of road freight transport have different causes. The energy efficiency of trucks of a given size has improved in every country, with the increased penetration of diesel and with general technical improvements in diesel or petrol trucks. But the ratio of fuel used to freight hauled has not fallen in all countries, and varies considerably between countries. With production dominated by large, international firms, the differences are not due to differences in the energy efficiency of trucks, but arise mainly from differences in fleet mix (between large, medium and light trucks), traffic and, above all, in loading and utilisation (Enerdata, 2001). The usage of trucks is also increasingly governed by the need for just-in-time deliveries, the rising value (as opposed to tonnage) of freight, and the importance of costs other than fuel cost.

The energy efficiency of rail **passenger** transport has not changed much in recent decades. However, in some countries (Denmark, Finland and the United Kingdom) the energy efficiency of rail passenger transport increased significantly between 1990 and 1999: by 12 % in Denmark, 8 % in Finland and as much as 35 % in the United Kingdom. In Austria, France, Ireland, Luxembourg, Portugal and Spain, energy efficiency of rail decreased.

The energy efficiency of rail **freight** transport has decreased by 15 % over recent years in the EU, though some countries show increasing energy efficiency. In Denmark, Finland and the United Kingdom, rail freight efficiency increased in line with observations made for rail passenger transport. Austria and Portugal also saw their rail freight energy efficiency increase, in contrast to decreased efficiency in rail passenger transport. This could be related to the combined effect of increased loading factors for rail freight and lower occupancy rates for rail passenger transport.

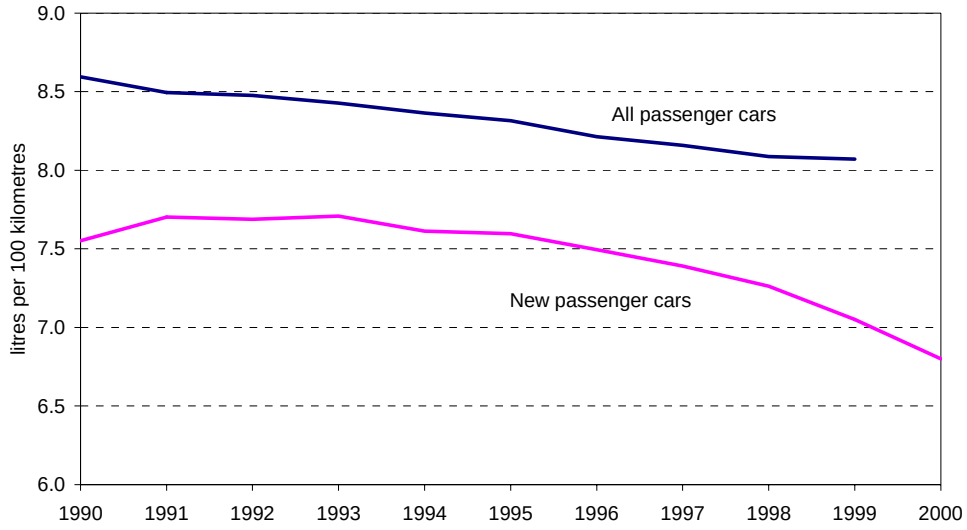
The very few data available for domestic air passenger transport (three countries only) show that energy efficiency has slightly improved in the past decade (+ 3 %). Air passenger travel remains the least energy-efficient mode.

The energy efficiency of aviation is expected to improve by between 15 and 24 % in 2010, compared with 1995 (European Commission, 1999a), as a result of improved aircraft and engine design and improvements in aircraft operations through better air traffic management.

Sub-indicator: Fuel efficiency of passenger cars

☺ **Fuel efficiency of new passenger cars has improved, mainly due to the voluntary agreements with car manufacturers associations. Fuel efficiency of the entire passenger car fleet also improved, due to the voluntary agreements, fuel quality improvements and a shift towards diesel cars.**

Figure 3: Specific fuel consumption of (new) passenger cars in the EU-15, 1990–2000



NB: Source for test values: national agencies, except Ireland, Luxembourg and Portugal. For these countries, the data is elaborated for Odyssee from data provided by associations of car manufacturers from Europe (ACEA), Japan (JAMA) and Korea (KAMA). Data are based on the new test cycle, in accordance with Directive 93/116/EC. For 1995, data were initially based on the old cycle; they have been adjusted by the ACEA by applying a 9 % adjustment 'across the board'. For previous years, data have been adjusted to be consistent with the new cycle.

Source: Odyssee, 2002.

Assessment of the sub-indicator

Fuel efficiency (litres per 1 000 km) of passenger cars improved. New cars consumed around 6.6 % less fuel in 1999 than they did in 1990. The average new car consumes about 7 litres of fuel per 100 km. In the same period, the entire passenger car fleet also improved its fuel efficiency, though a little bit less: on average 6.1 % less fuel per 100 km was needed in 1999 than in 1990. An average passenger car in the EU consumes about 8 litres of fuel per 100 km.

Fuel efficiency of the total passenger car fleet has decreased less in recent years than that of new cars. When looking at a somewhat longer period of time (from 1985 up to 1999), we see that fuel consumption of the entire passenger car fleet reduced by 11 % versus 8 % for new passenger cars. Fuel quality improvement in the late 1980s and early 1990s is probably the

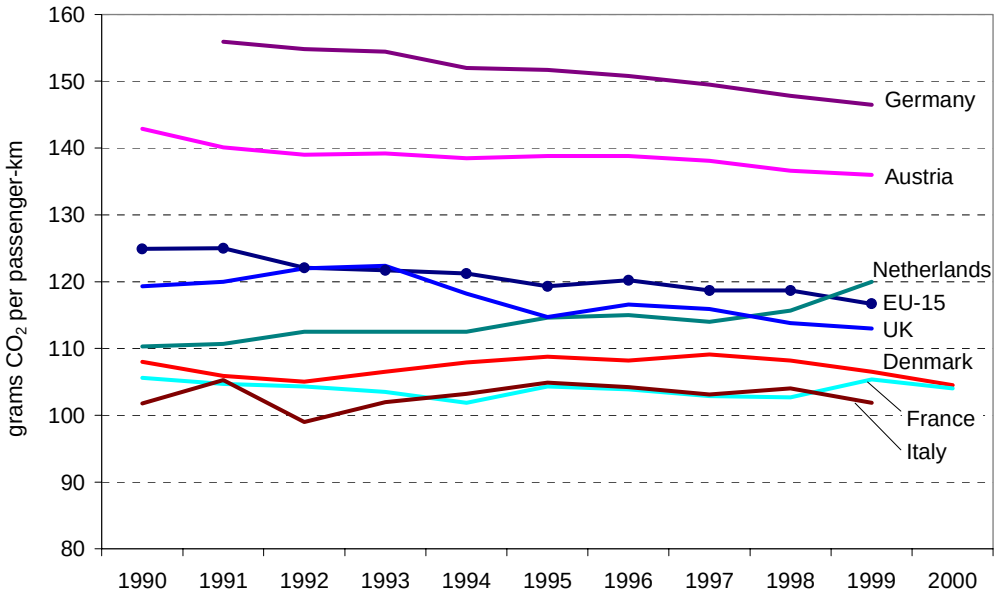
main cause of this difference. Dieselisation (more and more cars running on diesel, which is more energy intensive) also partly explains the observed trends. Lastly, diesel engines have experienced great technological improvements, which have made them less energy intensive.

Research has shown discrepancies between 'on road' fuel consumption and emission rates (i.e. real driving circumstances) and test emission values, as a result of poor driving behaviour, worsening traffic conditions and other problems that are not generally taken into account in policy-making. This emphasises the need for regular maintenance and inspection programmes, improvement of traffic management and changes in driving behaviour.

Sub-indicator: Specific CO_2 emissions from passenger cars

☺ **With increasing energy efficiency of new passenger cars, specific CO_2 emissions decreased significantly.**

Figure 4: Development of CO_2 emissions from passenger cars in the 1990 – 2000 period



Source: Odyssee, 2002.

Assessment of the sub-indicator

The Community strategy to reduce CO_2 emissions from passenger cars, in particular the voluntary agreement with the car manufacturing associations, has significantly reduced the CO_2 emissions per passenger-kilometre. On average, the European passenger car emitted 6 % CO_2 per passenger-kilometre less in 1999 than it did in 1990. Additional efforts are, however, still needed to reach the Community goal of 140 g per vehicle-kilometre (note the difference between per passenger-kilometre and per vehicle-kilometre) — see Box 1.

The low specific CO_2 emissions in France result to a large extent from the high share of diesel passenger cars ([1]) (see TERM 2002 32 EU — Size of the vehicle fleet). The high CO_2 emissions per passenger-kilometre might result from the unification process, which has decreased the average performance of the passenger car vehicle fleet by the inclusion of relatively old and obsolete vehicles from eastern Germany.

In addition, the Commission started work on mobile air conditioning, focusing on possible options to (i) measure and, if possible, reduce the additional fuel consumption and related CO_2 emissions, and (ii) to reduce emissions of the coolant HFC-134a.

References

([1]) The same probably also applies for Italy, though no statistics are available to support this statement.

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Metadata

Technical information

1. Data sources: Energy efficiency data, 1990–99 from the Odyssee database, developed under the SAVE–ADEME project on energy efficiency indicators.
2. Description of data: Energy efficiency of passenger transport (in ktoe per passenger-kilometre), energy efficiency of freight transport (in ktoe per tonne-kilometre) and specific fuel consumption of entire car fleet and new passenger cars (in litres per 100 km).

   File: TERM 2001 27 EU — Energy efficiency.xls
3. Geographical coverage: EU-15 (Belgium, Denmark, Germany, Greece, Spain, France, Ireland, Italy, Luxembourg, the Netherlands, Austria, Portugal, Finland, Sweden and the United Kingdom).
4. Temporal coverage: 1990–99.
5. Methodology and frequency of data collection: Data are collected annually.
6. Methodology of data manipulation, including making 'early estimates': The energy efficiency of domestic air (EU-3) is based on the weighted average of the selected countries, using Eurostat, 2002. The same goes for road freight (EU-6).

Quality information

7. Strength and weakness (at data level): For certain modes (aviation, road freight) few data exist. Results obtained for these modes should be interpreted with care.
8. Reliability, accuracy, robustness, uncertainty (at data level): Data can be considered as fairly reliable. Calculated EU-3 and EU-6 series need to be interpreted with care.
9. Overall scoring (give 1 to 3 points: 1 = no major problems, 3 = major reservations): 2

   Relevancy: 1
   Accuracy: 3 (Efficiency figures are calculated rather than based on representative measurements of vehicles.)
   Comparability over time: 1
   Comparability over space: 2 (Possible methodological differences from country to country related to truck-efficiency, but generally, the data are well harmonised.)

Further work required

Data on maritime shipping and bus/coach transport need to be included in the Odyssee database. Additional modes like powered two-wheelers, tram/metro and air freight transport need to be included, eventually, as well.

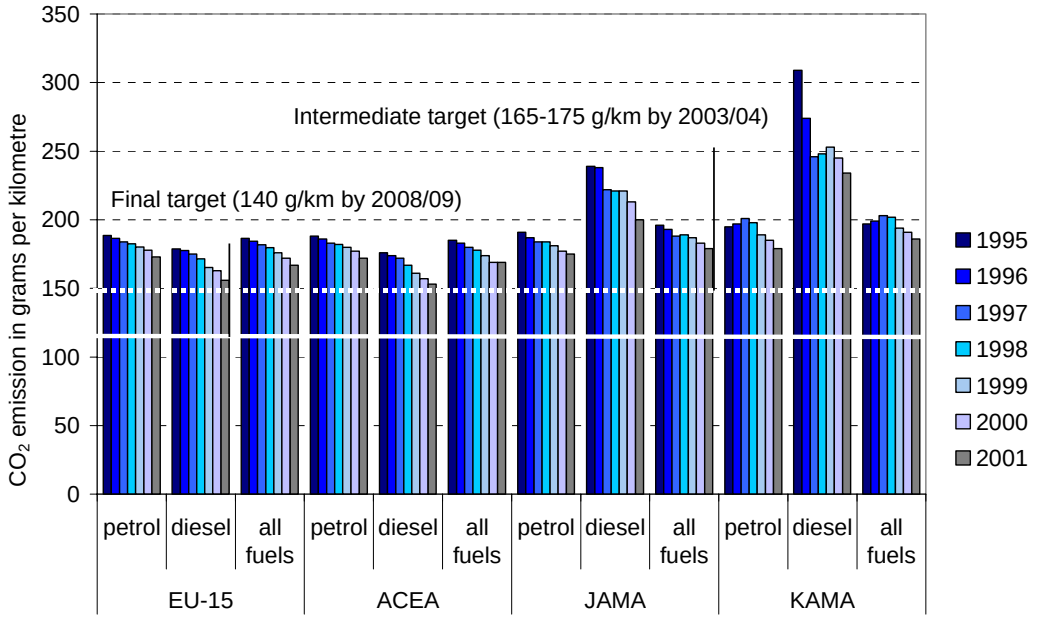
After being finalised and validated, Trends might offer an alternative. The fuel consumption of road transport calculated from Trends will be extended to include aviation, rail and shipping. Eventually, the energy efficiency per mode (in MJ per transport unit) will also be included in Trends.

Box 1: Effectiveness of the agreement with the car industry

The Community's strategy to reduce CO_2 emissions from passenger cars and improve fuel economy is aimed at achieving an average specific CO_2 emission figure for new passenger cars registered in the EU of 120 g CO_2/km by 2005, and by 2010 at the latest. In its third annual report on the effectiveness of the Community's strategy to reduce CO_2 emissions from passenger cars (European Commission, 2002b), results from the voluntary agreements with the car manufacturing industries have been evaluated. The main finding for the reporting period (1995–2001) is that the average specific CO_2 emission from passenger cars decreased in the period 1995–2001 from 186 g CO_2/km to about 167–170 g CO_2/km (a 9–10 % reduction).

In its 2002 review report, the Commission concludes that 'it is quite unlikely that the Community target of 120 g CO_2/km will be reached as early as 2005. However, it is realistic to hope that the target would be met by 2010 if the necessary measures are taken and all efforts are made.'

Figure 5: Achievements of the car manufacturing industries regarding CO_2 emissions from new passenger cars, 1995–2000



Source: European Commission, 2002b.