UNEP

The environmental price to pay for heavy goods traffic

New methods of production and consumption, as well as ongoing economic growth in the European region in recent decades, have led to an increasing demand for faster and more flexible transport modes, often favouring road freight. This trend is mainly sustained by the fact that environmental costs are not internalised (included) in road transport prices. Developing and switching to more environmental-friendly transport modes will require major efforts in all European countries.

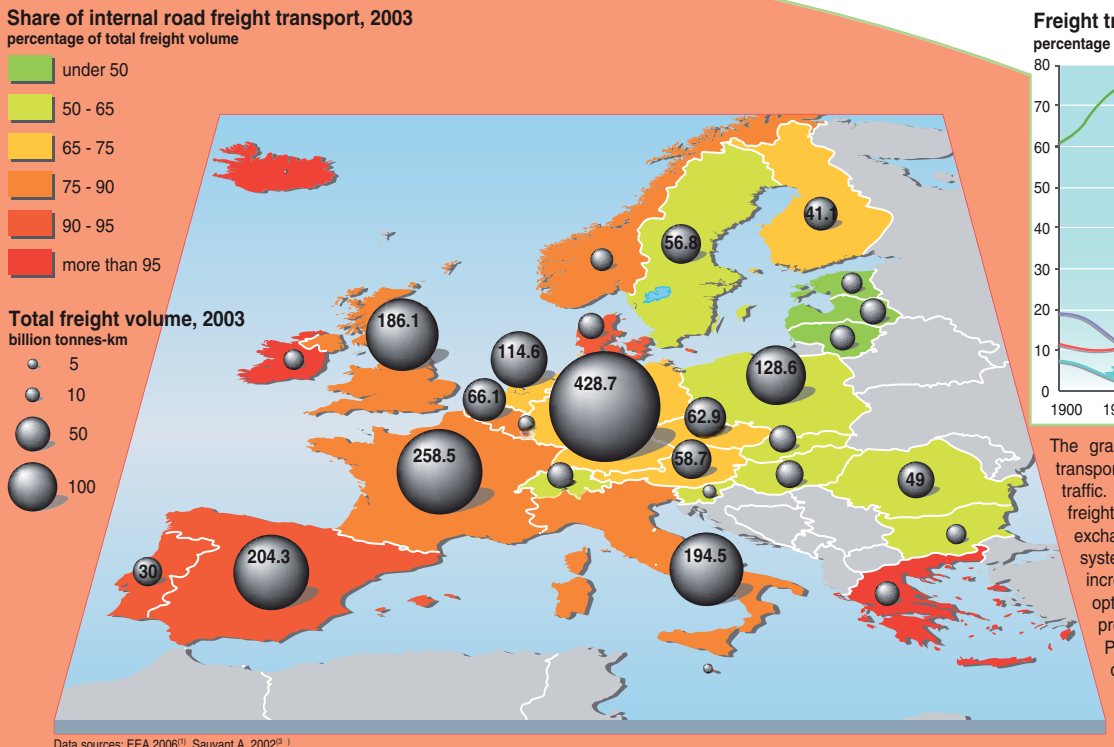
Economic development in a global economy (relocation of production, EU expansion) as well as new consumption habits, have been leading to increased freight volumes being transported over longer distances. With a 78% market share (2004), road transport dominates the inland freight transport market, growing steadily over the past decade at the expense of rail and inland waterway transport. This has been occurring despite the latters' significant carrying capacity and relatively low greenhouse gas emissions per kilometre compared to road[1]. Transport volumes by road are high in Europe: the absolute rate increased by 35% over the past 15 years for countries covered by the European Environment Agency (EEA; pers. comm.).

The road transport system offers great flexibility (*e.g.* doorstep delivery), but has had a negative influence on the optimisation of load factors (truck load). For example, a survey conducted in Alsace, France, showed that 23% of trucks travelled empty. In EEA countries, this figure for 2005 falls in the range between 20 and 30%[2]. This situation is only viable because distance-related charges (fuel taxes and infrastructure charges) levied on road transport are well below the minimum estimate of marginal external costs that remain for civil society (air pollution, climate change, health - see p. 2).

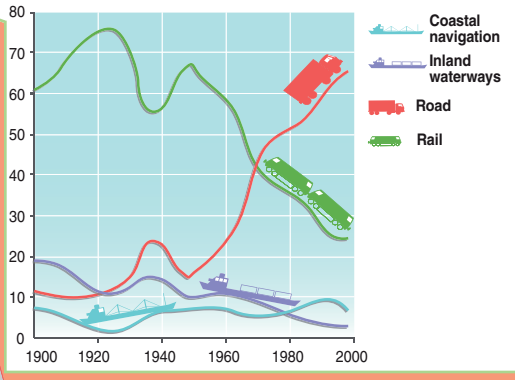
Individual road transport for both day-to-day purposes and leisure travel has also increased. To avoid disadvantages of the urban environment, people are living further away from their work places and depend more on individual transport to cover longer distances. Although new car engine efficiency in the EU-15 has gained 13% in the past eight years, this has been offset by the increased number of cars per inhabitant (+18.5% for the same period).

Today, road transport in Europe depends 98% on petrol and diesel fuels and accounts for 31% of total energy consumption (Fig.2): pollutant emissions are closely linked with transport demand. The environmental challenges caused by transport are a vivid reality in a European Union that now extends to 27 members.

Fig. 1: Road transport in Europe



Data sources: EEA 2006[1], Sauvant A. 2002[3]



The graph shows that in France, the share of road transport increased over time to the detriment of rail traffic. The map shows that the share of internal road freight is much higher in Western Europe, where exchange with neighbouring countries has been systematic for a longer period. With the EU's territory increasing, land planning strategies must be optimized in order to minimize distances between production centres and consumption areas. Particular care should be taken to maintain and develop environmentally-friendly infrastructures, keeping in mind their environmental performances to reduce our dependency on fossil fuels.

Causes of increasing road transport

New consumption habits

Globalisation of trade, with relocation of manufacturing to lower production cost areas, has two consequences: longer distances between consumers and production centres, and lower item prices leading to higher volumes of merchandise purchased and therefore transported. It also induces a change in consumer habits (e.g. exotic fruits, vegetables and many other products available any time of year, such as lamb from New Zealand or wine from Chile). This requires long distance (but rapid) transport and is only possible given low transport costs.

Oil costs "externalised"

Oil prices can be considered artificially low as they only include extraction, refining and distribution costs. Furthermore, the use of petroleum products does not include any cost for cleaning up pollution impacts on the environment or human health costs, during these three phases or after fuel use. These other costs from road transport were estimated at 650 billion euros for the EU-15, Switzerland and Norway in 2000[(1)].

Road transport emissions

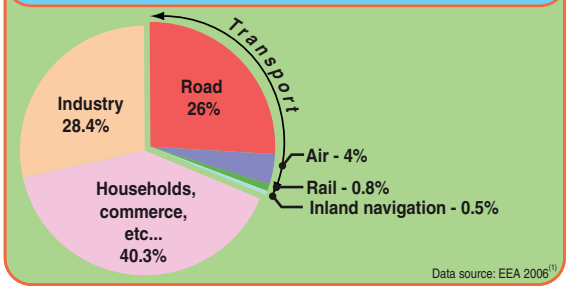
Greenhouse gases (GHG)

In the EU-15, transport now accounts for 21% of total GHG emissions (mainly CO_2, excluding international aviation and maritime transport) of which 92% is from road transport (Fig.3). While GHG emissions of many other sectors are decreasing due to stronger regulations and technological improvements, the contribution from transport continues to grow (+23% between 1990 and 2003), offsetting to a large extent reductions of emissions from other economic sectors[(1)].

Fine particles, ozone and health

Ground level ozone is a cause of respiratory problems and allergies. Ozone (O_3) is not emitted as such, but results from the interaction between exhaust gases and atmospheric ones when exposed to solar radiation. Fine particles are either directly emitted by exhaust[(4)], or result from road and tire deterioration[(5)]. The "Clean Air for Europe" (CAFE) programme estimates that 370 000 people die prematurely due to air pollution each year, mainly from fine particle matter and ozone[(1)]. The European Commission (EC)[(6)] estimates that fine particles in the air statistically reduce life expectancy in the EU by more than eight months on average. An effective application of current policies could reduce this number to 5.5 months. Children, elderly and asthmatic persons are more vulnerable. In monetary terms, damage caused to human health alone is estimated as costing 189 to 609 billions euros per year until 2020, depending on various experts' analysis and opinions.

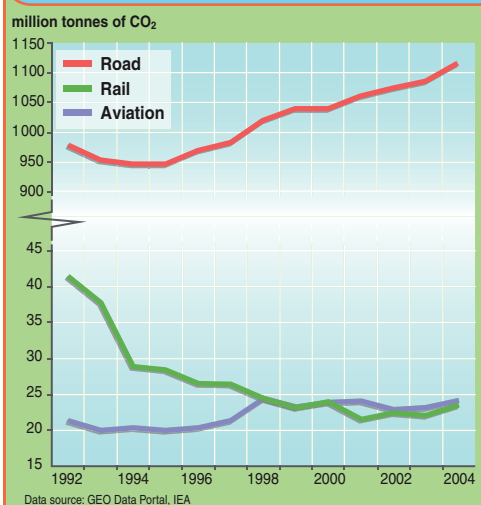
Fig. 2: EU-15 energy consumption by sector



Impacts on biodiversity and ecosystems

Ecosystems continue to be impaired by acidic deposits (NOx, SO_2 and NH_3), leading to animal and plant species' damage and loss. Nitrogen excess can negatively affect vegetation and infiltrate surface water, leading in both cases to a decrease of biological diversity. Ground ozone causes physical damage and retards the growth of crops, forests and plants. The most serious consequences come from road infrastructure which impact on landscapes, and can be an obstacle to animal movements. On average, highway infrastructure disturbs ten hectares per kilometre of road constructed[(5)], and often leads to even wider ecosystem degradation and fragmentation. Noise from traffic can disturb local fauna as well.

Fig. 3: Emissions of CO_2 by European transport means



When comparing air emissions from different domestic (internal) transport means, road is by far the largest source of such emissions. In 2004, CO2 emissions from road transport in Europe were more than 20 times those from rail and domestic air transport together (data on emissions from international flights are not available).

The use of less polluting renewable energy sources - such as solar, wind, hydropower or biomass - depends on their immediate availability/generation, and therefore their consumption cannot exceed production. Fossil fuels such as petroleum are the result of geological processes that took place over millions of years. However, they are being exhausted relatively quickly and are not renewable. At the same time, their use is increasing noxious air emissions.

Data source: GEO Data Portal[(a)], IEA[(b)]

Potential solutions

Sustainable consumption

One solution is to encourage sustainable consumption by, for example, promoting the use of locally-produced and seasonal foods, and reducing consumer goods' turnover by using longer life-span items, thus also reducing the amount of waste generated[(c)].

Combined transport

Rail (average speed 18km/h) and water transport cannot compete with road transport (average speed 56km/h) in terms of rapidity of delivery[(5)]. However, trains and boats are on average more environmentally-friendly than trucks, even if environmental performance generally depends more on installed technology and logistical characteristics than on the mode *per se*[(1)]. Combined transport appears to be the best solution for simultaneously improving environmental performance, flexibility and efficiency, as long as the appropriate logistical structure and infrastructure have been established.

Taxation

Existing European highway toll fees and road taxes are generally not based on environmental performance

Fig. 4: Transalpine tunnels

With their central position in Western Europe, the Alps are inevitably crossed by many freight corridors (in black), mainly by road, through busy tunnels and passes (white boxes). In 2003, 44% of European east-west freight transport went through the alpine arc, for a total volume of 145 million tonnes.

Petrol consumption and pollution impacts in mountainous areas increase due to the road slopes and topography. Trucks already emit 50 times more pollutants than cars besides local climatic parameters related to topography can increase the pollution by a factor of three. Road transport in mountainous areas should thus be minimised. Transportation speed can be optimised by using high-speed trains passing natural barriers through secured tunnels. This is the case today in four sites under construction in the Alps (Lyon-Turin, Lötschberg, Gothard and Brenner). However, tunnel construction also requires large amounts of energy and material disposal. Optimisation of existing tunnels and those under construction, as well as reduction of transport, should be considered prior to future new projects.

Photo: J.L. Rigaux/CFF

Road freight transport through mountainous areas affects the environment, causes annoyances for local inhabitants and generates security concerns for other road users.

Data source: EEA 2006[1], FNE 2006[5], Alpes 2020[d]

and are well below marginal costs (costs of measures which can be taken to control environmental effects).

However, some countries have recently implemented road charges for trucks based on environmental performance (Austria, Germany, Switzerland) and some others plan to do so (Czech Republic, United Kingdom). Denmark modified its annual circulation tax to reflect the energy efficiency of vehicles that resulted in a 15% fuel consumption reduction between 1998 and 2005, versus a 10% European average.

Applying a taxation rate for polluting fuels could be beneficial to subsidise renewable energies, "cleaner" transport modes and public transportation, but also to make sure that load factors are optimal, to develop technologies and know-how that could, in the long run, lead to a society less dependant on fossil fuels.

New technologies

European car makers have committed themselves to reduce average CO_2 emissions to 140 grammes/km in 2008 (2009 for Japanese and Korean) and 130 grammes/km in 2010. Even if CO_2 emissions have already begun decreasing, a mid-term evaluation shows that greater efforts are needed if targets are to be met (Fig.5). The EU is in the process of including these stricter objectives in its legislation.

Many different low-energy concepts have been developed for passenger cars but are also used in freight vehicles. Electric cars still remain a niche market and environmental performance depends on the impact caused by the electricity production. One of the most successful concepts is the combination of fuel or gas engine with electrical energy ("hybrid"), leading to a reduction of CO_2 emissions of around one-third. A conventional system can also be optimized to reduce the amount of fuel needed and particles emitted.

Other new technologies include particle filters, exhaust gas recirculation, selective catalytic reduction, direct injection, lightweight materials, low-resistance tyres and lubricants. They have the potential to significantly reduce emissions of fine particles in road transport inland and sea shipping, as well as rail transport. Such technological solutions can only be effective in the long-term, as it takes around 20 years for a new technology to be adopted by the broader car market[7].

Biofuels

Currently, the GHG emission balance for biofuels remains negative due to high levels of emissions during biomass cultivation. Biofuel crop production also competes with food production, and large amounts of land are required to cultivate the biomass needed. Finally, it generates by-products that currently remain unused. Production of biofuels on a large scale may affect the intensity of agricultural land use, and may have a negative effect on biodiversity[1]. In order to minimize such negative impacts and reduce the costs of production, second-generation research points towards production of biofuels from oil and wood residues or cereal straw[7].

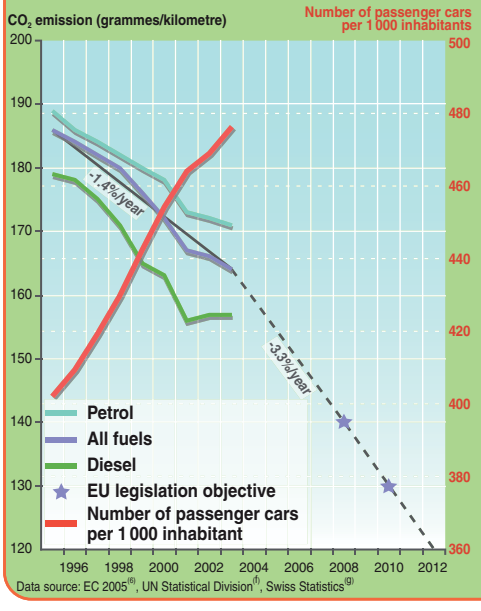
Logistical improvements

Haulers try to ensure that their vehicles are as fully loaded as possible for longer distances (average vehicle load in 2004 11.4 t < 500km, to 14.5 t > 2000km."[e]. Nonetheless, the load factor of heavy goods has been slightly decreasing to less than 50% overall[1].

Very simple measures such as loading improvement (e.g. removal of air or water, clustering of suppliers and customers) or the use of computerised vehicle routing package software to cut transport costs and distance travelled can in some cases reduce transport volumes significantly. However, in the long run, consumption patterns and levels will have to be addressed as well.

(continued)

Fig. 5: Average CO_2 emissions of new passenger cars sold in the EU-15



Data source: EC 2005[6], UN Statistical Division[f], Swiss Statistics[g]

CO_2 emissions from new passenger cars sold in the EU-15 are declining. Emissions from diesel cars were reduced by 12.3% between 1995 and 2003 and emissions from petrol cars have been reduced by 9.5%. However, the number of cars greatly increased between 1980 and 2000. In Portugal it increased four-fold, three-fold in Greece, and by 39% in Switzerland to reach 523 cars per thousand inhabitants in 2006.

Manufacturers are committed to limiting the CO_2 emissions of new passenger cars sold in the EU to 140 g/km by 2008 and to 130 g/km by 2010. Recently, the European Commission has made statements that it no longer believes industry will meet these targets.

EU objectives

The European Commission addresses traffic volume directly for the first time in the newly proposed Marco Polo II programme. The "traffic avoidance" part of the programme sets a target of 10.5 billion tonne-km to be avoided between 2007 and 2013, without economic disadvantage. This corresponds to 0.7% of the roughly estimated 1 500 billion tonne-km transported by trucks in the EU-25. The programme also proposes to develop innovative concepts such as the "maritime highway" that focus on developing *intermodality* (*i.e.* freight containers being easily transferred from one mode of transportation to another without being unpacked).

However, there remains a fundamental difference between European wishes as written in a recent "White Paper"[8] and actual European policies. Many decisions are still being taken from an economic rather than a sustainable development perspective[5]. Perhaps fundamental changes will need to come via a truly holistic strategy, including both a modification of current production and consumption habits, and changes in the budgetary and fiscal policies by integrating real external costs, both environmental and social[8].

One kg of petrol allows to move a single kilometre: 50 tonnes by truck, or 127 tonnes by waterway[a].

Conclusion

Currently, more than half the overall expenditure on transport infrastructure, including the Cohesion Fund and loans from the European Investment Bank have, at the request of Member States, favoured road over rail, despite opposite European orientations found in the "White Paper"[8]. The EC[6] also mentions that "significant negative impacts will persist even with effective implementation of current legislation".

The European freight transport system would need major changes to be consistent with sustainable development objectives. Any modifications in the transport system would have to be made along with a change of European consumers' habits. Such an objective may indeed be attainable, as 69% of Europeans are in favour of an "ecotax" and agree with the "polluter pays" principle[5].

European policies are often said to be examples for developing and transitional countries and those looking forward to joining the EU, where environmental concerns (including climate change) are high on the policy agenda[4]. These existing guidelines and further measures are options for Western countries to adapt that would benefit affected sectors and set an example to the wider continent, and even the rest of the world.

Photo: Economic Development Research Group (EDR Group)[h]

The environmental burden of rail freight is much less significant than the one of road transport. This mean of transport is, however, still underused in Europe.

Sources:
[1] EEA 2006, "Transport and environment: facing a dilemma - TERM 2005: indicators tracking transport and environment in the European Union". European Environment Agency, Copenhagen, Denmark, 2006.
[2] Eurostat 2007, "Average loads, distances and empty running in road freight transport – 2005". Statistics in focus – Transport – 117/2007, Eurostat KS-SF-07-117-EN-N.
[3] Sauvant A. 2002, "Volume et partage modal du transport de marchandises en France de 1845 à nos jours". Notes de Synthèse du SES, 2002.
[4] CEC 2005, Commission of the European Communities, "Communication from the commission to the council and the European parliament: Thematic strategy on air pollution", SEC(2005) 1132 and 1133, http://ec.europa.eu/environment/air/cafe/index.htm
[5] FNE 2006, "Construire en France une politique soutenable des transports de marchandises", Rapport d'Expertise. France Nature Environnement.
[6] EC 2005, Communication from the Commission to the Council and the European Parliament entitled "Implementing the Community strategy to reduce CO2 emissions from cars — Fifth annual communication on the effectiveness of the strategy", COM(2005) 269 final, European Commission 2005.
[7] IFP 2006, "Quelles énergies dans les transports de demain? Les réponses de l'IFP". Presse conference IFP 21 November 2006, www.ifp.fr/IFP/fr/espacepresse/fi.htm
[8] EC 2001, "European transport policy for 2010: Time to decide", European Commission White Paper, http://ec.europa.eu/transport/white_paper/documents/index_en.htm

URLs:
[a] UNEP/GRID-Europe GEO Data Portal at http://geodata.grid.unep.ch
[b] The International Energy Agency at www.iea.org
[c] UNEP/DTIE Sustainable Consumption at www.uneptie.org/pc/sustain
[d] Alpes 2020 – Les Nouvelles Tarversées at www.alpes2020.org
[e] Eurostat 2006, at http://epp.eurostat.ec.europa.eu
[f] United Nations Statistics Division, Transport Statistic Database at http://unstats.un.org/unsd/cdb/cdb_topic_xrxx.asp?topic_code=21
[g] Swiss Statistics at www.statistique.admin.ch
[h] Economic Development Research Group (EDR Group) at www.edrgroup.com

This publication was completed with valuable contributions from Mr Peder Jensen from the European Environment Agency whom we would like to thank.

UNEP | GRID Europe
B. Chatenoux, A. De Bono
S. Kluser, P. Peduzzi
November 2007

For further information
United Nations Environment Programme
DEWA / GRID-Europe
Tel: (41.22) 917.8294
Fax: (41.22) 917.8029
E-mail: earlywarning@grid.unep.ch
Web: www.grid.unep.ch/ew