Rail Transport and Environment
FACTS & FIGURES

June 2008

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CER

The Voice of European Railways

Table of Contents

Foreword 2

Climate change and CO_2 emissions 3

Energy efficiency 8

Electricity mix 12

Land take 15

Local air pollution 17

Noise emissions 21

Subsidies and external costs 25

European transport : core statistics 28

Glossary 32

References 36

Foreword

Transport presents real challenges as society tries to ensure a more environmentally sustainable future. It is the only sector in the EU in which greenhouse gas emissions have consistently risen since 1990, and current transport patterns are clearly unsustainable. As well as contributing to climate change, the growth in congestion on our roads, accidents, air pollution, and noise pollution of transport all lead to substantial costs that are borne by people, business, and society.

In order to make long term decisions on the future of transport, it is important that there is accurate data to consult. Using a variety of sources, this booklet has been compiled jointly by the Community of European Railway and Infrastructure Companies (CER) and the International Union of Railways (UIC) to present the statistical and factual evidence on the impact of the different transport modes. We believe it shows that the environmental case for rail is compelling. We hope it will be of use to policy makers, researchers, and anyone else with an interest in the environmental impact of transport.

Johannes Ludewig
CER Executive Director

Luc Aliadiere
UIC Chief Executive

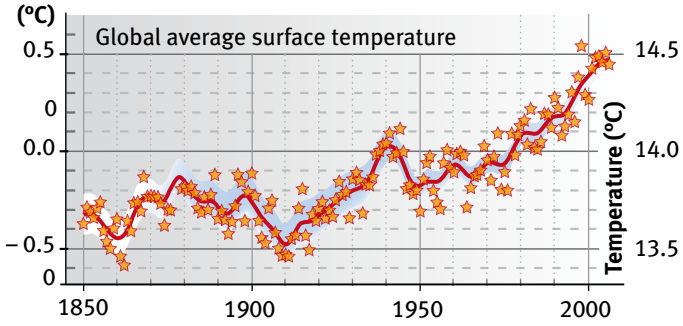
Climate change and CO_2 emissions

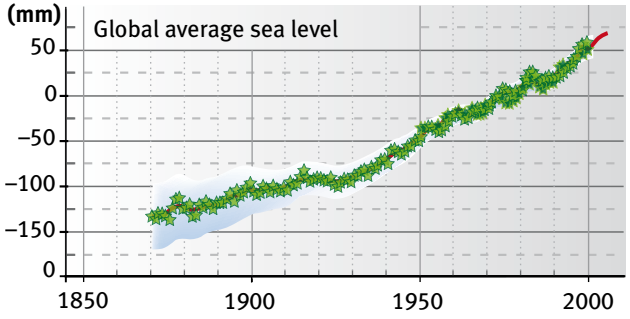
- ★ **Travelling by rail is on average 3-10 times less CO2 intensive compared to road or air transport**
- ★ **With 7-10% of market share, rail still contributes less than 2% of the EU transport sector's CO2 emissions**
- ★ **The rail sector has committed itself to cut the specific emissions of rail transport by 30% over the period 1990-2020**

Global warming and greenhouse gases (GHG)

In its latest assessment report (AR_4) in November 2007, the Intergovernmental Panel on Climate Change (IPCC) said that warming of the climate system "is unequivocal". Global greenhouse gas (GHG) emissions due to human activities have grown since pre-industrial times, with an increase of 70% between 1970 and 2004 alone. This development has led to clear changes in temperatures and average sea level compared to the standard period used (1961-1990), as shown in the graph below.

An additional temperature rise of between 1°C and 4°C is projected between 2000-2100, depending on the level of stabilisation of GHG emissions. CO_2 is the major greenhouse gas contributing to global warming and climate change; it is emitted by both natural and anthropogenic sources. The Kyoto Protocol regulates five GHGs beside carbon dioxide: methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC_s), perfluorocarbons (PFC_s) and sulphur hexafluoride (SF_6).



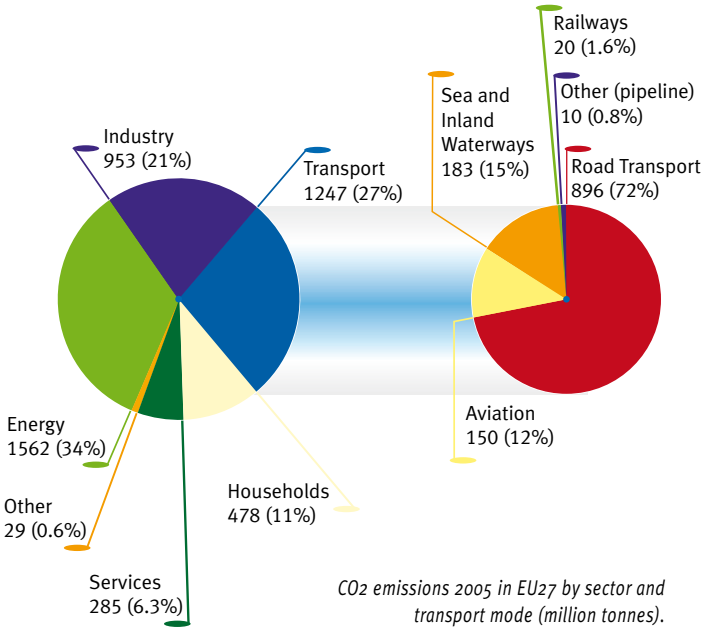


Source: IPCC report (AR_4), November 2007

In March 2007, the European heads of state agreed to set precise, legally binding targets in a move to reduce Europe-wide emissions by 20% over the 1990-2020 period and keep overall warming below the widely accepted 2 degrees "threshold". The European Commission put forward legislation on achieving this in January 2008.

EU transport sector today

Transport causes around one quarter of all EU CO_2 emissions. Between 1990 and 2005, EU-15 GHG emissions from domestic transport (inside EU only) increased by 26%. More than 90% of total domestic transport emissions are due to road transport. Rail only accounts for 0.6% for diesel emissions and for less than 2% including emissions for electricity production.

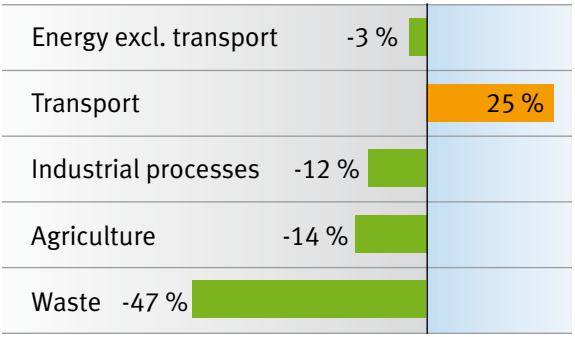


CO2 emissions 2005 in EU27 by sector and transport mode (million tonnes).

Source: EC 2007 and UIC Energy / CO2 database

EU transport sector tomorrow

Despite multiple initiatives the transport sector is projected to remain the fastest growing sector when it comes to CO_2 emissions. At the last UN meeting (the so-called Conference of the Parties, "COP_{13}") in Bali (December 2007), the United Nations Framework Convention on Climate Change (UNFCCC) confirmed that total CO_2 emission reduction targets cannot be met without limiting transport emissions.



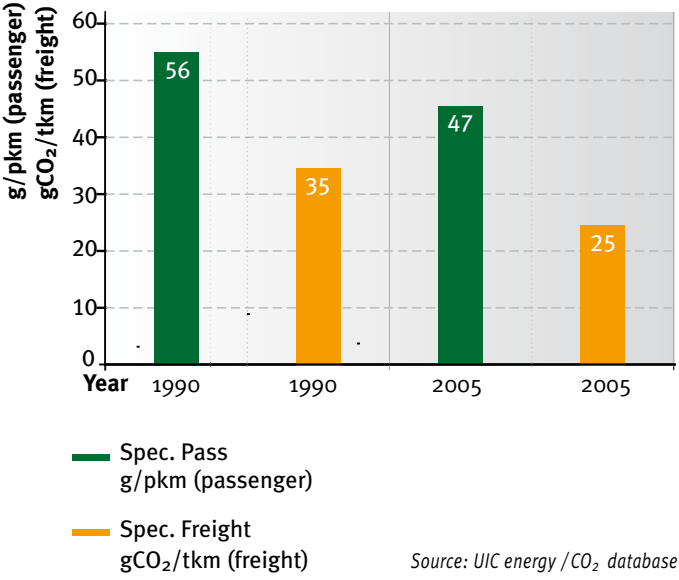
Projected changes in EU15 GHG emissions from 1990 to 2010 with existing policy measures.

Source: EEA 2007

Rail CO_2 performance

From 1990 to 2005 the European railways cut their CO_2 emissions by 21% in absolute terms. For specific emissions (i.e. emissions per passenger-km or tonne-km) during the same period, the railways reduced their CO_2 emissions per passenger-km by 14%, and per tonne-km by 28%. In May 2008, the members of CER agreed to a target of an average sector-wide cut of 30% in specific emissions over the 1990-2020 period. The table below shows the difference between 1990 and 2005 for rail transport passenger and freight.

Average European specific railway CO_2 performance 1990-2005

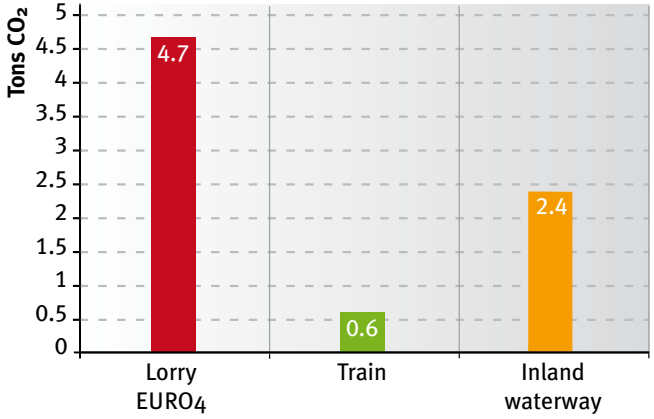


Source: UIC energy / CO_2 database

Freight transport CO_2 comparison

The table below compares the total CO_2 emissions from transporting 100 tons of average goods from Basel, Switzerland to the port of Rotterdam, Netherlands. CO_2 emissions from rail are almost 8 times less than lorries and 4 times less than inland waterways (www.ecotransit.org).

Carbon dioxide (100 tons cargo, Basel - Rotterdam, 700 km)

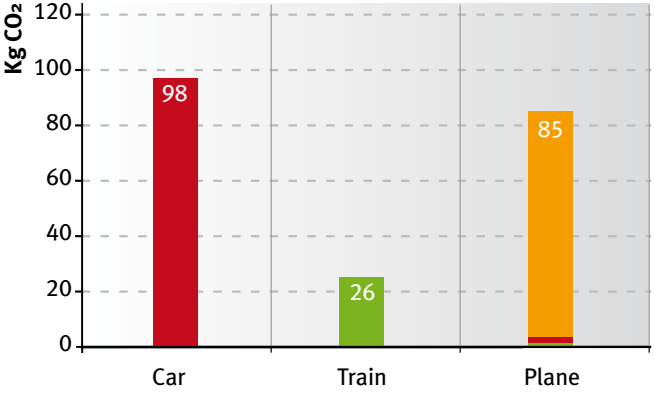


Source: www.ecotransit.org *2008*

Passenger transport CO_2 comparison

For passenger transport, going by rail is on average 4 times more efficient than taking the car and more than 3 times better than taking the plane. The table below compares the total CO_2 emissions from transporting 1 passenger between Berlin and Frankfurt city centres in Germany.

Carbon dioxide (1 person Berlin - Frankfurt, 545 km)



Note: Plane emissions include travel to and from the airport; they are not increased to take account of the effect of emissions at high altitude.

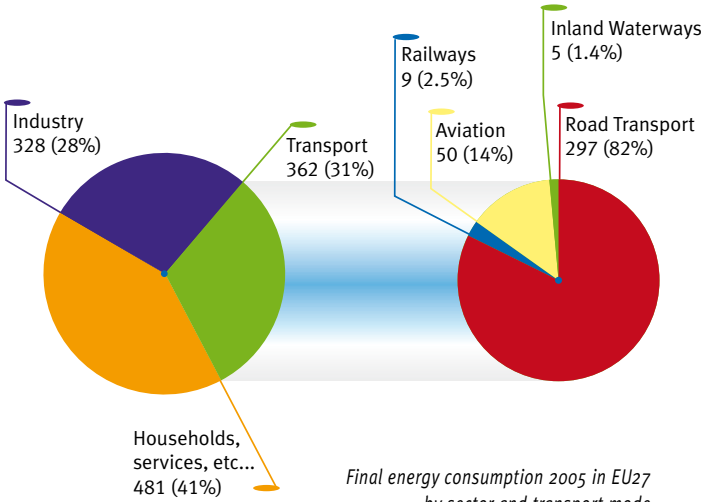
Source: www.ecopassenger.org *2008*

Energy efficiency

- ★ **Rail is on average 2 - 5 times more energy efficient than road, shipping and aviation**
- ★ **Through approaches including eco-driving, use of new rolling stock, and operational measures, railways continue to improve**

EU transport sector today

Since 1970, transport activity has more than doubled in the European Union: +185 % for the transport of goods and +145 % for the transport of people. In the EU, the final energy consumption of the transport sector equals to 31% of the total European wide consumption. Railways' share of the transport energy consumption is less than 3%, while its market share is between 6% (passenger) and 10% (freight).



Final energy consumption 2005 in EU27 by sector and transport mode (million tonnes oil equivalent)

Source: DG TREN 2007

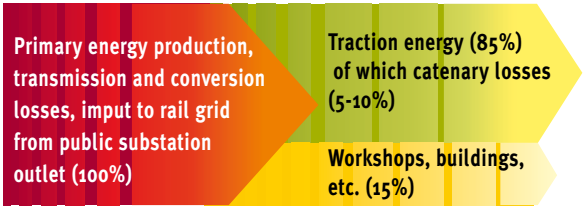
There has been a very strong growth in mobility over the last 30 years, and the increase in distance travelled has been mainly by road. In 1970 every European citizen travelled an average distance of 17km per day; today this figure has reached 35km per day.

EU transport sector tomorrow

Despite multiple initiatives, transport demand is projected to remain one of the fastest growing of all sectors and with only limited decoupling of energy consumption from transport demand, the resulting energy consumption will grow nearly as much. The EC predicts a rise of 21% in energy consumption for transport from 2000 to 2030 (EC 2006a).

Rail traction energy

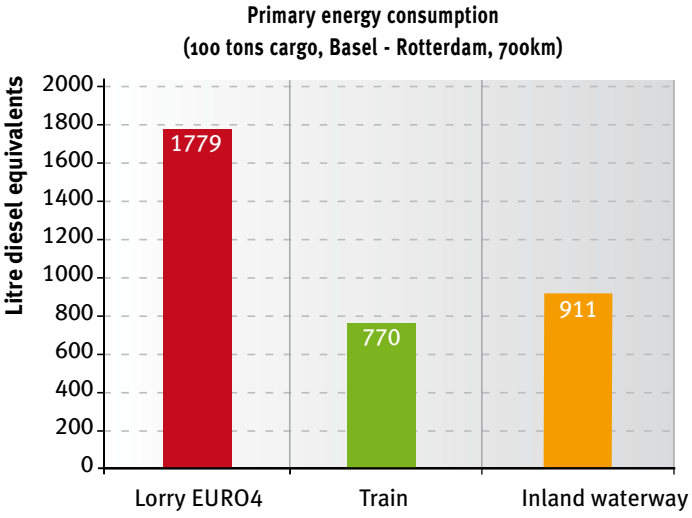
Approximately 85% of total energy consumed by the rail sector is used directly for rail traction as illustrated in the figure below.



Energy efficiency offers a powerful and cost-effective tool for achieving a sustainable energy future. Improvements in energy efficiency can reduce the need for investment in energy infrastructure, cut fuel costs, and increase competitiveness. Environmental benefits can be achieved by the reduction of greenhouse gases emissions and local air pollution. Energy security can also profit from improved energy efficiency by decreasing the reliance on imported fossil fuels.

Freight transport energy comparison

Comparing heavy or spacious cargo, short or long-haul, rail is the most energy efficient transport mode if used appropriately. The table below compares the total primary energy consumption from transporting 100 tons of average goods from Basel, Switzerland to the port of Rotterdam, Netherlands.

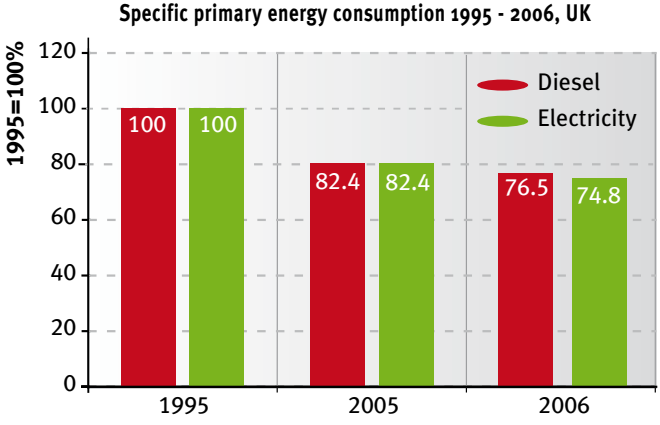


Source: www.ecotransit.org *2008*

As can be seen from the graph, rail is more energy efficient than inland waterways and over twice as efficient as lorries. Compared with air transport, rail would be around 20 times more energy efficient.

European rail operator examples

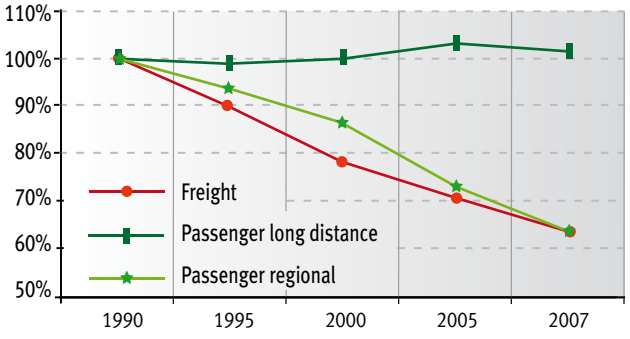
In the UK, energy consumed per passenger kilometre fell by around 25% between 1995 and 2005 for both diesel and electric trains, and continues to improve.



Source: ATOC

In Germany, the consumption of specific energy for Deutsche Bahn, both for regional passenger trains and freight has decreased constantly since 1990, due to the energy efficiency action plan of the company.

Specific primary energy consumption (per pkm or tkm) 1990 - 2007, Deutsche Bahn



Source: Deutsche Bahn

Railway energy efficiency projects

The railways continuously seek to improve their performance. The European rail sector is collaborating on a number of projects, with measures being taken within the technical, operational, commercial and procurement areas. Research and development projects include:

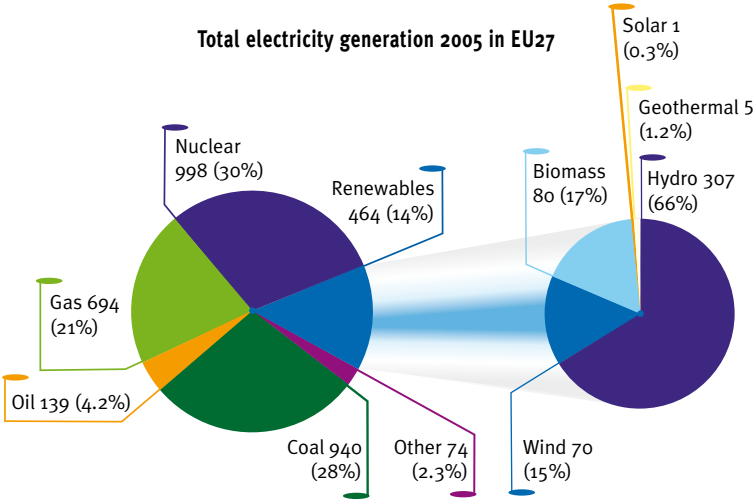
Railenergy	EU project, 2006-2010	www.railenergy.org
Trainer	EU project, 2006-2008	www.iee-trainer.eu
Hyrail	EU project 2007	www.hyrail.eu
Event	UIC project, 2000-2003	www.railway-energy.org
Energy Management Systems for Railways 2008		www.uic.asso.fr/environment
CO_2 Reduction Guidelines for Railways 2008		www.uic.asso.fr/environment

Electricity Mix

- ★ Electric traction accounts for 80% of rail production in Europe (measured in passenger-km and tonne-km)
- ★ Electric railways could achieve zero CO_2 emissions if the electricity production is sourced from renewable energy sources

EU electricity generation today

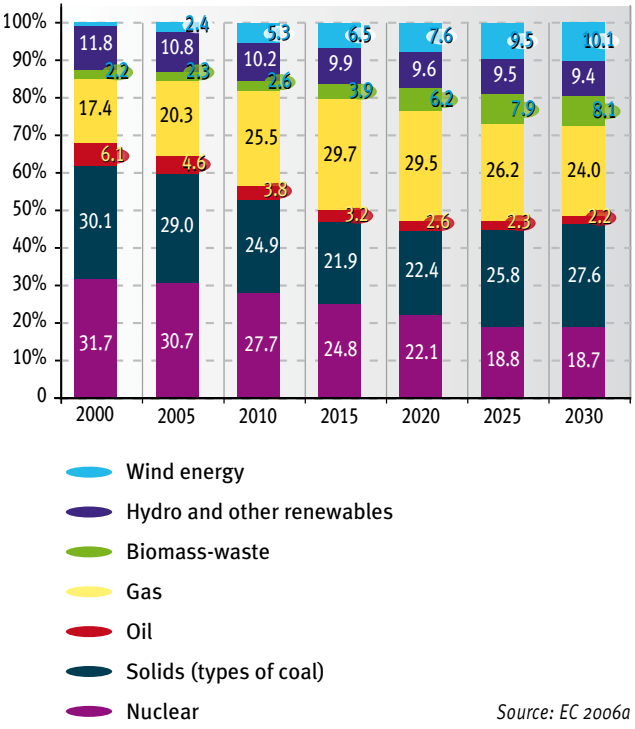
Gas, solids (coal) and oil are the three fossil fuels that cause additional CO_2 when incinerated in power plants. Nuclear and renewables (hydro, biomass, wind, solar and geothermal) are considered the two CO_2 neutral energy sources. At present, renewable energy only accounts for 14% of EU electricity production (see below), but the European Commission seeks to raise this to 20% by 2020.



Source: EC 2007

EU electricity mix of tomorrow

Projections made by the European Commission (see graph below) show that the share of nuclear power production will reduce, and renewable sources like hydro, wind and biomass will increase in the EU25 from 2000 to 2030 (EC 2006a). The total share of fossil fuels (coal, oil and gas) will remain.

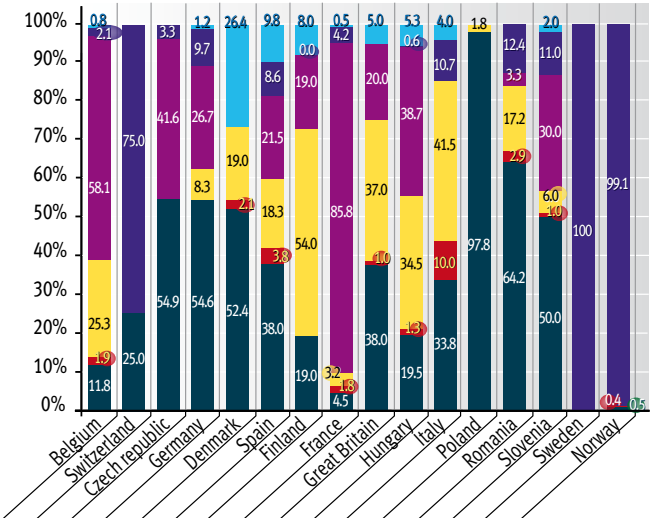


Source: EC 2006a

Railways' electricity mix

Due to its use of electricity, rail is the only motorised mode of transport which is capable of shifting from fossil fuels to renewable energy without any separate investment in the propulsion units, simply by changing the energy sources in the electric energy production.

Electricity mix for railways in selected countries



Source: UIC database / Railenergy project

The graph shows the large differences in Europe when it comes to electricity mix for the year 2005. Railways' emission performance is crucially linked with the energy supply of each country which is decided by the national energy sectors and political objectives.

Some railways own dedicated railway electricity production facilities for historic and technical reasons and therefore can have a different mix.

Land take

- ★ **Railway infrastructure occupies 2-3 times less land per passenger or freight unit than other modes of transport**
- ★ **Railways, having a market share of 6-10%, occupy less than 2% of the land used for transport infrastructure**

EU transport sector today

The negative consequences of land use are associated with three factors. Firstly, the actual space taken for infrastructure leads to the sealing of the top soil, as well as disturbances resulting from noise, resource use, waste dumping and pollution. Secondly, transport networks which connect cities add to the fragmentation and degradation of the natural or urban landscape due to the "barrier" effects of the infrastructure. Finally, urban sprawl involves the inefficient development and use of urban land. Roads account for 98% of total transport infrastructure compared with rail.

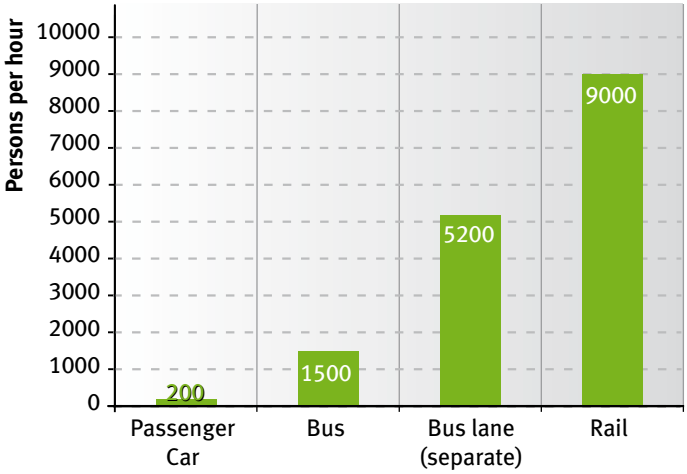
EU transport sector tomorrow

Transport infrastructure investment should take into consideration the amount of land take and favour rail over road transport. This approach would be similar to that of the Trans European Transport Networks (TEN-T), which in the near future (2010-2020) will have the main proportion of its budget focussed on building rail infrastructure.

Rail data

Comparison of capacities in an urban setting is shown below. As can be seen from the graph, rail has the highest capacity when comparing throughput per hour and infrastructure width. This is mainly due to efficient traffic management in urban conditions, with many trains that have high carrying capacity passing per hour.

Capacity of urban transport modes per metre of infrastructure width



Source: UNEP railway sector report 2002

Local air pollution

- ★ **All electric rail transport is free of direct local air pollution**
- ★ **New engines and exhaust after-treatment systems are reducing the already low local emissions caused by rail diesel traction**

EU transport sector today

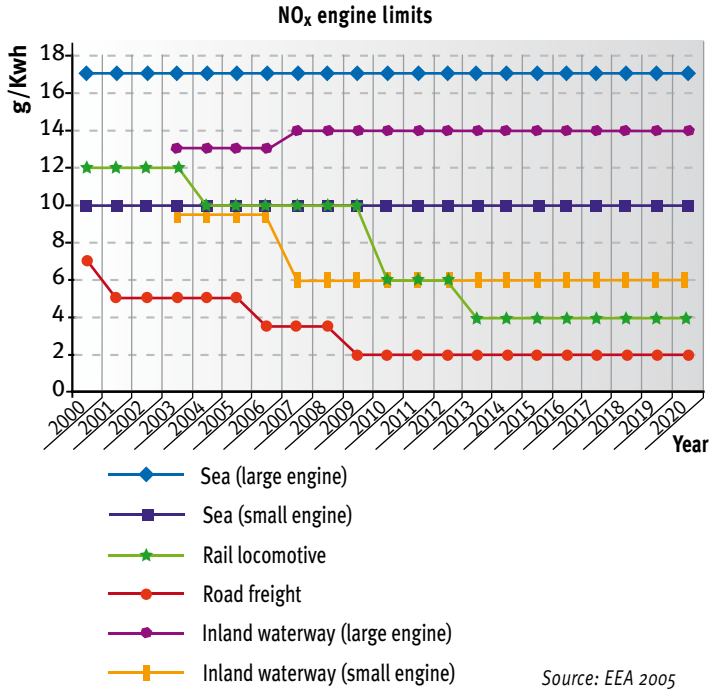
Air quality, especially in urban dwellings and city centres around Europe, is being threatened by exhaust gas emission from the increasing road traffic. Nitrogen oxides (NO_X) and particulate matter (PM10) are the most critical for exposure and health problems among regulated emission types.

Regulated emissions from transport have decreased significantly since 2003: PM10 by 30%, acidifying substances (mainly SOx and NOx) by 34% and ozone depletion substances by 40%. Nevertheless, local air pollution, in particular from road transport, remains a major hazard.

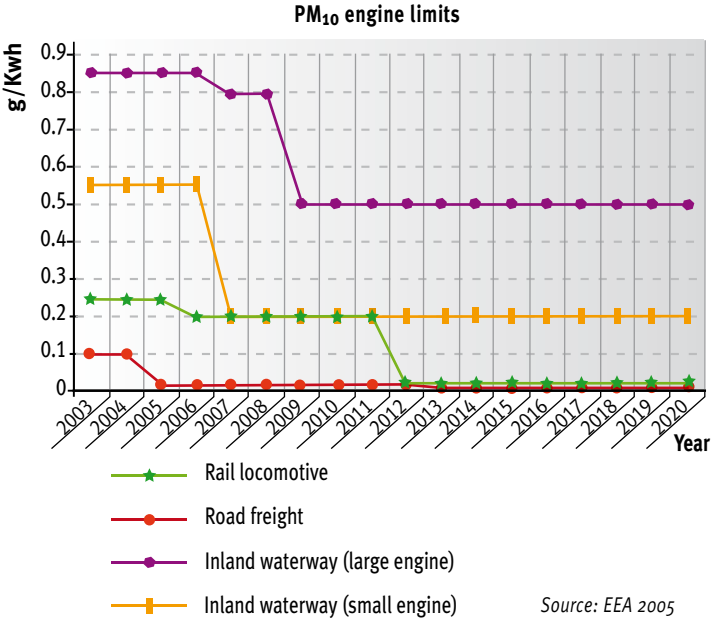
EU transport sector tomorrow

The European Commission has put general emission ceilings into force covering sulphur oxides (SO_2), nitrogen oxides (NO_X), non-methane volatile organic compounds (NMVOC) and ammonia (NH_3). Current developments indicate that these future ceilings will be met.

The two graphs below show the development of engine emission standards for rail, road, shipping and inland waterways. Road is the only mode with stricter NO_X and PM_{10} limits, but due to the higher energy efficiency (see related section), rail would come out best if comparing system performance.



Source: EEA 2005

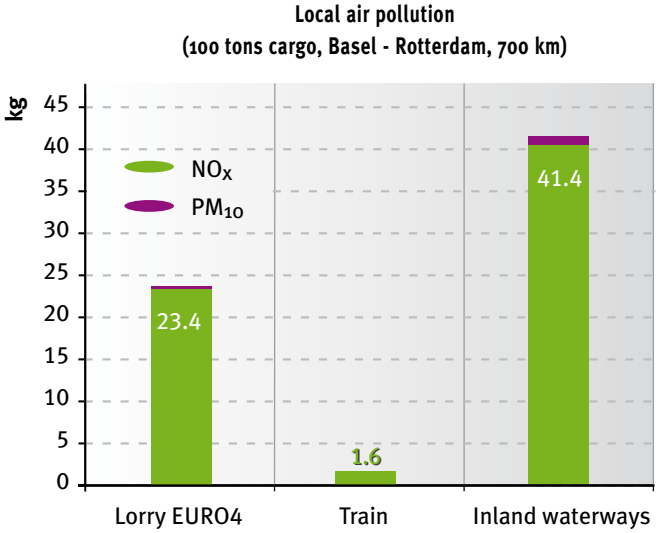


Source: EEA 2005

New combustion technologies, efficient transmission systems and exhaust after-treatment will ensure that rail diesel traction will remain more environmentally friendly in the future than road and inland waterways. Electrification of remaining lines is also one of the many approaches that may be taken.

Freight transport NO_x and PM_{10} comparison

The table below compares the local air pollution from transporting 100 tons of average goods from the port of Rotterdam, Netherlands, to Basel, Switzerland.

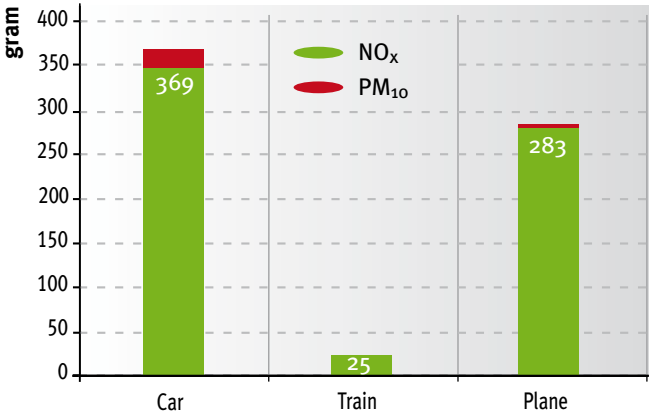


Source: www.ecotransit.org *2008*

Passenger transport NO_x and PM_{10} comparison

Suburban and urban railway lines are nearly completely electric. The table below compares the local air pollution from transporting one passenger from Berlin to Frankfurt in Germany.

Local air pollution
(1 person, Berlin - Frankfurt, 545 km)



Source: www.ecopassenger.org *2008*

The emissions from rail are 10-30 times lower than lorry or inland navigation. The benefit would be even bigger compared with air cargo. In the examples above, 100% electric rail traction is used and the local air pollution contribution is therefore coming from the electricity production.

Railway local air pollution reduction projects

The sulphur content in rail diesel fuels is currently being reduced towards the level of road vehicles as railways continuously seek to improve their performance technical, operational, commercial and procurement measures. Research and development projects include:

Green project	2005-2009	http://green.uic.asso.fr
Rail Diesel Study	2005-2006	www.uic.asso.fr/environment
Railways and biofuel	2007	www.uic.asso.fr/environment

Noise emissions

- ★ **Noise is perceived as the most important environmental problem for people living close to railway lines**
- ★ **Infrastructure companies and railway operators are working at progressively reducing noise emissions from rail**

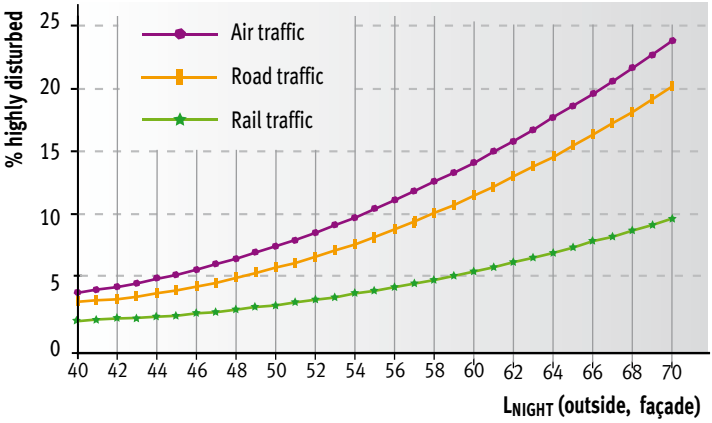
EU transport sector today

Noise is one of the key concerns for people living near transport infrastructure. The fast growing demand for transport in Europe leads to disturbance of an increasing number of citizens during day and night time. To avoid and control exposure to excess levels of transport related noise, the European Commission has implemented the Directive on Environmental Noise 2002/49 covering major roads, rail lines and airports. This is done mainly by defining a noise indicator L_{DEN} to monitor the exposure round the clock and asking member states to deliver maps and action plans.

The graph below shows that the perceived noise annoyance is much higher for air and road traffic than rail, and in general the quality of living close to a railway line is higher than living close to a highway for a constant noise exposure level (L_{NIGHT}).

So far, the two most common means to reduce railway noise in Europe have been noise barriers and insulation of windows. Reducing noise at the source has been recognised, by an EU Commission position paper and by the UIC Noise Action Plan, as the most effective solution, both in technical and economical terms.

Percentages of citizens who are "highly disturbed" when exposed to rail, air and road traffic noise



Source : EC 2004

EU transport sector tomorrow

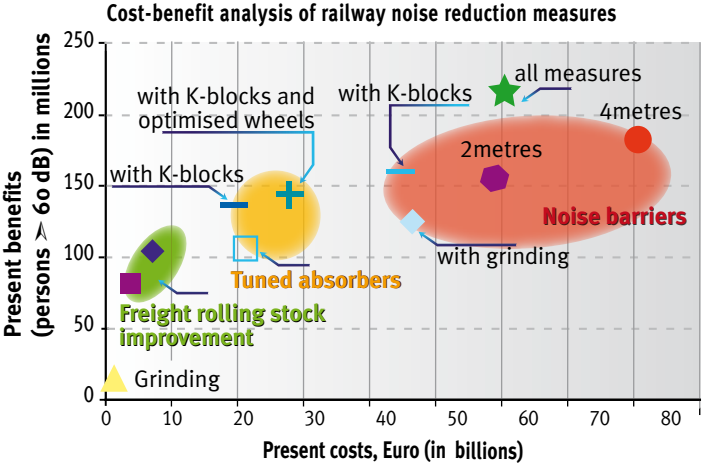
Noise will remain one of the key environmental problems for all EU transport for a long time due to the inherent nature of the problem and its link to transport growth. As part of the Directive on Environmental Noise, noise mapping of major roads, railways and airports will be made in each Member State.

The UIC Noise Action Plan has shown that it is possible to follow a good cost-benefit approach, by:

- Balancing the infrastructure measures (barriers, windows) with the measures at the source (retrofitting);
- Implementing the retrofitting considering the age and the expected life of European wagons;
- Involving the local authorities and the population in a detailed Action Programme.

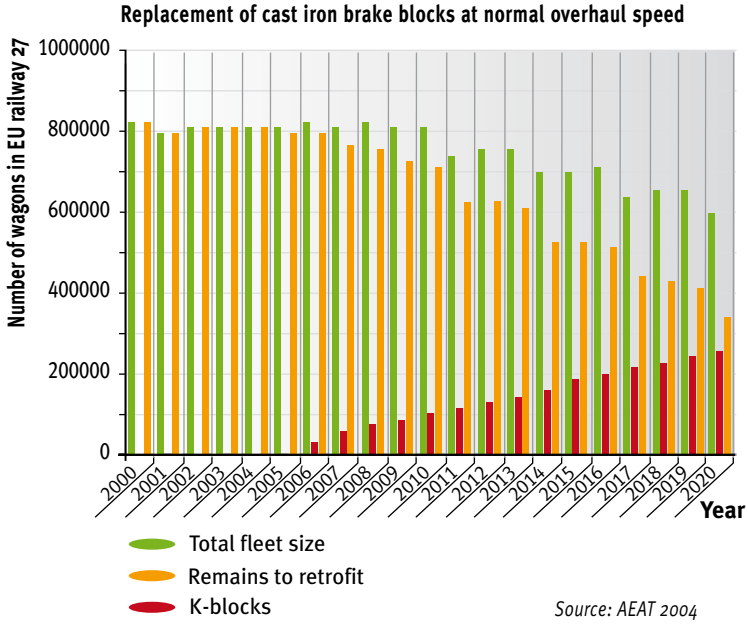
Railways noise development

The main potential for noise reduction on the railways is the replacement of brake blocks on the 800 000 European freight wagons, from cast iron to composite material (so-called K or LL-blocks). This measure alone will cost 1-4 billion Euro on a European-wide basis depending on the technical solution finally agreed on. It will bring about a noise reduction of 8-10 dB especially at night when a major percentage of freight trains operate.



Source: STAIRRS 2003

The figure below shows the age and the projected number of freight wagons in the "EU railway 27" (EU27 plus Norway and Switzerland) with the scenario for exchange of cast iron brake blocks with K-blocks at normal wagon overhaul speed. An accelerated exchange would increase costs for the railways further (AEAT 2004).



Source: AEAT 2004

Railway noise reduction projects

Railways have, in the last decade, developed sector funded or EC co-funded research and development projects to understand and mitigate railway noise from its source. Recent and ongoing important rail noise activities include:

Silence, EU project	2005-2008	www.silence-ip.org
QCity, EU project	2005-2009	www.qcity.org
STAIRRS, EU project	2000-2003	www.stairrs.org
UIC/CER/EIM Workshops on rail freight noise abatement	2005, 2006, 2007, 2008	www.uic.asso.fr/environment

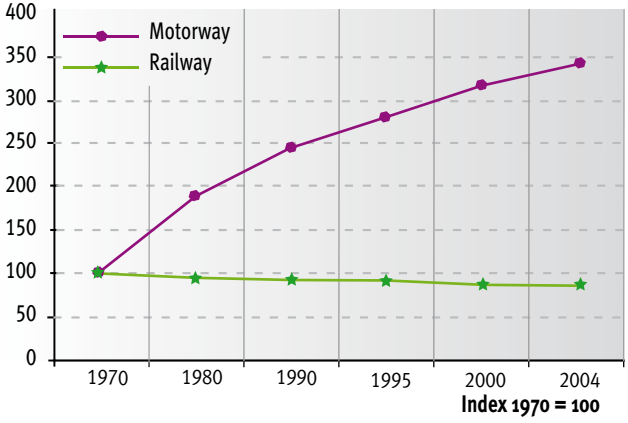
Subsidies and external costs

- ★ **Investment in EU transport infrastructure overwhelmingly favours road over rail**
- ★ **The external costs of rail may be as low as 1% of those of roads**

EU transport sector today

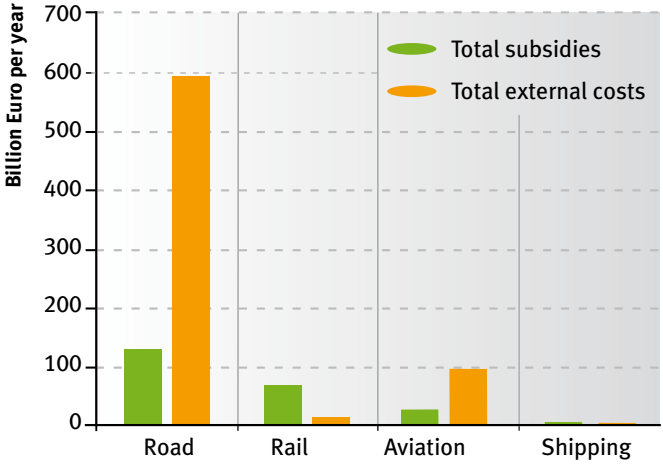
Investment in transport infrastructure in the EU still overwhelmingly favours road over rail. As the graph below shows, the length of rail infrastructure in the EU-15 has declined since 1970, while for motorways it has more than tripled.

Length of rail lines and motorways (km) in EU-15 (1970 = 100)



Source: EC 2006c

The graph below shows that in the EU-15, road transport receives around 110bn Euros a year in infrastructure funding subsidies, while for rail this figure is around 37bn Euros (EEA 2007). Aviation receives significant subsides that add up to between 27 and 35bn Euros per year. But as climate change becomes a bigger issue, there has been growing acknowledgement of the need to take greater account of the external costs associated with transport.



Source: EEA 2007

External costs

External costs are the negative effects of transport that are not internalised into the price paid by the user (e.g. pollution, accidents and congestion) and are therefore not taken into account by users when they make a transport decision. However, they cannot be disregarded as they give rise to real costs to society, such as global warming, health bills, and delays.

There are various studies that have attempted to put a value on external costs. Differences in figures come mainly from different methodologies and initial values in the estimation of congestion, accidents, and air pollution. However, they all put the external costs of road transport as being significantly higher than rail (see table below). The IMPACT report on internalisation of the external costs of transport carried out for the European Commission in 2007 said: "Although the estimation of external costs has to consider several uncertainties, there is consensus at scientific level that external costs of transport can be measured by best practice

approaches and that general figures (within reliable bandwidths) are ready for policy use."

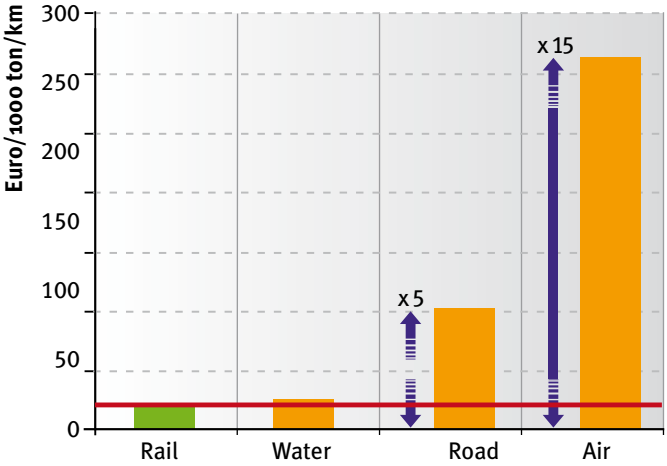
External costs	Road	Rail
Congestion	268	-
Accidents	156	0.3
Noise	40	1.4
Climate Change	70	2.1
Air Pollution	164	2.4
TOTAL	698	6.2

Total external costs (billion Euro) for road and rail in the EU-15+Switzerland+Norway.

Source : INFRAS / IWW2004

EU transport sector tomorrow

The greater internalisation of external costs using market-based instruments would lead to a more efficient use of infrastructure, reduce the negative side effects of transport, and improve fairness between modes. Pricing in this way has already been advocated by the European Commission, including in the "European Transport Policy 2010" (published in 2001) and its 2006 mid-term review. For rail, the internalisation of external costs is currently legally possible. However, the existing Eurovignette Directive forbids the possibility of Member States taking into account external costs when setting road charges.



The average external costs for freight indicate the advantage that rail offered in 2000 (excluding congestion)

Source: INFRAS/IWW 2004

European transport: core statistics

Total freight transport in the EU-25 has grown significantly by 31.3% from 1995 to 2005 with road, sea and air transport seeing the largest expansion. The growth is partly due to the fact that the external costs of transport are not internalised, and only rail is affected by the increased costs associated with the EU Emissions Trading System through its large-scale use of electricity. As the table below shows however, railways still increased their output by 9.2% over this period.

Freight transport (EU 25)

1000 mio tonne-kilometres

	Road	Rail	Inland Waterways	Pipelines	Sea	Air	Total
2005	1 724	392	129	131	1 525	2,5	**3 903**
2000	1 487	374	130	124	1 345	2,1	**3 462**
1995	1 250	358	117	112	1 133	1,9	**2 972**
1995 -2005	37.9%	9.2%	10.2%	17.5%	34.6%	31.1%	**31.3%**
per year	3.3%	0.9%	1.0%	1.6%	3.0%	2.7%	**2.8%**

Source: DG TREN Energy and Transport in figures 2006

Total passenger transport in the EU-25 has grown slower than freight, but still increased by 17.7% between 1995 and 2004. Air transport has been the dominant mode of expansion, partly due to the fact that aviation is completely excluded from any fuel taxes. As with freight, the external costs of passenger transport are not internalised and rail together with tram and metro is the only mode affected by the increased costs associated with the EU Emissions Trading System. However, railways still saw an increase in passenger-kilometres of 8.6%.

Passenger transport (EU 25)

1000 mio passenger-kilometres

	Passenger Cars	Two wheels engine	Bus & Coach	Railway	Tram & Metro	Air	Sea	Total
2004	4 458	143	502	352	75	482	49	**6 061**
2000	4 196	132	492	353	71	440	49	**5 734**
1995	3 787	120	474	324	65	324	55	**5 149**
1995 -2004	17.7%	19.7%	5.8%	8.6%	16.4%	48.8%	-11.1%	**17.7%**
per year	1.8%	2.0%	0.6%	0.9%	1.7%	4.5%	-1.3%	**1.8%**

Source: DG TREN Energy and Transport in figures 2006

Railways: length of lines by country

km

Country	1970	1980	1990	2000	2004	Of which electrified
EU25	**230 650**	**222 741**	**215 441**	**201 303**	**197 937**	**100 674**
EU15	**175 274**	**168 150**	**161 638**	**151 227**	**150 213**	**80 423**
Austria	5 901	5 857	5 624	5 665	5 675	3 523
Belgium	4 605	3 971	3 479	3 471	3 536	2 993
Cyprus	-	-	-	-	-	
Czech republic				9 444	9 612	3 037
Denmark	2 352	2 015	2 344	2 047	2 785	619
Estonia	1 227	993	1 026	968	971	131
Finland	5 804	6 075	5 867	5 854	5 741	3 047
France	37 582	34 362	34 070	29 272	29 246	14 319
Germany	43 777	42 765	40 981	36 588	34 732	19 600
Greece	2 602	2 461	2 484	2 385	2 449	106
Hungary	8 487	7 836	7 838	8 005	7 950	2 573
Ireland	2 189	1 987	1 944	1 919	1 919	52
Italy	16 073	16 138	16 066	16 187	16 236	11 455
Latvia	2 606	2 384	2 397	2 331	2 270	462
Lithuania	2 015	2 008	2 007	1 905	1 782	122
Luxembourg	271	270	271	274	275	262
Malta	-	-	-	-	-	-
Netherlands	3 147	2 880	2 798	2 802	2 811	2 028
Poland	26 678	27 181	26 228	22 560	20 250	11 846
Portugal	3 588	3 609	3 064	2 814	2 849	1 436
Slovakia				3 662	3 660	1 577
Slovenia	1 055	1 058	1 196	1 201	1 229	503
Spain	15 850	15 724	14 539	13 868	14 395	8 042
Sweden	12 203	12 006	11 193	11 037	11 050	7 736
UK	19 330	18 030	16 914	17 044	16 514	5 205
Bulgaria	4 196	4 341	4 299	4 320	4 259	2 913
Romania	11 012	11 110	11 348	11 364	10 844	3 978
Croatia	2 411	2 437	2 429	2 726	2 726	980
Macedonia FYR of)		673	696	699	699	234
Turkey	7 985	8 387	8 429	8 671	8 697	1 920
Iceland	-	-	-	-	-	-
Norway	4 242	4 242	4 044	4 179	4 077	2 509
Switzerland	3 161	3 178	3 215	3 216	3 381	3 330

Source: DG TREN Energy and Transport in figures 2006 and UIC statistics

The reduction in the length of railway lines within Europe over the last four decades is clearly shown in this table. This reduction put the growth factors for passenger and freight rail transport production into perspective: the European railways have been able to increase significantly their production despite a shrinking infrastructure.

Rail passenger transport by country

YEAR 2006	UIC statistics	Rail passenger transport	
		Passenger-kilometres	
Country	Railway operator company	millions	diff. (%) 2006/1995
Europe		633 836	
EU 27		371 269	
Austria	ÖBB	8 646	-10%
Belgium	SNCB NMBS	9 607	42%
Bulgaria	BDZ	2 422	-48%
Czech Rep.	CD	6 887	-14%
Denmark	DSB	5 652	18%
Estonia	EVR	260	-38%
Finland	VR	3 606	13%
France	SNCF	78 465	42%
Germany	DB AG	74 727	23%
Greece	OSE	1 811	15%
Hungary	GYSEV/RÖEE	181	74%
Hungary	MAV	6 742	10%
Ireland	CIE	1 872	45%
Italy	FNM	1 203	–
Italy	FS SpA	46 439	-7%
Latvia	LDZ	992	-28%
Lithuania	LG	430	-62%
Luxembourg	CFL	298	4%
Netherlands	NS	15 414	10%
Poland	PKP	16 976	-19%
Portugal	CP	3 514	-27%
Romania	CFR Calatori	8 049	-57%
Spain	Euskotren&FEVE	493	–
Spain	FGC	767	–
Spain	RENFE	20 260	32%
Slovak Rep.	ZSSK	2 194	-48%
Slovenia	SZ	793	33%
Sweden	SJ AB	5 680	-9%
UK	ATOC	45 600	56%
UK	Eurostar UK	904	–
EFTA		17 355	
Norway	NSB	2 492	5%
Switzerland	BLS	596	45%
Switzerland	SBB CFF FFS	14 267	22%
CEEC		2 567	
Albania	HSh	80	-59%
Bosnia-Herzegovina	ZBH	30	–
Bosnia-Herzegovina	ZRS	36	–
Croatia	HZ	1 362	44%
Macedonia (FYR of)	CFARYM	105	62%
Montenegro	ZCG	108	–
Serbia	ZS	846	–

Rail freight transport by country

YEAR 2006	UIC statistics	Rail freight transport	
		Tonne-kilometres	
Country	Railway operator company	millions	diff. (%) 2006/1995
Europe		403 167	
EU 27		382 062	
Austria	ÖBB	18 868	44%
Belgium	SNCB NMBS	9 835	35%
Bulgaria	BDZ	5 225	-39%
Czech Rep.	CD	16 306	-28%
Estonia	EVR	10 152	184%
Finland	VR	11 060	16%
France	SNCF	40 924	-15%
France	VEOLIA	1 200	–
Germany	DB AG/Railion	89 690	30%
Greece	OSE	661	126%
Hungary	GYSEV/RÖEE	701	165%
Hungary	MAV Cargo	8 382	16%
Ireland	CIE	166	-72%
Italy	FS SpA	20 869	-6%
Italy	RTC	799	–
Italy	SERFER	184	–
Latvia	LDZ	15 273	57%
Lithuania	LG	12 896	79%
Luxembourg	CFL	441	-17%
Poland	PKP	42 651	-37%
Portugal	CP	2 763	37%
Romania	CFR Marfa	11 576	-52%
Romania	CTF & CTV	621	–
Romania	GFR	1 243	–
Romania	SERVTRANS	890	–
Romania	UNIFERTRANS	390	–
Spain	FEVE, FGC, Eskotren	528	–
Spain	RENFE	11 012	10%
Slovak Rep.	ZSSK Cargo	9 703	-29%
Slovenia	SZ	3 373	17%
Sweden	GREEN CARGO	11 500	-38%
UK	FOC	22 180	77%
EFTA		11 695	
Norway	NSB		–
Switzerland	BLS Cargo	3 256	712%
Switzerland	SBB CFF FFS	8 439	3%
CEEC		9 411	
Albania	HSh	36	-32%
Bosnia-Herzegovina	ZBH	682	–
Bosnia-Herzegovina	ZRS	408	–
Croatia	HZ	3 305	67%
Macedonia (FYR of)	CFARYM	614	263%
Montenegro	ZCG	134	–
Serbia	ZS	4 232	–

Glossary

Term	Explanation
AC electricity	Alternating current electricity (normally use in railways at 25 kV 50 Hz or 15 kV 16 2/3 Hz)
Carbon dioxide (CO_2)	Carbon dioxide is a greenhouse gas and by-product of any carbon combustion process (mostly involving fossil fuels) as well as being exhaled by every living organism
COP	Conference of the Parties, annual meeting among all countries that have signed the Kyoto protocol under UNFCCC. In 2008 COP14 will take place in Poznan, Poland
DC electricity	Direct current electricity (normally use in railways at 750V, 1.5 kV or 3 kV)
Direct emissions	Emissions related directly to the onboard combustion of diesel or use of electricity
DMU	Diesel Multiple Unit (a train set self-propelled by a diesel engine)
EC	European Commission
EMU	Electric Multiple Unit (a train set self-propelled by an electric engine)
Environmental Performance Indicator	Figure monitoring an environmental performance that has clearly identified scope and measurement method
EU-25	Members of the European Union as of the May 2004 expansion
EU-27	Members of the European Union as of the January 2007 expansion (inclusion of Bulgaria and Romania)

Term	Explanation
Final energy consumption	Final energy (diesel or electricity) is the amount of direct consumption by motive power units. The final energy consumption can be measured in terms of the fuel (volume of diesel) consumed or electricity consumed at the pantograph
Greenhouse gases (GHG)	Many gases have a global warming potential, and are thus known as greenhouse gases. The Kyoto Protocol specifies six greenhouse gases: CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6
Hydro-fluorocarbons (HFCs)	Hydrofluorocarbons (HFCs) make a group of the greenhouse gases specified by the UNFCCC and the Kyoto Protocol
Indirect emissions	Emissions related to the initial energy provision (production of the diesel or making the electricity available at the "end of pipe")
IPCC	Intergovernmental Panel on Climate Change, the United Nation's scientific panel on climate change (www.ipcc.ch)
L_{DAY} (noise level)	The A-weighted long term average sound level as defined by ISO 1996-2: 1987, determined over all the day periods of a year typically 06:00 – 18:00 (Environment Noise Directive 2002/49/EC)
L_{DEN} (noise level)	Equivalent noise level for all day (24h): Day-Evening-Night (den), L_{DEN} is derived from L_{DAY}, $L_{EVENING}$ and L_{NIGHT}
$L_{EVENING}$ (noise level)	The A-weighted long term average sound level as defined by ISO 1996-2: 1987, determined over all the evening periods of a year typically 18:00 – 22:00 (Environment Noise Directive 2002/49/EC)

Term	Explanation
L_{NIGHT} (noise level)	The A-weighted long term average sound level as defined by ISO 1996-2: 1987, determined over all the night periods of a year typically 22:00 – 06:00 (Environment Noise Directive 2002/49/EC)
Land take	Space of land occupied by a certain activity, e.g. railway tracks or stations, highways, cities, farm land etc
Metadata	Information about the data collected, e.g. data sources, quality, collection procedures, assumptions, exceptions etc.
Methane (CH_4)	Methane is one of the greenhouse gases recorded by the UNFCCC and the Kyoto Protocol
Noise exposure	The exposure to human ears of any noise source. Exposure is regulated in Europe by various regulations e.g. 2002/49/EC
Nitrous oxide (N_2O)	Nitrous oxide, one of the regulated greenhouse gases specified by the IPCC and the Kyoto Protocol
Nitrogen oxide (NO_X)	Nitrogen oxide, one of the EC regulated air pollution gases
Perfluoro-carbons (PFC_S)	Perfluorocarbons make up a group of the greenhouse gas emissions recorded by the UNFCCC and the Kyoto Protocol
Pkm	Passenger-kilometres: 1 pkm = 1 passenger transported 1 kilometre
PM_{10}	Particulate Matter up to 10 microns in diameter (PM_{10}). The number 10 refers to the particle size measured in microns. PM_{10} is widely considered the most dangerous to human health. $PM_{2.5}$ is also used occasionally

Term	Explanation
Primary energy consumption	Final energy, plus energy consumed for the extraction, transport and transformation of primary energy carriers, plus energy consumed in the process of energy distribution
Reference Variables	Production data (such as pkm or tkm) for the denominator of the equation, where the nominator is the environmental performance
Railway undertaking	Railway company responsible for operating the rolling stock only and not the infrastructure
Rolling Stock	Collective term for a variety of wheel based railway wagons: locomotives, passenger and freight vehicles, and multiple units
Sulphur hexafluoride (SF6)	Sulphur hexafluoride is one of the greenhouse gases specified by the UNFCCC and the Kyoto protocol
Tonne-km (tkm)	Tonne-kilometres, 1 tkm = 1 ton transported 1 kilometre
Transport Unit (TU)	1 TU = Passenger-km + Tonne-km. Even though the two units are not quite the same (1 passenger km is usually ~ 0.5-0.8 Tonne-km), it is historically accepted to add the two units in this way
TWh	Terawatt hour, unit of energy related to watt hours (or joules). 1 TWh = 1 Billion kWh = 1 Million MWh
UNFCCC	United Nations Framework Convention on Climate Change (www.unfccc.int)

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