PACT

PILOT ACTIONS FOR COMBINED TRANSPORT

CO_2 REDUCTION THROUGH COMBINED TRANSPORT

SUMMARY REPORT

JULY 2003

THE PROJECT PARTNERS

Project coordinator:

UIRR, International Union of Combined Road-Rail Transport Companies, Brussels (Belgium)

UIRR was founded 1970 and is regrouping 18 Combined Transport operators, covering about 65% of the European market. Amongst other major activities, UIRR regularly elaborates harmonised European statistics on CT, which are a major source for the current study.

Consultants:

SGKV, Frankfurt (Germany)

Nestear, Gentilly (France)

Logistic company:

Lugmair, Roitham (Austria)

Energy and Transport policies are at the centre of environmental concerns. The 1997 Kyoto Protocol marked the commitment of the EU to reducing emissions of greenhouse gases - including CO_2 -, by 8% by 2008-2012 compared with their 1990 level. The reality: until 2002, the Member States were able to keep the CO_2 emissions at the level of 1990, but a reduction has not yet been achieved.

It is time to act!

- The warming rate over the last 25 years has accelerated.
- Transport is becoming less and not more environmentally sustainable.
- Transport is the fastest growing energy consumer in the EU.
- Carbon dioxide emissions from transport are a major contributor to the greenhouse effect.

The European Commission's White Paper of 2001 "Time to decide" states that, "in 1998 energy consumption in the transport sector was to blame for 28% of emissions of CO_2, the leading greenhouse gas. According to the latest estimates, if nothing is done to reverse the traffic growth trend, CO_2 emissions from transport can be expected to increase by around 50% to reach 1113 billion tonnes in 2010." … "Because road transport is totally dependent on oil (accounting for 67% of final demand for oil), road transport alone accounts for 84% of CO_2 emissions attributable to transport."

The EU therefore is looking for effective measures to reduce CO_2 emissions, in particular in targeting actions in the transport area. The European Commission has considered intermodal transport and especially combined transport as an important tool to reduce CO_2 emissions in the transport sector.

In the final report of the European Climate Change Programme (ECCP) published in Brussels in January 2002, a modal shift from road to more sustainable modes of transport such as rail and waterways was considered. It came to the conclusion that they could result in a reduction in fuel consumption and therefore play an important role reducing the greenhouse effect.

For this reason, the European Commission and participants in the combined transport field were interested in a research project, which would evaluate the amount of CO_2 reduction in Europe that could be generated by the shift from road to rail. The study was supported by the PACT programme (Pilot Actions for Combined Transport).

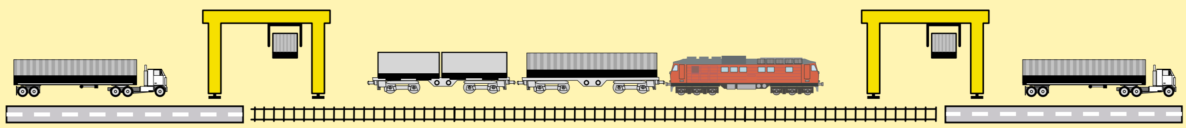
With the objective to draw a realistic picture, the project partners have taken a pragmatic approach, updating existing research with recent data and by an evaluation of all chosen cases according to their practical importance.

OVERVIEW

Intermodal Transport: The movement of goods in one and the same loading unit or road vehicle, which uses successively two or more modes of transport without handling of the goods themselves in changing modes.

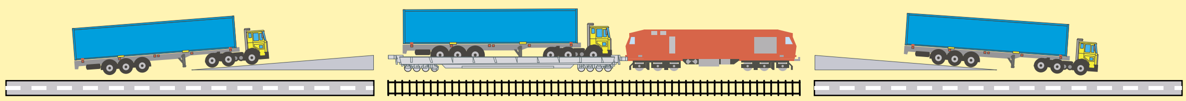
Combined Transport road-rail: Intermodal transport where the major part of the journey is by rail and any initial and/or final legs carried out by road.

Unaccompanied CT: Transport of a road vehicle, container, swap body or trailer, not accompanied by the driver.



Unaccompanied CT

Rolling Motorway (RoMo, accompanied transport): Transport of a complete road vehicle on train, accompanied by the driver.



Rolling Motorway

Prior studies

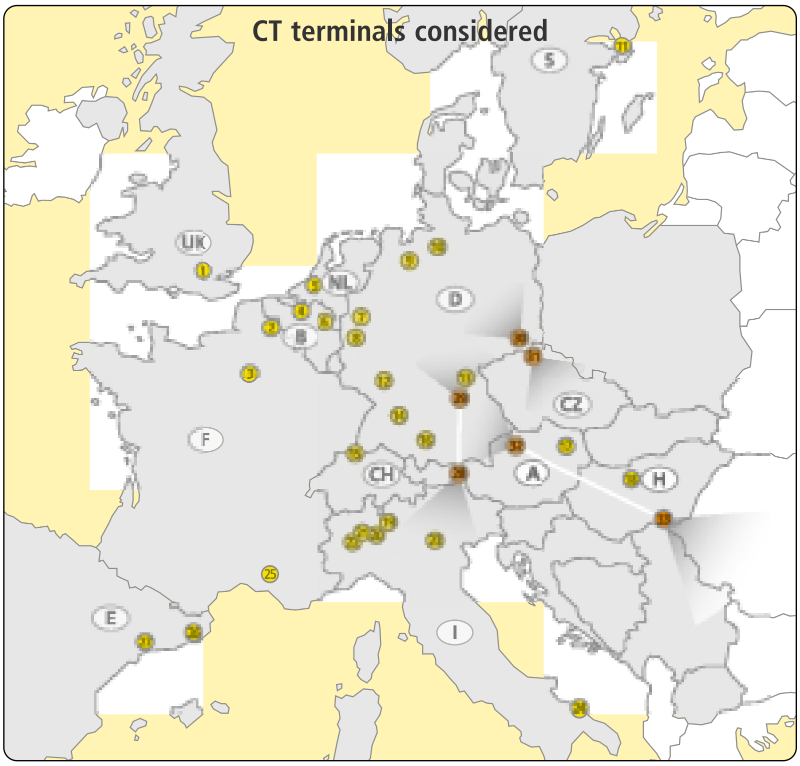
Different German, English, French and Italian studies about the energy consumption and CO_2 emissions in the road and rail transport sectors have been examined. They were published during the last fifteen years and the majority of them later than 1998.

- Twelve studies analyse certain transport relations, while 27 of the examinations deal with a global country-specific or EU-wide analysis.
- Different methods lead to results that are difficult to compare. Nevertheless, in all of the assessed studies the ratio of the emissions for combined road/rail transport or pure rail transport to road transport rates between 1 to 1 and 1 to 7, in average 1 to 3.
- Most of the research studies calculate CO_2 emissions as a result of energy consumption.
- Rail transport is always favourable if one considers only the main course and neglect the pre/post haulage.

One of the most specific and recent studies in this field is the "Comparative Analysis of Energy Consumption and CO_2 Emissions of Road Transport and Combined Transport Road/Rail" by the two German consultants IFEU and SGKV (also a partner of this project). Their energy model was the basis for the current study.

ANALYSED CORRIDORS

The objective of the current study is to obtain a realistic picture of the environmental performance of combined transport. The project partners have chosen relations, which are representative for today's combined transport. While the focus was merely put on the most current road-rail techniques (the transport of swap bodies, containers and semi-trailers in block trains) three relations using the rolling motorway have been examined as well[1]. The analysed corridors represent 631.000 consignments (one consignment is equal to the capacity of a heavy road vehicle), 28% of UIRR's traffic and approximately 15 to 20% of total European combined transport.



CT relations

(17)	Wien	Neuss	(7)
(6)	Genk	Novara	(21)
(4)	Antwerpen	Busto Arsizio	(19)
(8)	Köln	Granollers	(26)
(12)	Ludwigshafen	Tarragona	(27)
(31)	Hamburg	Budapest	(18)
(8)	Köln	Busto Arsizio	(19)
(16)	München	Verona	(23)
(13)	Nürnberg	Verona	(23)
(3)	Paris	Vercelli	(22)
(1)	London	Novara	(21)
(21)	Novara	Rotterdam	(5)
(11)	Stockholm	Basel	(15)
(10)	Hamburg	Basel	(15)
(14)	Stuttgart	Bremen	(9)
(3)	Paris	Avignon	(25)
(2)	Lille	Avignon	(25)
(20)	Milano	Bari	(24)
(29)	Manching	Brennersee	(28)
(33)	Szeged	Wels	(32)
(30)	Dresden	Lovosice	(31)

On all corridors, typical transports by road were compared with typical cases of combined transport. As road transport is the dominant mode, its energy consumption and CO_2 emissions were, for easy comparison, set to 100% and the CT level is shown in percentage compared to this benchmark.

Always two versions are calculated:

1. **Road versus CT chain,**
   all modes used from origin to destination, including the initial and final road leg, the main rail part and in one case the ferry.
2. **Road versus Rail per kilometre,**
   to compare the specific performance of the two modes.

This distinction is especially important in the cases of RoMo where the CT chain includes long initial road legs, or in cases where either in pure road transport (transit restrictions) or on the rail, detours occur in today's traffic.

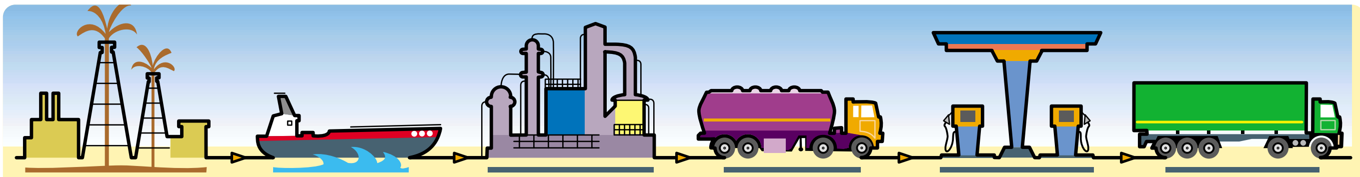
1) The only 117 km long rolling motorway Dresden-Lovosice is a very special temporary case and is mentioned separately as it is not representative for other RoMo's.

ENERGY CONSUMPTION

THE ROAD TRAFFIC

The first step for the determination of the CO_2 emissions is the analysis of the energy consumption. In all cases the primary energy use was calculated.

For road this includes the extraction, processing and transport of petrol as well as the conversion into diesel and the final diesel consumption by the road vehicle.



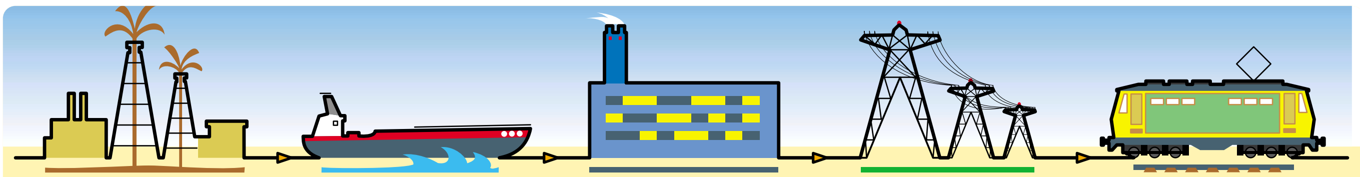
Scheme of energy chain road

For the energy consumption of road the IFEU energy model has been used, with the following diesel consumptions for an average load on the different road categories: 34.0 l/100km on highway, 36.0 l on rural main roads and 47.7 l on other (urban) roads. Up and downgrade factors were used to take the grade into consideration.

A detailed analysis of the truck fleet consumption of the project partner Lugmair has shown only little differences and generally confirmed the parameters of this model.

THE RAIL TRAFFIC

For the rail part of the CT chain the extraction, processing and transport of primary energy and the transformation into electrical energy as well as the final energy consumption of the trains, shunting and intermodal transfers, are taken into account.



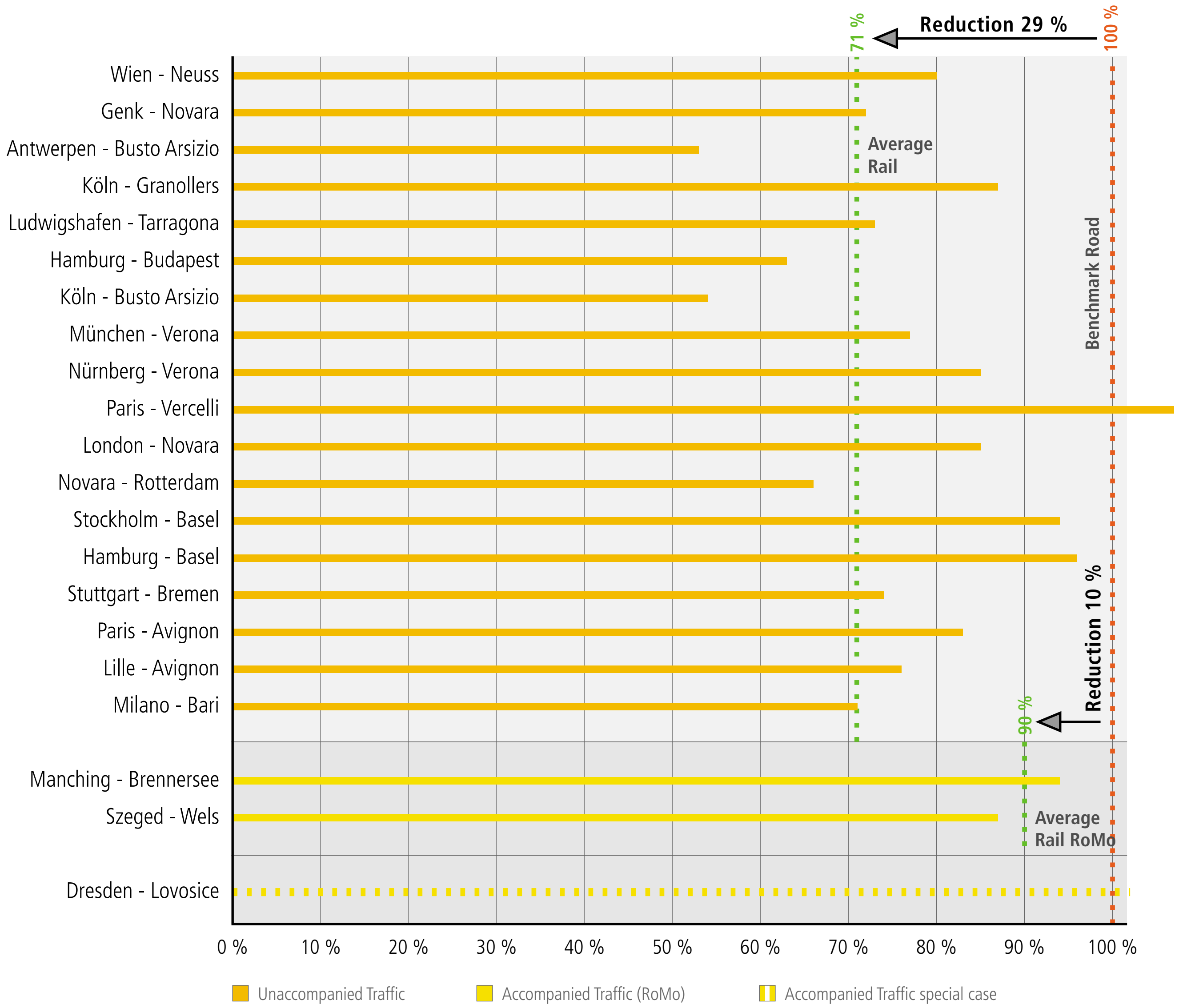
Scheme of energy chain rail

The final electric energy consumption of a consignment transported in a train is then mainly dependent on the following factors:

- Type and number of locomotives
- Train length and total weight
- Ratio load/empty weight of wagons and transport vessel
- Route characteristic (gradient)
- Driving behaviour (speed, acceleration) and air resistance.

The main parameter influencing the railway transport energy consumption is the ratio between the payload and the total weight. The best performing trains are long trains carrying swap bodies and containers with rather heavy goods.

Energy Consumption of Road versus CT chain

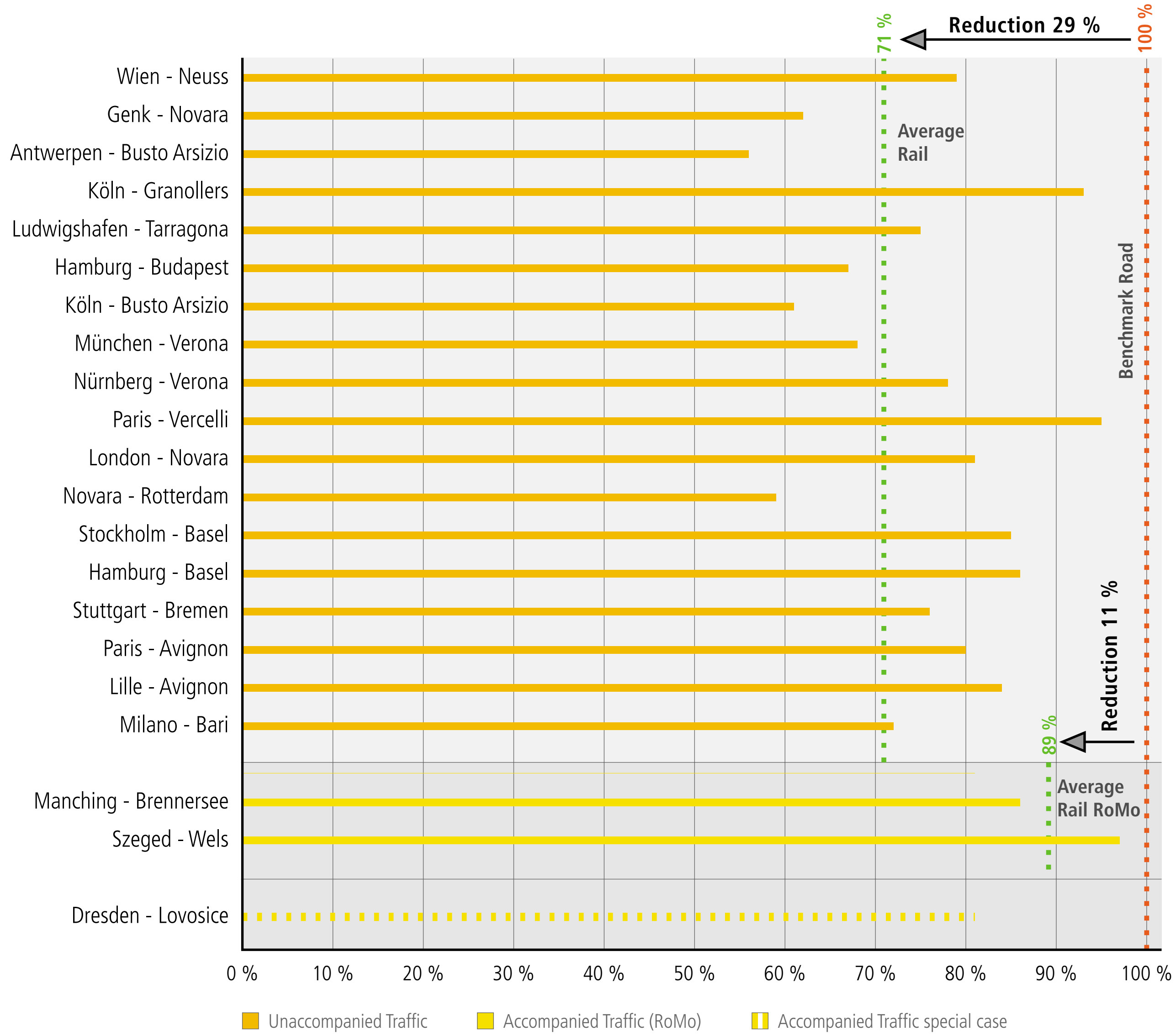


This graphic shows the energy consumption of the whole CT chain compared to pure road transport between the same origin and destination.

In order to calculate the energy consumption, some parameters have been taken into account, in particular:

- The routes followed in reality, considering that distances covered between road and the CT chain are different.
- Sometimes road has to use deviations for political reasons, for example transit restrictions. On the other hand, there are cases where the motorway connections on road are shorter than the connection on the existing rail infrastructure or where certain deviations are necessary to reach CT terminals.
- As regards the rolling motorway, the road traction (which is included in the CT chain) might be even longer than the rail part. Consequently, the energy consumption of the road leg has a major influence on the results of the CT chain.

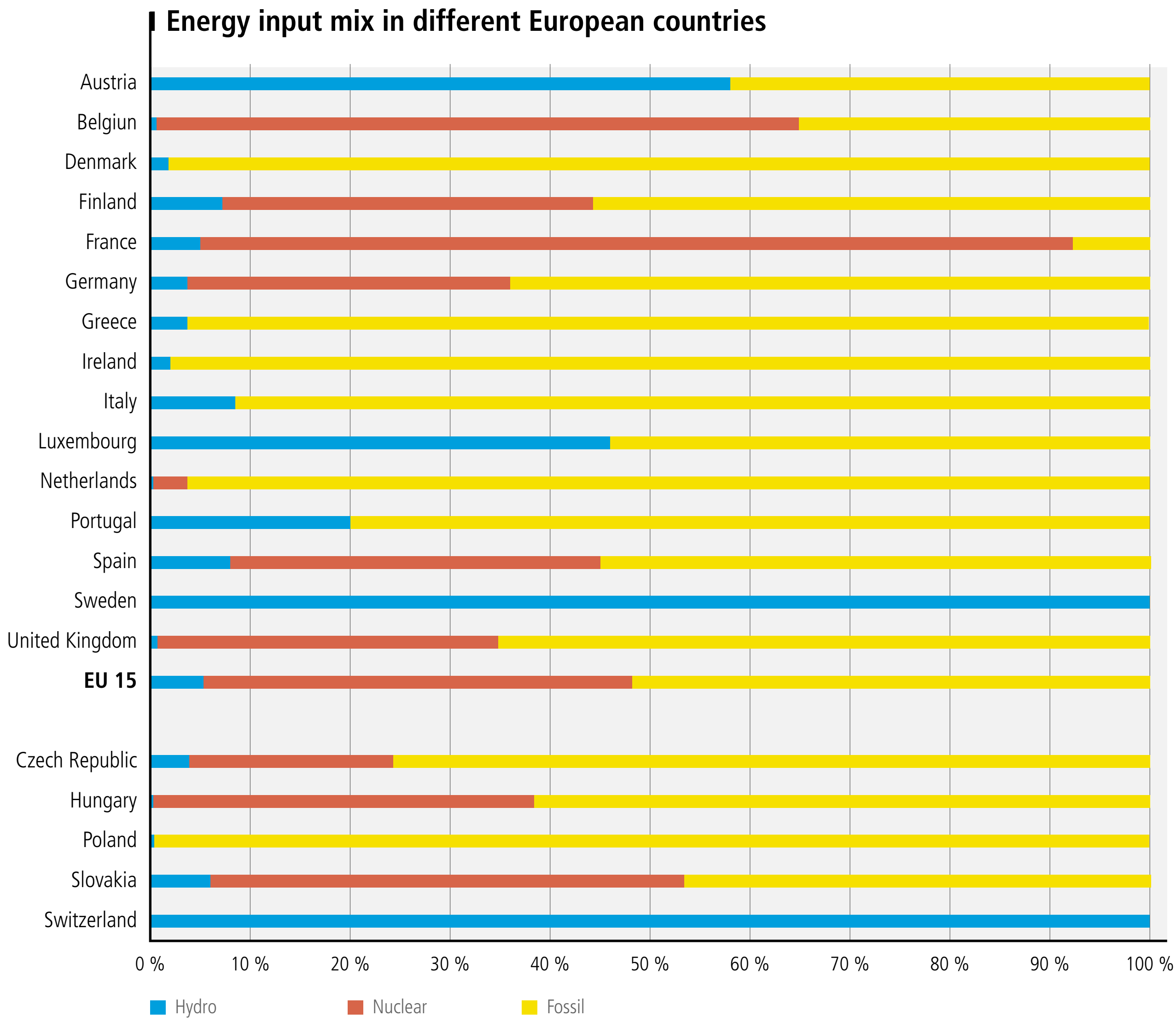
Energy Consumption of Road versus Rail per Kilometre



Unaccompanied combined traffic on rail saves 29% of energy compared to road, while rolling motorway saves around 11%.

The graphic does only consider the road transport mode versus the rail mode. The energy consumption per kilometre of road or rail excludes all influences and particularities mentioned the page before. The capacity use of combined transport trains is very high, attaining in average 87% for unaccompanied transport and 91% for the rolling motorway. These percentages are a consequence of the high railway pricing, allowing the operators only a profitable exploitation with optimised capacity use. This is in favour of a good energy balance and low CO_2 emissions. But this "extreme" pricing policy currently limits the potential for a rapid growth.

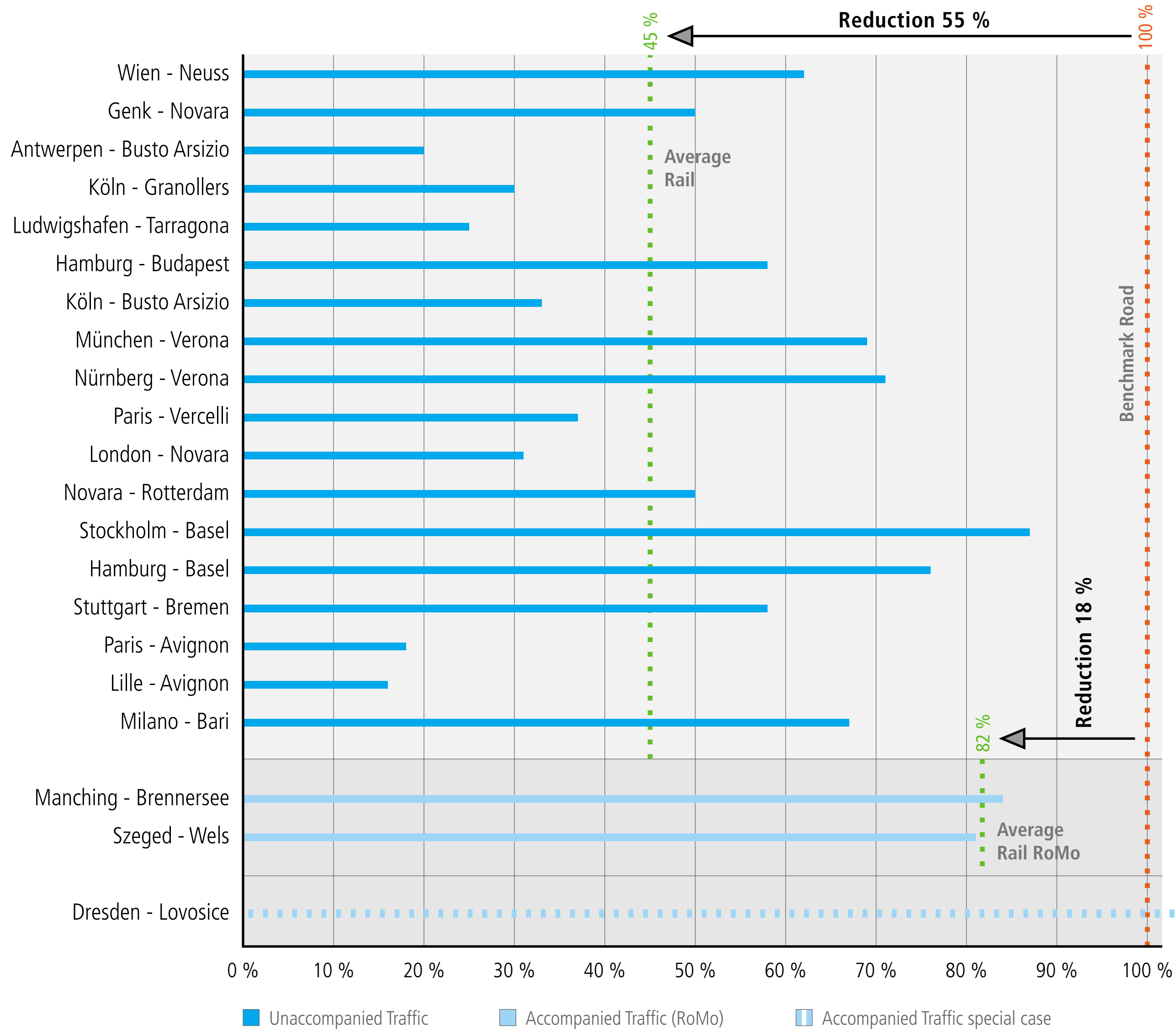
The current study used the energy model of IFEU, which takes into account the special split of electric energy production between fossil, hydro and nuclear energy per country. In Germany and Austria even the specific mix of input for the electricity used by the railways was considered.



The efficiency of electricity production in thermal power plants ranges between 30 and 40%. In some countries combined heat and power production increases the total efficiency. The losses attributable to transforming and transport of electric energy are estimated to be about 11% of the produced electricity. The emission factors for CO_2 depend on the mass-related energy content of the combustible being the lowest for natural gas followed by fuel oil, then hard coal and lignite.

CO_2 Emissions of Road versus CT chain

This graphic shows the CO_2 emissions of the whole combined transport chain compared to pure road transport between the same origin and destination.



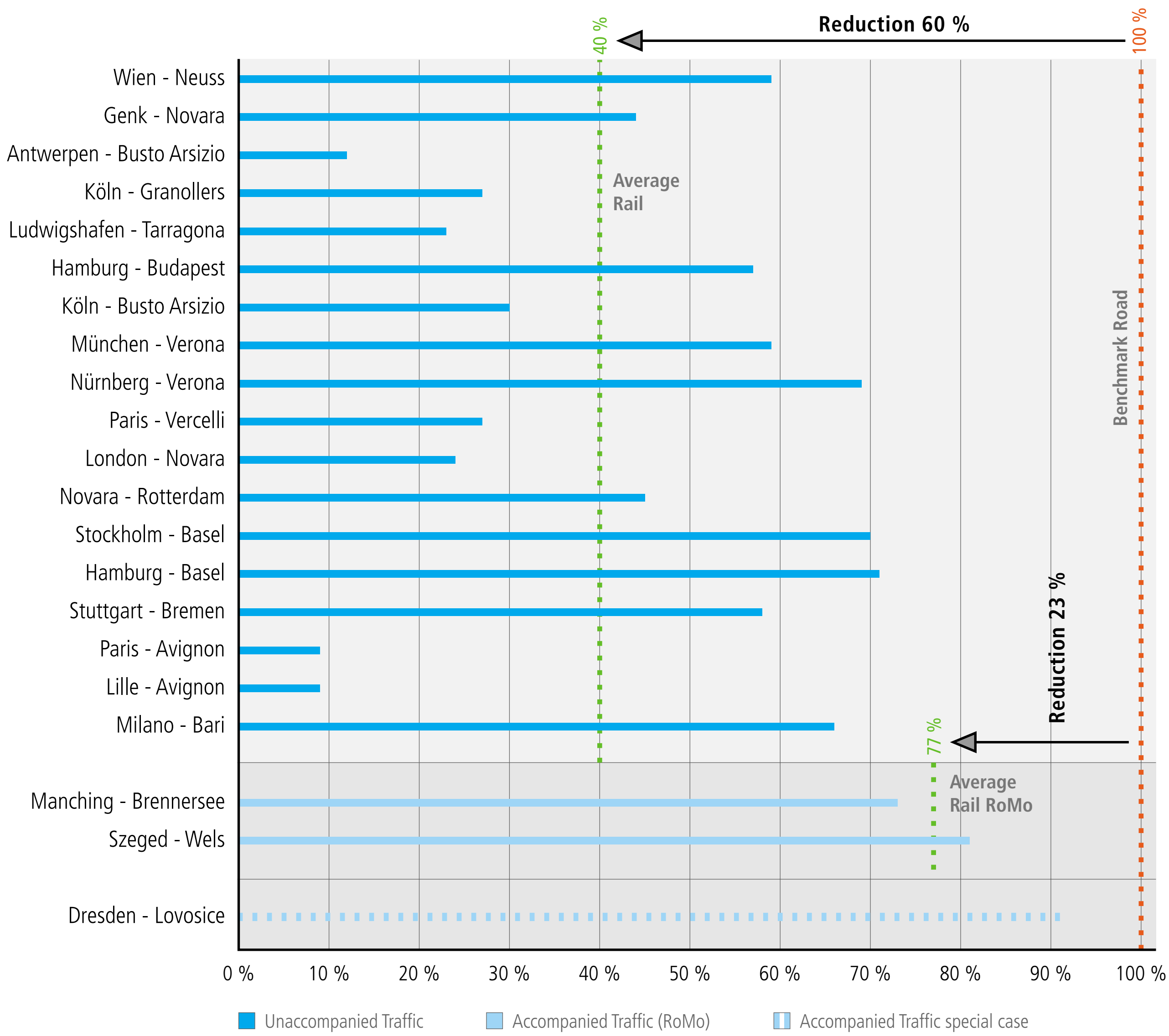
Unaccompanied combined traffic chains reduce the CO_2 emissions by 55% compared to road, while CT chains including rolling motorway reduce emissions by 18%.

Depending on the routes employed in reality, the distances between road and the CT chain are different.

The latter includes the pre- and post-haulage and even short sea in one case. Road is taken as a benchmark (100%) and so the graphic shows the percentage of the CT chain emissions compared to road. The corresponding reductions are 100% minus the mentioned figures.

CO_2 Emissions of Road versus Rail per Kilometre

This is the graphic containing the main results of the study. Road emissions are compared with CT rail. All other influences resulting from the specific cases like deviations or the use of other modes than rail in the combined transport chain are excluded. The message of the results is quite clear:



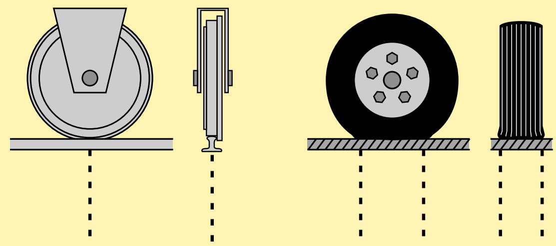
If we take road as a benchmark (100%), a transfer to unaccompanied combined rail traffic will reduce the emissions to 40% only. This means reductions of 60%! Even the Rolling Motorways with their higher deadweight allow a CO_2 reduction of 23%.

The higher savings per km show that it is desirable to keep the main rail part as long as possible. For example, the rail distance of the RoMo Manching-Brennersee is today limited as in Italy the rail gauge is too low to transport 4.00m high lorries on rail.

CO_2 EMISSIONS

SYSTEM ADVANTAGES OF RAIL

One important factor which explains the superiority of rail is the three to six times lower rolling friction of steel wheel on rails compared to those of rubber lorry tyres on road. This energy advantage is the highest in long trains with a high ratio of payload to deadweight, which can best be achieved with swap bodies and containers.



In addition the further reduction of CO_2 is mainly due to the use of regenerative and non-fossil energy resources during the electricity production.

ABSOLUTE CO_2 COST SAVINGS AND MONETARY EVALUATION

Out of the results in the graphic 'CO_2 Emissions of Road versus CT chain', the actual absolute CO_2 reductions can easily be obtained by taking into account the real traffic volume for each relation. Based on the situation of the year 2001, the observed relations have helped to reduce the CO_2 emissions for each transferred consignment by 610 Kg. For the whole unaccompanied traffic of UIRR with 1.75 million consignments this means savings of 1.1 million tonnes carbon dioxide. Every truck transported on the Rolling Motorway reduces the emissions by 190 Kg, for the 466,000 consignments this means a reduction of 90,000 tonnes. The transfer of 2.2 million consignments to rail by UIRR companies reduced emissions in total by 1.2 million tonnes carbon dioxide.

Besides the UIRR companies, who represent about two thirds of the market, there exist other operators. Including these actors the emission reductions may be estimated at 1.8 Million tonnes.

According to scientific evaluations in France and Germany, the environmental damage of a tonne CO_2 is evaluated at about 100 EUR.

The whole European combined transport yearly reduces CO_2 emissions by 1.8 million tonnes with environmental savings of 180 million EUR.

If the polluter-pays-principle is introduced, the combined transport would have a real additional commercial advantage. In a transitional time until the announced EU policy of inclusion of all external costs is realised, these and other environmental savings justify measures in favour of combined transport.

Doubling Combined Transport

The objective is at least a doubling of Combined Transport by 2010, which means an annual growth rate of 7%. This seems not to be unrealistic given that international CT of UIRR companies has had an average growth rate of 16% between 1987 and 1996 and assuming that the EU policy designed in the white paper "Time to decide" will be put into practice.

Three different scenarios have been elaborated based on the doubling of the CT traffic:

- The **reference scenario** counting on a uniform doubling of the combined transport traffic for the different international traffic flows.
- The **sensitive area scenario** focusing on an over proportional growth in the Alps and the Pyrenees, due to traffic restrictions on road, and supported by accompanying measures in favour of rail transport.
- The **globalisation scenario** concentrates on Europe's enlargement, with an over proportional growth of the East-West traffic as well as of the traffic to the western ports.

All three scenarios are based on the current split between unaccompanied and accompanied traffic. Therefore, the results show CO_2 reductions between those of unaccompanied traffic (-55%) and RoMo (-18%). Possible technical progress in road or combined transport has not been taken into account.

Scenario	reference	sensitive area	globalisation
Reductions CO_2	43%	45%	40%

The sensitive area scenario shows better savings, which are mainly due to the more favourable energy mixes on Alpine and Pyrenean corridors.

The variation of the percentage of CO_2 savings of Combined Transport compared to road shows only minor differences between the scenarios. Consequentially structural changes will have little influence. A doubling of CT will also globally double the savings of energy and the reductions in CO_2 emissions.

RECOMMENDATIONS

The shift of traffic from road to rail is an important instrument to reduce the emissions of the greenhouse gas CO_2.

Basically, all savings in CO_2 emissions realised by intermodal transport can be traced back to three sources:

- Intermodal transport consolidates smaller loads into large volumes which can be moved with less energy consumption per unit.
- Combined transport shifts traffic from road to rail. The rolling friction of steel wheels on rails is less than that of rubber lorry tyres on road.
- Rail transport, at least in long distance traffic on the main axes, uses mainly electric traction in Europe. The relative savings in CO_2 are higher than those of energy, where electric energy is generated by waterpower or nuclear power.

Concerning the energy mix, it is obvious that for environmental reasons it is beneficial to rise the part of renewable resources, mainly water, wind and solar energy. The project partners abstain from recommending more use of nuclear energy to reduce CO_2 emissions as this is accompanied by other environmental disadvantages.

There are a number of further parameters to reduce the CO_2 emissions:

- Encourage and promote all technical, operational and commercial solutions that increase the average capacity use per intermodal transport train.
- Encourage and promote all infrastructure upgrades, which will allow the operation of longer and heavier trains.
- As the saving of energy is achieved mainly during the rail carriage: construction of terminals and promotion of rail infrastructure (alpine basic tunnels) in order to reduce rail distance and grade.
- Set fair and equal framework conditions for all modes including external costs, then competition will drive operators to minimise distance, energy input and to maximise the capacity use.

If the appropriate measures are undertaken, combined transport will be able in the future to contribute even more to the protection of the climate and to the safeguard of the environment.

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