



The “First Comparison of Environmental Performance of Rail Transport”

Targets, Results and further Tasks

Sponsored by



**Bundesministerium
für Umwelt, Naturschutz
und Reaktorsicherheit**

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Dirk Flege, General Manager



Sustainable development is unthinkable without rail transport. This is why the German government has provided considerable funding in recent years to strengthen rail transport in competition with other modes, especially road transport. However, while new exhaust gas standards were introduced for passenger cars and lorries within a few years, comparable developments for rail transport have, to a large extent, yet to appear. However, anyone wishing to remain competitive in the long term must not miss their connection as far as environmental protection is concerned. This is especially true for rail transport, which has a good reputation to uphold in this context.

The idea of the Pro-Rail Alliance to initiate an intra-modal comparison of environmental performance was therefore ideally suited to conveying this key issue to the decision-makers at rail enterprises and to signalling the future direction to manufacturers. The First Comparison of Environmental Performance of Rail Transport is in my opinion a complete success: The review has shown that a range of enterprises have already actively improved their environmental balance on their own initiative. More information can be found in this brochure. In future, however, “lighthouse projects” alone will not be sufficient to secure the entire spectrum of traditional environmental benefits of rail travel in the long term. In view of the predicted growth in traffic, without considerable efforts towards implementing ambitious environmental standards man and the environment would have to reckon with a considerable burden over the coming years. This could impinge upon the ecologically friendly benefits of rail travel. Noise pollution in particular poses a health and acceptance problem among residents and travellers - not only along the Rhine valley. Further initiatives are also required for climate protection and air pollution control.

I am therefore pleased that this project and thus the issue of quality standards for rail transport will continue rather than be shelved after the awarding of prizes. It is a further contribution to increasing the appeal of rail travel.

A handwritten signature in blue ink, reading "Jürgen Trittin". The signature is fluid and stylized, with a long horizontal line extending from the end.

Jürgen Trittin
Federal Minister for the Environment, Nature Conservation and Nuclear Safety

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Why is the Pro-Rail Alliance carrying out a Comparison of Environmental Performance?

The environmental advantages of the railway form one of the most important arguments for promoting our mode of transport with transport policies. The environmental advantages form an important marketing argument for rail operators - when marketing to passengers and public authorities in regional passenger transport.

Physical and technological factors mean that the railway finds itself in a better position when it comes to the environment than other competing modes of transport such as the passenger car, lorry and aeroplane: The rolling drag of the railway is less than in road transport. A rail vehicle therefore consumes less energy per tonne and passenger kilometre under conditions that are otherwise identical. The toxic emissions are also more favourable in rail transport. The railway also brings advantages when it comes to noise emissions and the use of space.

This favourable position should not be a cause for complacency for rail operators and other active players in railway transport. Noise emissions are the Achilles' heel of rail transport. Residents protest with increasing frequency whenever upgrading or construction work is carried out, or when rail services are noticeably intensified, because the noise often occurs concentrated especially in residential areas. Furthermore, the noise of freight transport takes place mainly at night. For those people who cannot sleep at night there is little consolation in the fact that the railway line behind their house is sparing a several-fold number of residents living by a motorway from the noise created by lorries.

Like in almost every other industry, rail enterprises also hold reservations against environmental protection measures and requirements. But the fear of would-be high additional costs is dangerous in terms of business management and is often unfounded. Of course there are expensive innovations that cannot be carried out under the current economic conditions, or at least not without funding. But there are also many measures that do not involve excessive costs or even contribute to the reduction of costs, such as the "whispering brake" with new freight carriages or the energy-saving driving modes. Other measures pay for themselves by underlining the credibility of the rail enterprise that attracts passengers with its environmental benefits. Environmental and quality management systems are also closely linked: Those who systematically look for measures which are environmentally sound will also discover the potentials for reducing costs and for the improvement of quality.

The Pro-Rail Alliance has initiated the "First Comparison of Environmental Performance of Rail Transport" competition with the support of the Federal Ministry for the Environment, in order to convince the railways that a greater level of environmental protection not only benefits the people affected but is also first and foremost important for rail companies themselves. We want to demonstrate the possibilities that are now available

to rail enterprises to improve the environmental performance of their own operations. We also want to provide information about how incentives for more environmental protection can be wisely implemented and where the need for research and development still exists.

Committed Rail Enterprises

With this project and the assessment brochure available we can demonstrate to the general public and all customers of the German railways that there is a whole set of rail enterprises that are dedicated to the issue of “environmental protection in railway transport” and are moving the issue forward with good results. From a range of activities that exceed legislation, they show that the ecological development of railway transport is economically feasible and sensible. This is true of the companies that have taken part in the competition. It is also true of a further group of companies that did not participate in the first round but where we are aware of progressive environmental measures taken (details of which we publish on the Internet, see the back page of the brochure). And this is of course especially true of the winners of the “First Comparison of Environmental Performance of Rail Transport”.

We would like to thank the members and sponsors of the Pro-Rail Alliance, who have supported the “First Comparison of Environmental Performance of Rail Transport” project as an enterprise for the promotion of rail transport and who have endorsed it with dedication. We thank the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety for the support it has provided the project both in terms of input and funding. We thank the members of the advisory board for their intensive and dedicated work on the project. And we thank the project team from SCI Verkehr GmbH and the IFEU -Institute for Energy and Environmental Research Heidelberg GmbH - for their good work, the intensive discussions and the many good ideas.

But above all we would like to thank the enterprises that took part and the dialogue partners from rail enterprises, the railway industry and environmental organisations for their support, feedback and varied suggestions.

International Cooperation Required

The positive response from rail enterprises, the railway industry and organisations has prompted the Pro-Rail Alliance and the Federal Ministry for the Environment to extend the project in order to continue to promote dialogue with active players on the issue of the “improvement of practices affecting the environment within rail enterprises”, to make known the possible measures available and to prepare a second round of the “Comparison of Environmental Performance of Rail Transport”. Rail enterprises and the railway industry have also developed good ideas in other European countries and have put these ideas into practice, thus improving the environmental performance of rail transport. In order to make these measures known on an international scale and to find pioneers and imitators across Europe to act as an example for ecological operational practices, we are aiming to carry out a second round of the competition in international cooperation with similar projects.



Norbert Hansen (Chairman of the Pro-Rail Alliance)



Dirk Flege (General Manager)

Conception and Assessment System

The particular challenge for this project was to develop an assessment system which enables the environmental efforts of rail transport companies to be compared and appraised in a fair manner.

Noise emissions, viewed by many as the ecological “Achilles’ heel” of rail transport, should form the impact category with the largest focus in the assessment system. In addition, the toxic emissions that are involved above all in diesel operations and the specific energy consumption (i.e. relating to the transport performance) should form the focus.

Open Dialogue Process

The assessment system was devised and developed in a process of open dialogue in order to achieve a competition result that all target groups of the project accepted. This process was made up of three essential elements:

- The assessment system was drawn up by both SCI Verkehr GmbH and IFEU - the Institute for Energy and Environmental Research Heidelberg GmbH - acting as independent third parties. This consortium also assessed the entries to the competition and prepared the jury decision.
- The assessment system was decided upon by an advisory board, in which 13 acknowledged experts from industrial, occupational and environmental organisations, and the environment and transport ministries, as well as scientists were represented. The formation of the board guaranteed competence and neutrality. The advisory board also acted as the jury in selecting the winners.
- The interim results for the assessment system were presented in a total of three workshops with various different target groups and developed by means of general discussion. High-ranking representatives from the railway industry, rail enterprises and their organisations, from environmental organisations, ministries and the Federal Environmental Agency, as well as scientists specialised in environmental issues were involved in this discussion process.

There was a large degree of willingness from those organisations and individuals approached to work on the project as part of the advisory board. This highlights how important the issue of the environment is considered within the rail industry and how seriously environmental organisations and scientists specialised in environmental issues take the environmental improvements to railway transport that are being strived for.

The prominent political significance of the issue was underlined by the fact that Margareta Wolf, the Parliamentary State Secretary in the Federal Ministry for the Environment, personally took on the position of Chairman of the advisory board and the jury. The members of the advisory board will be introduced on pages 9-11 of this brochure. The quality and intensity of the discussions within the advisory board is also shown by the fact that nearly all decisions were made unanimously.



The most important measure to reduce the environmental impact caused by transport is to switch modes of transport from passenger cars to rail. But even rail transport can be made quieter, cleaner and more economical: The S-Bahn Berlin is one of the winners in the comparison of environmental performance.

Focus on Traction Operations

The greatest cause of noise and toxic emissions, as well as energy consumption of rail transport comes from traction operations. The measures for improving the environment which involve stationary parts of the train operating business (stations, repair workshops, administration) should therefore be analysed on a lower-ranking scale. Nevertheless, the participating rail transport companies were asked about such measures but the aim was to gather as many positive examples as possible and to incite rail companies to improve their environmental performance in these parts of their operation as well. The possibility could also not be ruled out that, for instance, a lower level of drinking water consumption in the vehicle washing plant would ultimately be the deciding factor for the awarding of prizes in the event of a tight decision.

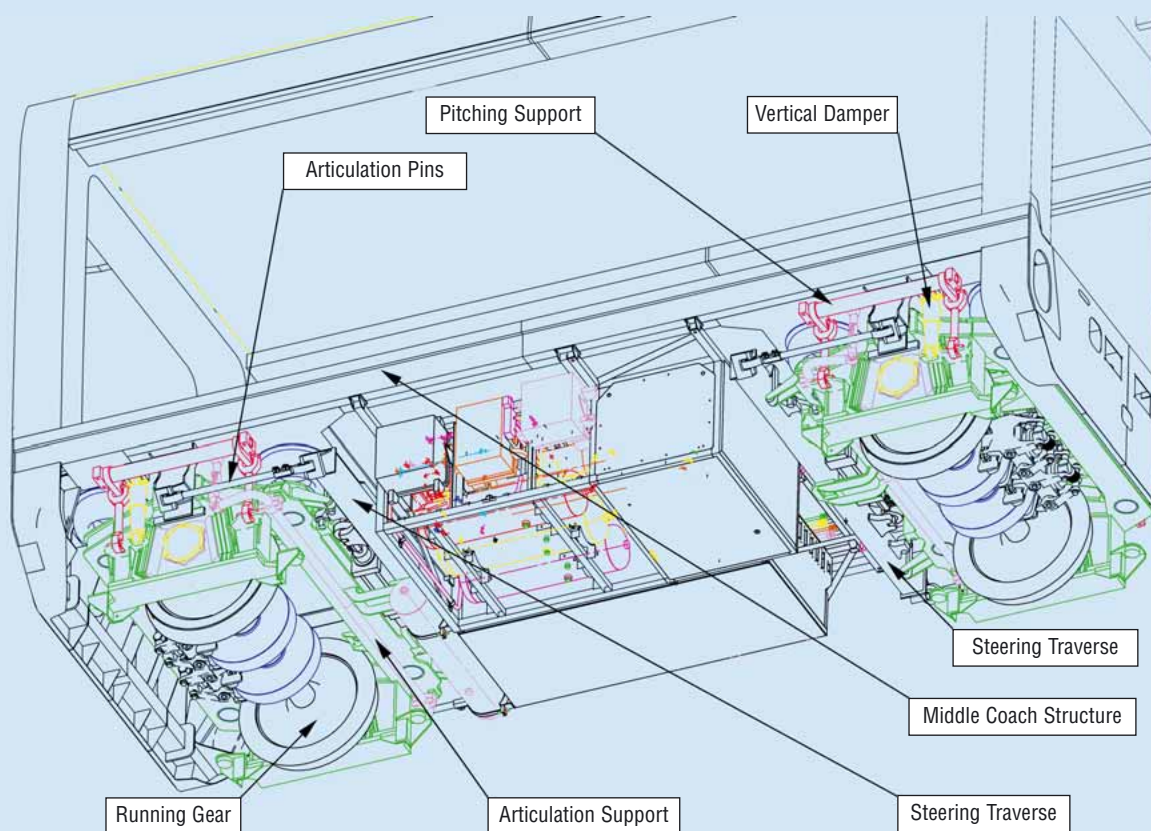
A second landmark decision was that the train operating companies should be the target group of the competition and not, for example, the enterprises from the railway industry or rail infrastructure companies. There were three reasons for this:

- The rail transport companies decide not only on the procurement of new types of vehicles but also have the relevant competence for making decisions concerning environmental issues when selecting the equipment or refitting old vehicles as well as in everyday operation and in the stationary parts.
- There are now a large number of rail transport companies (almost 200) that regularly operate railway transport in Germany. There is therefore a large and varied target group that can be addressed using the competition as an instrument.
- The rail transport companies have the immediate contact with the “end customers” of the railway, the passengers and the shipping agents. They also deal with the decision makers of regional passenger rail transport and are often the direct recipients of complaints from residents. The rail transport companies represent the railway transport system to the general public and therefore carry the greatest responsibility for the credibility of the railway as an environmentally friendly mode of transport.

Voluntary Participation

Participation in the environmental competition should be voluntary. No form of ranking should take place but rather one or several “best practice” enterprises should be awarded a prize. “Best practice” is related to the entire range of practice within the enterprise, rather than to individual measures. No rail transport company should be pilloried because participation in the competition involved a significant amount of effort for each respective company and demonstrated in itself their dedication to the issue of the environment.

The “overall company practice” nevertheless only included those operations being relevant to the transport taking place on the railway lines; in other words, railway lines on which the railway construction and operation guideline (Eisenbahn-Bau- und Betriebsordnung - EBO) or its equivalent for narrow-gauge railways is applied. Operations involving bus transport, ports or light railway vehicles that only operate on tram lines were not included in the analysis.



Radially adjustable undercarriage at the “Bayerischen Oberlandbahn (BOB)”: prevents noise and costs caused by abrasion.

Source: Bayerische Oberlandbahn GmbH



BR 294 Railion diesel locomotive (engine power class 1.000 kW). Particle and nitrogen oxide emissions have been significantly reduced by means of remotorisation.

The conditions and the history of rail transport companies differ considerably. Enterprises should not be favoured or discriminated against on the grounds of their structure, for example on the grounds of their size or the age of their fleet of vehicles. The competition was concerned with current company practice, taking the last few years into consideration. Taking into account the fact that the life cycle of a railway vehicle is between 30 and 40 years, points should not automatically be taken away if a rail enterprise has so far failed to replace its 20-year-old vehicles because this would not make economic sense and would often not be environmentally friendly either. On the other hand, points should not automatically be given if a company deploys vehicles that are exclusively very young and modern, be it because the enterprise has just gone into operation or because the old fleet has just had to be completely replaced due to its old age. It should also be noted that “modern” vehicles are not necessarily better than older vehicles in every respect, such as when it comes to noise.

Four Fields of Action

The project team solved this problem by placing the focus on the analysis of processes and by defining and examining various different “fields of action” within rail enterprises. “Analysis of processes” means that company policies for the improvement of emission and consumption values will be examined as a whole, and not the status quo, as would be the case if, for example, the actual noise emissions of all rail transport companies was measured and assessed on a particular test day or if exhaust emissions were measured and assessed over a particular period of time. The interesting

issues were, for example: Is the rail transport company at pains to make sure that newly manufactured vehicles adhere to the high emission standards? Does the rail transport company undertake modernisations that are motivated by environmental issues or does it take good emission and consumption values into consideration in the case of remotorisations or similar modernisations? Does the rail transport company deploy its vehicles in such a way that as little noise and exhaust gas as possible is created and as little energy as possible consumed?

An analysis matrix was created from these considerations, which was initially made up of nine cells with the rows “Noise”, “Energy consumption”, “Toxic emissions” and the columns “Procurement”, “Refitting”, “Service”. Another column was later added to include the field “Innovation”, in order to be able to take particular research and development work of a rail transport company into consideration. Those measures which are still in the development stage but have already been tested in regular operations should be valued particularly highly. “General environmental standards” was then added as a fourth row to include measures concerning the stationary part, the overall environmental policy of the enterprise, and individual measures that would not otherwise have fitted in to the scheme. This all resulted in the following analysis matrix:

	Procurement	Refitting	Service	Innovation
Noise				
Energy Consumption				
Toxic Emissions				
General Environmental Standards				

Source: Allianz pro Schiene

A weighting of the matrix cells could not be defined in a hard and fast way as this depended on the relevance of the individual fields of action and the impact categories of the rail transport companies taking part. It was nevertheless agreed that the (avoidance of) noise emissions should, if possible, be given more weight than the other impact categories. Moreover, the weighting according to entrant categories (see below) should have been varied. Weighting did not become a practical problem in the analysis because the winners were predominantly selected by the fact that they tackle the issue of the environment comprehensively and that they therefore had consistently good results in different fields whilst at the same time achieving the same or better results than the other participants in their entrant category.

Five Entrant Categories

The definition of various different entrant categories was necessary because the conditions under which rail transport companies work and the relevance of individual environmental protection measures differ considerably according to the particular transport sector or type of traction. The rail transport companies are faced with very different requirements, depending on which transport sector they are operating in. The project group initially differentiated between passenger and freight transport, but further differentiation was necessary in order to satisfy the various different opportunities for action that the rail transport companies have available to them. There are serious differences between long-distance passenger transport and regional passenger transport. The **long-distance transport enterprises** exist on the basis of ticket sales. State funding is only received in exceptional cases. The **regional transport enterprises**, on the other hand, are contracted by the individual federal states or by municipal administration unions that also decide which company receives the transport contract. These public authorities have a say in which vehicles are put into operation. There are also important differences in terms of the way of operating: High speeds are important in long-distance transport, and the trains do not stop very often. Aerodynamic aspects play an important role here. Trains stop frequently in the case of regional transport and do not travel quite as fast. Often, light trainsets can be put into operation. The frequent acceleration and braking sequences have to be taken into consideration, when noise emissions and energy consumption shall be reduced.

Local transport was then subdivided into diesel traction and electric traction, as these differ considerably from one another in terms of the opportunities available for improving the environmental performance and because the electrification of a railway line is a matter of the infrastructure company and not connected with the competence of the rail transport companies. The overhead traction wire is an external condition. Diesel-run regional trains travelling under an overhead traction wire is a rare exception, apart from shorter parts of the line or heading into electrified stations. This differentiation was omitted in the case of long-distance passenger transport because only a small number of enterprises operate in this field. Just two entrant categories were defined for freight transport, due to the fact that **short-distance and regional freight transport** only operates with diesel traction with very few exceptions and that those very rare examples of rail transport companies that operate local freight trains electrically operate electric long-distance freight transport as well, meaning that an analysis could be made there. Several control questions devised by the project team and the jury were used in the analysis process to assess whether or not potential winners were put at a disadvantage in terms of their classification as a result of the definition of the entrant categories. The selection of the entrant categories nevertheless proved to be meaningful, appropriate and non-discriminating.

The questionnaire was developed on the basis of the analysis matrix and the results of literature research, discussions at conferences, workshops and within the advisory board, as well as on the basis of individual discussions with experts and interested parties from the railway industry, environmental organisations and scientists. This questionnaire can be downloaded as a PDF document at www.allianz-pro-schiene.de. The versions used for individual entrant categories differed to a small extent due to the fact that individual questions that were not relevant to the entrant category concerned could be disregarded.

Previous research had shown that only a small number of rail transport companies would have figures available on emission measurements (for noise or exhaust gases). It was unclear to what extent these figures could be made available by the railway industry during the course of the competition. The project team and jury also feared that the noise measurements available might have been compiled according to different standards and that comparisons between enterprises would be limited - something which transpired to be the case. Questions were also posed about the particular vehicle characteristics that were relevant for environmental protection, to act as a "fall-back level" and to make sure that older and modernised vehicles for which there are almost no measurements could also be taken into consideration.

Specific Energy Consumption

The specific energy consumption of rail transport companies (i.e. that which is related to passenger and tonne kilometres) should be given particular weighting in the analysis. It is nevertheless affected amongst other things by a range of external conditions that cannot be influenced by rail transport companies, for example the distribution of the passenger numbers over the day and over the specific lines travelled on, the distances between stops, the incline and curve ratios, the comfort level desired by the orderer in local passenger transport, etc. A simple comparison of the specific energy consumption of the participating rail transport companies would therefore not be meaningful. Instead, passenger transport participants were asked about the development of the ratio between passenger kilometres performed and the (level of) energy consumption. The rail transport companies had the opportunity to draw attention to any particular positive or negative effects, as well as to make any particular measures known that increase the level of utilisation of their train services. No such solution was available in the case of freight transport because the transport performance adduced and the level of efficiency are subjected to very extreme qualitative fluctuations (e.g. the rate of empty runs depends strongly on the type of freight transported). Enquiries into the technical and operational measures undertaken to reduce energy consumption were also made in freight and passenger transport though.

The Project Advisory Board (= The Competition Jury)

Politics



Margareta Wolf
Member of the German Parliament,
Chairman of the Advisory Board

Federal Ministry for the Environment,
Nature Conservation and
Nuclear Safety (BMU),
Parliamentary State Secretary

“Rail transport is and remains the backbone of sustainable mobility. This can only be the case however if the rail industry intensifies its efforts regarding environmental protection, to make sure that it isn't left by the wayside in the face of the competition from road transport. It's high time for this to happen. I therefore support the consistent introduction of ambitious environmental standards in rail transport in the interests of transport companies, their customers and, of course, the environment.”



Dipl.-Ing. Klaus Jürgen Beer

Federal Ministry for Transport, Building
and Housing, Head of Division EW 15
(Rail Technology, Industrial Safety,
Environmental Protection)

“The comparison of environmental performance of rail transport gives the rail transport companies a good opportunity to identify where they stand in terms of their commitment to the environment. There is therefore no outright winner in this project - it is far more fitting to view all of the participants as winners. I hope to see the continuation of this project with a broader spectrum of participants.”

The Corporate Side



Dr.-Ing. Gunther Ellwanger

Union Internationale des Chemins de
Fer (UIC), Director of the Economy,
Finance, Environment
(up until September 2004)

“Rail is the most environmentally friendly mode of transport. Rail enterprises are nevertheless called upon to improve their environmental performance in order to build upon their environmental advantage over other competing modes of transport. To this end, the UIC focuses its environmental work on three areas: the reduction of energy consumption, noise and diesel emissions in rail transport. These activities are being supported superbly by the Pro-Rail Alliance's comparison of environmental performance.”



Dr. jur. Martin Henke

Verband Deutscher Verkehrsunternehmen
(VDV), General Manager of the
Railway Division

“The recognition of particularly innovative concepts tackling the issue of the environment motivates companies and increases the general public's perception of our industry's contribution to the environment.”



Dr.-Ing. Claudia Langowsky

Verband der Bahnindustrie (VDB),
General Manager (up until April 2005)

“As manufacturers we welcome the initiative to bring the rail mode of transport and its environmental friendliness into the public forum. We recognise an acknowledgement of our continuing commitment to environmentally friendly vehicles and products with this initiative as well. And we will be continuing to dedicate much attention to the issue of the environment in the future.”



Prof. Dr. Werner Fassing

KfW IPEX-Bank,
Environmental Protection Officer

“The competition has shown that rail transport companies in Germany are prepared to take on the responsibility of improving the environmental sustainability of the rail transport system on a continuous basis. The comparison of environmental performance of rail transport will hopefully trigger even larger impulses for carrying out such a comparison on a larger scale in the future.”

Science



Prof. Dr. Udo J. Becker

Technical University of Dresden,
Professorship for Transport Ecology

“A great project - finally an initial start for a fundamental review of the situation. If rail enterprises have to play the “environment” card in the future then they will most certainly need data material on their strengths and weaknesses - and this project has made an excellent start! All the best for the future!”



Prof. Dr.-Ing. Markus Hecht

Technical University of Berlin,
Institut für Land- und Seeverkehr (ILS),
Specialist subject: rail vehicles

“Noise reduction of the railway is far more a question of know-how than a question of money. The comparison of environmental performance has shown that there are already economically viable examples for ways of reducing noise levels. Suitable incentive systems, such as noise-dependent train path rates for instance, can push this process strongly forward in order to achieve a sustained improvement of the situation.”



Dr. Karl-Otto Schallaböck

Wuppertal Institute for Climate,
Environment and Energy,
Transport Department

“Rail transport is good, but it can and must be made even better. Many thanks to the Pro-Rail Alliance for the pleasant working atmosphere and the smart organisation of the project.”

The Non-Profit Side



Prof. Dr. Helmut Horn

Bund für Umwelt und Naturschutz Deutschland (BUND), Member of the Federal Steering Committee

“The competition has meant that criteria have been developed for the first time that allow environmentally sound measures in both traction operations and the maintenance of the vehicle fleet to be objectively assessed. This has laid the foundations for a comprehensive analysis of the environmental friendliness of rail transport.”



René Waßmer

Verkehrsclub Deutschland (VCD), General Manager

“The positive reactions and the good level of response to the pilot project should, on the one hand, encourage the comparison of environmental performances to be carried out on a permanent basis and should, on the other hand, be an incentive for the rail transport companies to take part to a much more involved extent.”



Gerd Billen

Naturschutzbund Deutschland (NABU), General Manager

“Rail transport still has much potential when it comes to the protection of the environment and resources. The competition has meant that the efforts of companies have been supported in a positive way.”



Dr. Edgar Darr

Verband Deutscher Eisenbahn-Ingenieure (VDEI)

“Rail-bound transport should not be satisfied by the benefit of being environmentally friendlier than other modes of transport. More efforts are required to retain and build upon this advantage. The competition of rail transport companies that created a large response was a very promising start. But politics is also required to create good and reliable basic conditions for the rail industry to invest in the environment.”



The participants in the competition in one photo: Rüdiger Gastell (DB Fernverkehr AG), Dr. Carsten Hein (metronom Eisenbahngesellschaft mbH), Ulrich Solbach (Railion Deutschland AG) (hidden), Margareta Wolf (Federal Ministry for the Environment), Dirk Flege (Pro-Rail Alliance), Günter Ruppert (S-Bahn Berlin GmbH), Dirk Zabel (Ostmecklenburgische Eisenbahn GmbH), Arno Kramer (Museums-Eisenbahngemeinschaft Wachtl), Stefan Brunotte (S-Bahn München GmbH), Heino Seeger (Bayerische Oberlandbahn GmbH und Bayerische Cargo Bahn GmbH), Karlheinz Drüg (Kölner Verkehrsbetriebe AG), Rolf Schulke (Häfen und Güterverkehr Köln AG), Dr. Axel Grüter (Verkehrsbetriebe Peine-Salzgitter GmbH)



5 Winners and One Beneficiary - Environmental Protection

The Pro-Rail Alliance was present as a guest at the InnoTrans 2004 at the exhibition stand of the Federal Environmental Agency. On Thursday 23 September the Parliamentary State Secretary in the Federal Ministry for the Environment, Margareta Wolf, presented the winners' trophies to the five winners of the "First Comparison of Environmental Performance of Rail Transport" in front of a varied audience made up of experts in the field and journalists. The winners then presented their company and environmental strategy at a specialist event. The response was impressive with nearly 100 people in the audience.

■ Margareta Wolf

Rail transport of the future depends on high environmental standards.

Mrs. Wolf, who was also present in her capacity as Chairman of the jury, spoke in her honorific speech in favour of the sustained introduction of high environmental standards in rail transport. The results of this competition, according to Margareta Wolf, make us feel optimistic for the prospect of environmental protection playing an increasingly important role in the rail transport companies. "I am particularly pleased that the best entrants in the First Comparison of Environmental Performance of Rail Transport, carried out by the Pro-Rail Alliance, can be awarded as part of the InnoTrans. They provide practical examples of how noise and toxic emissions can be reduced - even under market conditions - and how energy can be saved to the benefit of the climate," said the State Secretary in her honorific speech.

"The winners are ultimately the transport companies, their passengers - and of course the environment itself. The First Comparison of Environmental Performance shows that environmentally friendly mobility is not a dream of the future - it is already a real possibility," said Margareta Wolf.

■ Dirk Flege

No room for complacency on the environmental advantage!

"The Pro-Rail Alliance competition has given many companies a wake-up call and motivated them to promote the issue of environmental protection within their company," said Dirk Flege, General Manager of the Pro-Rail Alliance, at the award ceremony with reference to the individual entries and the very large response at the InnoTrans specialist trade fair. "One of the aims of the project is," continued Flege, "to make it clear to the general public that rail transport companies are not complacent about their environmental advantage and that



"Environmental protection brings with it competitive advantages," according to Margareta Wolf, Parliamentary State Secretary, in her closing remarks, on the occasion of the awarding of prizes for the Pro-Rail Alliance First Comparison of Environmental Performances in Rail Transport at the InnoTrans.

they are actively working to improve their environmental performance." It was particularly true in the case of the reduction of noise emissions, which was given particular weighting by the jury, that the rail enterprises and rail industry would have to make great efforts to overcome the acceptance problems of residents and passengers.

■ BOB

Environmental protection on a broad scale

Heino Seeger, the General Manager of the **Bayerische Oberlandbahn GmbH (BOB)** collected the winning trophy on behalf of the company in the entrant category "regional passenger transport with diesel traction". "BOB is distinguished by the fact that it has implemented concrete and effective measures in all impact categories and fields of action relevant to protecting the environment," said Flege by way of an explanation of the jury's decision.

■ S-Bahn Berlin

New ways to protect against noise

The **S-Bahn Berlin GmbH** implemented a series of often innovative measures to reduce noise, as well as working systematically to reduce the level of energy consumption. It therefore became the worthy winner in the regional passenger transport with electric traction category. Günter Ruppert, Spokesman for the Management Board, represented the S-Bahn Berlin at the award ceremony.

■ DB Fernverkehr

Saving energy protects the environment and reduces costs

The **DB Fernverkehr AG** was awarded the prize in the long-distance passenger transport category, as it was able to demonstrate varied and systematic activities it has employed to reduce its level of energy consumption and noise. Rüdiger Gastell, Quality Manager at the DB Personenverkehr GmbH, came to accept the trophy from Mrs. Wolf.

■ VPS

Pulling the plug on toxic emissions

The **Verkehrsbetriebe Peine-Salzgitter GmbH (VPS)** was awarded the trophy in the short-distance and regional freight transport category because it is an innovative rail enterprise that tests and applies even at its own risks - the relevant measures for improving energy consumption and toxic emissions. Mrs. Wolf presented the award to Dr. Axel Grüter, the Technical General Manager of VPS.

■ Railion

“Whispering brakes” and new motors

The **Railion Deutschland AG** is the winner in the long-distance freight transport category. With measures to reduce noise levels, to an energy-saving driving operation and remotorisation of diesel locomotives, which have improved levels of emissions, the company is committed to all fields of action and with respect to all of the impact categories examined in the competition. Ulrich Solbach, the Head of Department for Quality, Environmental and Safety Management, collected the trophy from the jury Chairwoman.

■ All participants

Environmental protection is worth it

Once the winners had received their prizes, representatives from all of the other participants took to the stage. All of those companies that took part received a trophy in recognition of their participation, according to the olympic motto: “It is the taking part that counts.” The extensive questionnaire represented a great deal of additional work, especially for the smaller rail enterprises. The mere participation in the competition was therefore proof in itself of commitment to the environment that deserves to be recognised. A total of 14 companies took part in the comparison of environmental performance. Five of these rail transport companies applied in two entrant categories, bringing the overall number of competition entries to 19.

After the prizes had been awarded, representatives from the winning companies presented their company and their environmentally friendly measures in a conference hall at the InnoTrans trade fair.



Representatives of the five winners of the comparison of environmental performances - their companies serve as examples for rail transport.

All contributors made clear that an important fundamental of each company's strategy was to systematically open up opportunities to reduce energy consumption and emissions, although priorities in each individual company differ. All of the companies awarded with prizes do not, however, see their environmental strategy as a compulsory chore but rather as a means of improving company results - on the one hand by reducing costs and risks and on the other hand by acting as a marketing instrument, bringing more traffic onto the railway and gaining a greater number of passengers or freight to their own trains.

■ The five winners in profile

Role models for rail transport

On the following pages we introduce the winners and their environment policies. The presentations of the specialist event at the InnoTrans trade fair can be requested from the Pro-Rail Alliance as a PDF document (info@allianz-pro-schiene.de).

Five winners were selected in the First Comparison of Environmental Performance of Rail Transport, in accordance with the five entrant categories. They act as role models for other rail enterprises with their systematic approach to the issue of “environmental protection in railway transport”.

Regional passenger transport with diesel traction The Bayerische Oberlandbahn GmbH (BOB)



The Background

A whole range of other companies now operate alongside DB Regio AG in the regional passenger rail transport sector with diesel traction. They often operate exclusively in this market segment. Many have gone into operation since the German railway reform and have acquired transport contracts as a result of applications for tenders. Several operators had been operating their own networks as non-federally owned rail enterprises even prior to the railway reform and travel in some cases today on tracks of DB Netz AG as well. In 1996, when the regionalisation of regional passenger rail transport became effective, a large part of the vehicles being in use were already several decades old and there was a great need for renewal. Many of the train operating companies that overtook transports from DB Regio have therefore acquired brand new vehicles in the past few years with the same being true for DB Regio on many of the lines it still keeps. The Bayerische Oberlandbahn also acquired new vehicles which, after surviving a few serious "teething problems", now run reliably, successfully, and above all in an environmentally friendly manner.

The Company

As a pickup for more competition, a tender was offered by the Bayerische Eisenbahngesellschaft, the Public Authority for regional passenger rail transport in Bavaria for the lines Munich - Bayrischzell/Tegernsee/Lenggries with a total length of 120 kilometres. In 1998 the Bayerische Oberlandbahn GmbH (BOB) went into operation. Its concept envisages that a train unit made up of three trainsets travels from the Main Train Station in Munich to Holzkirchen in normal cases. From there, one

trainset travels on to Bayrischzell. The other two trainsets travel together to Schaftlach and then individually on to Tegernsee and Lenggries.

Approximately 13,500 passengers are now transported daily and a total of 1.7 million train kilometres are travelled annually. The company has approximately 140 employees and a fleet of 17 diesel trainsets of the "Integral" type, as well as three "Talent" trainsets since July 2004. The Connex Verkehr GmbH is now the sole shareholder of the BOB. In May 2003 the BOB was certified to have a quality management system with the certificate of quality according to DIN standard.

The Distinguishing Environmental Characteristics

Transport in both congested urban areas and recreational areas, where the railway lines are often located within close proximity of residential properties, is very suited to the deployment of quiet vehicles with low toxic emissions. All vehicles are equipped with exhaust silencers and a noise-reducing, radially adjustable undercarriage. 6 per cent of the fleet were modernised with the addition of wheel noise absorbers in the summer of 2004. New wheels will be fitted to the remaining carriages as part of the rotational modernisation process. Exhaust gas and hydraulic systems were subsequently passed uncoupled from the body, thereby preventing the development of noise. The use of modern trainsets of the "Integral" type was planned from the outset. The vehicles are manufactured by means of lightweight construction. The heat generated from the brakes (retardant heat) can be used for the interior heating in the appropriate weather conditions. Integral trains are noteworthy for their favourable toxic emission levels. The level of particle emissions is lower than the limit suggested by the UIC for 2008. Other positive points to be mentioned include the use of FCKW-free cooling agents, wheel flange lubricants and purified water. Vehicle test runs and fuelling only take place during the day so that residents' sleep is not disturbed during the night. The motors are turned off during stops that last longer than 5 minutes. The BOB participates in the joint project "Leiser Verkehr" ("Quiet Transport").

Jury Assessment

The BOB is one of the pioneering projects in regional passenger transport, including with respect to its environmental policy. The BOB distinguishes itself by having implemented concrete measures in all impact categories and fields of action relevant to the environment. The Bayerische Oberlandbahn places a focus on the reduction of noise levels, without neglecting any other areas.

Regional passenger transport with electric traction The S-Bahn Berlin GmbH



The Background

There are significantly less operators in regional passenger rail transport with electric traction than there are in the respective segment with diesel traction. The competition in this entrant category in the comparison of environmental performance was nevertheless the hardest. DB Regio companies have dominated this transport sector up until now. There are only a few operators that are non-federally owned. There are then also a series of city transport companies with trams and underground trains that run over into railway tracks to differing extents. Decision makers and network operators will probably stipulate standards for noise emissions in the future because electric regional passenger rail transport mainly operates in agglomerations and on densely operated lines. Entries to the competition in this category make clear that the rail enterprises are beginning to adjust to these challenges. The rail transport companies that operate electrically can, especially when based in large cities as is often the case, advertise their environmental advantage particularly confidently to passengers, meaning that they are measured by their customers whether and how they implement ecologically sound improvements in their own company on a consistent basis.

The Company

The electric S-Bahn has been an integral part of the local transport system in the region of the German capital city for the past 80 years. The S-Bahn Berlin GmbH was founded from the DB AG on 1 January 1995 as an independent operating company. The company had approximately 3,800 employees in 2004. It operates across a network of 331 km with 165 stations and 16 lines. The S-Bahn Berlin reports growing passenger numbers. There were 318 million passengers in 2004 (compared with 291 million passengers in 2000). The company's fleet amounts to 747 vehicles and is becoming increasingly modern.

The average age of the vehicles in 1996 was 43.8 years. In 2000, it was 22.3 years and in 2003 just 6.1 years.

An effective environmental operating policy is stipulated as an integral part of the company management. The expressed target of the company's environmental policy is to make environmentally friendly mobility an alternative option to individual transport and to guarantee environmental protection in its operations.

The Distinguishing Environmental Characteristics

The issue of noise is an important one for the S-Bahn Berlin, due to its operation in an agglomeration. Limit values that are in line with current recommendations were specified for external and internal noise levels with the new procurement. These limits were nevertheless viewed as insufficient after delivery had already begun. The last remaining vehicles were therefore fitted with wheel noise absorbers. It is also planned that the older vehicle series be gradually fitted with these as well. The vehicles have optimal noise-reducing compressors and a radially adjustable undercarriage. The company is currently working on the implementation of other noise-reducing measures in terms of the engine and bogies. The vehicles are equipped with an energetic recovery system when braking. The passenger heating system is also energetically optimised in all vehicles. The crews are trained in energy-saving ways of driving. Noteworthy measures that have been undertaken also include waste recycling (very high level of waste recycling) and reduction in the consumption of drinking water. The S-Bahn Berlin GmbH was certified as having a successful environmental policy and a functioning environmental management system at the end of 1999 after a five-day certification audit - a certification which meets the requirements laid down in the DIN standard ISO 14.001. A re-certification audit in November 2002 reconfirmed this declaration.

Jury Assessment

Die S-Bahn Berlin GmbH is implementing a range of measures that are often innovative, with the aim of reducing noise levels. It is also working systematically to reduce energy consumption levels. The comprehensive and good measurement documentation of the company is a distinguishing feature. There are meaningful statistics about the specific energy consumption that show a positive development. The S-Bahn Berlin GmbH is one of the few rail enterprises whose certified environmental management system also includes the driving operations. It is a worthy winner in the "First Comparison of Environmental Performance of Rail Transport".

Long-distance passenger transport The DB Fernverkehr AG



The Background

The long-distance passenger transport market segment is dominated by the DB Fernverkehr AG, which operates high-speed and tilting trains (ICE or ICE-T), as well as conventional locomotive-hauled trains. There are only three other rail operators that each operate one train pair. All three operators offer services from which the DB Fernverkehr had previously withdrawn because the connections were not profitable from DB's point of view. High-speed transport is the first type of transport to have been affected by the EU-wide introduction of Technical Specifications for Interoperability (TSI), which also stipulates noise-reducing measures.

The Company

The DB Fernverkehr AG is part of the passenger transport segment of the Deutsche Bahn AG (DB AG). Approximately 16,000 employees were involved in transporting around 115.3 million travellers (315,000 per day) in 2004. The specialist transport enterprises DB AutoZug GmbH and CityNightLine CNL AG also form a direct part of DB's long-distance transport segment. As legally and financially independent subsidiaries, they run the operation fields that do not belong to the core business of daytime line operation. Thalys is a cooperation in which the DB AG participates. According to its own declaration, it is the German Railway's (DB AG's) aim to halve the noise levels of rail transport across Germany by 2020. The company pays particular attention here to the reduction of noise levels at the source - the vehicle fleet. The company has also announced a specific (related to transport performance) 15 per cent decrease in emissions of the environmentally damaging greenhouse gas carbon dioxide (CO₂) by 2020.

The Distinguishing Environmental Characteristics

It is above all the ICE 3 and the ICE-T within the DB Fernverkehr AG vehicle fleet that are distinguishable for the aerodynamic form of their carriage body and their noise-reducing pantographs. Noise emissions are significantly reduced in this way. The ICE-T, equipped with tilting technology, also received ex works radially adjustable undercarriages. The aerodynamic improvements have a positive impact on the level of energy consumption. The company's project "energy-saving ways of driving" should be given special mention. Train drivers are given specialist training here and ideal incentive systems are put into use. The rail vehicles have had consumption meters fitted in them for this purpose. The enterprise has developed its own software for support during the driving process. Energy consumption on the railway lines in question has been reduced by an average of approximately 10% as a result of this project. Energy-saving measures have also been developed for vehicles that are temporarily stabled.

Emission limits, measuring systems and the application of the VDI (=The Association of German Engineers) guideline 3720 ("Noise abatement by design") have been stipulated for all new procurements. In the case of the class 101 which is still extremely modern (the most recent locomotive procurement by the DB for long-distance passenger transport), modernisation with wheel noise absorbers and readjustments to the outer body have resulted in a noise level reduction of 4 dB. When it comes to innovation, the company's participation, amongst other things, in the systematic noise source analysis in high-speed transport should be mentioned.

Another energy-saving measure implemented by the DB Fernverkehr is the energetic recovery system when braking, fitted as standard in all new procurements of the last ten years. Guidelines have already been laid out for heat insulation in the more recent ICE trains as well. A certified environmental management system does not yet exist.

Jury Assessment

The DB Fernverkehr AG demonstrates very positive activities in almost all action fields in the impact categories noise and energy consumption. The company shows in its competition entry that it is rising to the challenge of preventing noise levels of fast long-distance transport with various different instruments. The DB Fernverkehr AG, with its systematic opening up of energy-saving potentials, sets an excellent example for other rail transport companies in the passenger and freight transport sector.

Short-distance and regional freight transport with diesel traction

The Verkehrsbetriebe Peine-Salzgitter GmbH (VPS)



The Background

There is now a range of larger and smaller companies in the sector of local and regional freight transport with diesel traction. Alongside the main player, the DB subsidiary Railion, several non-federal-owned enterprises have existed for some time now. In addition, there are both former industrial railways and rail operators that have been newly founded since the railway reform. Some of them operate long-distance transport as well. Short-distance and regional freight transport is in the most difficult position in terms of the economical situation out of all railway transport segments. This can be seen in the appearance of the vehicle fleets being operated, which include a few newer models, but are in several cases made up of vehicles that are decades old. Environmental measures are far less common in this transport segment compared to other sectors. This is due on the one hand to the economic situation and on the other hand to the scope of operations as well. Motor noise and toxic emissions (particularly particle emissions) are nevertheless a relevant problem, due to the frequent proximity to residential and congested urban areas. In the future, the rail enterprises of the local freight transport sector will have to deal with the issue of noise reduction plans and plans for air protection.

The Company

The Verkehrsbetriebe Peine-Salzgitter GmbH were founded in 1971 as a merger of the Salzgitter Verkehrsbetriebe and the rail operations department of the Ilseder Hütte in Peine.

The company forms part of the Salzgitter AG. The main task of the rail and port operator and its 750 employees is the transport between the Salzgitter AG plants at the locations in Salzgitter, Peine and Ilsenburg, as well as the transport to and from the transfer stations of the DB AG. Other forms of transport are carried out in the south eastern region of Lower Saxony. The annual volume transported amounts to approximately 37 million tonnes. Operating on this scale means that the rail operator is one of the most important rail transport companies in Germany. A quality management system in accordance with DIN ISO 9001-2000 is in place.

The Distinguishing Environmental Characteristics

At the procurement stage the VPS specifies noise-reducing measures such as exhaust silencers, as well as the reduction of noise bridges between vehicle components. Exhaust silencers have been fitted in the majority of older vehicles. Preventative measures for the reduction of noise emissions are also implemented.

Almost the entire fleet was equipped with a self-developed and tested automatic start-stop mechanism (automatic cut-off after a longer standstill period), in order to reduce energy consumption and exhaust emissions. Staff are trained in energy-saving ways of driving, which includes supervised driver training. From 1996, the VPS has been the first rail enterprise in the world to test diesel motors with common rail fuel injection. The company now has 7 four-axle locomotives fitted with this technology. This enables significantly better toxic levels. The company sets itself environmental targets, but does not yet have an environmental management system. Out of a total of 61 VPS locomotives, 43 three-axle machines have been renovated in the past few years using environmentally friendly construction principles.

Jury Assessment

The VPS presents the image of an innovative regional freight transport enterprise that tests out and applies environmentally friendly improvements, even if these involve a degree of risk-taking for the company itself. The company works systematically to open up new opportunities for reducing energy consumption and toxic emissions.

Long-distance freight transport Railion Deutschland AG



The Background

Railion continues to own the biggest market share of the long-distance freight transport sector. Alongside Railion there are now a number of non-federally owned operators ("NE railways"), some of which have developed from former NE railways or industrial railways, and some of which are completely new enterprises. These "private" companies that are nevertheless often publicly owned, operate predominantly block trains and regularly scheduled trains of combined transport. Some also undertake delivery tasks as well. But they do not yet provide any nationwide individual waggon transport system.

The Company

The Railion Deutschland AG was created from DB Cargo on 1 September 2003. Prior to this date, between 1999 and 2001, the freight transport parts of the Dutch and Danish state railways had become partners of the freight subsidiary of the Deutsche Bahn AG in a joint venture. The new name was preceded by the purchase of the logistics company Stinnes AG by the DB AG. Stinnes incorporates four business fields as the transport and logistics part of the company: "Railion", "Freight

Logistics", "Intermodal" and "Schenker". Railion is responsible for freight transportation by rail here.

Railion has 23,000 employees. The company operates 2,900 locomotives and approximately 110,000 goods waggon. The largest proportion of the transport performance is carried out by electric locomotives. In 2004, Railion Deutschland transported 270 million tonnes of freight, reducing the number of lorries on European roads by 100,000 every day.

The Distinguishing Environmental Characteristics

Railion has been in the process of procuring several series of electric locomotives for a few years now. Noise emission levels have been applied for the classes 145, 152, 185 and 189. Class 182, procured in a small series, meets the Austrian noise standards. Such limits are not yet in place in Germany. The company also uses older electric locomotives and diesel engines. All diesel locomotive classes are fitted with exhaust silencers. Railion only procures new goods waggon with composite brake pads, also known as "whispering brakes". Waggon with composite brake pads are preferentially used in shuttle trains and combined transport trains. This makes sense because the noise reduction can only be heard if more than 80 per cent of the waggon of a train are equipped with composite brake pads. The project "energy-saving ways of driving" is also being introduced by Railion.

The remotorisation of different diesel locomotive models enables considerable reductions to the relevant types of exhaust emissions, as well as improvements to the engine noise levels. With respect to general environmental standards, biodegradable lubrication solvents and a very high rate of waste recycling should be noted. A certified environmental management system is in place.

Jury Assessment

Railion presents itself as an environmentally friendly company that is particularly dedicated in all fields of action and with respect to all impact categories. The procurement and sensible dispatching of goods waggon with composite brake pads should also be given special mention, as well as the preparations that have been made for energy-saving ways of driving. Railion is one of the few rail transport companies that have an environmental management system that incorporates traction operations as well.

Many Ideas for more Environmental Protection in Railway Transport

Emission Standards for Noise in the Case of Procurement; Effective and Future Legal Standards and Regulations

In the past there have not been any regulations (standards) for noise emissions of railway vehicles in Germany. There are standards for noise immissions in residential areas - values that are measured, for example, on the facades of residential areas in close proximity to a railway line. But these standards only apply to new or upgraded railway lines (not for existing lines) and revolve around infrastructure operators. They can reduce noise with the use of protective walls, sound-insulated windows or intensive maintenance (frequent grinding of the line). Network operators will be confronted in the midterm with more extreme requirements with the implementation of the EU noise emissions guideline, which will be stipulating the implementation of noise-reducing plans from 2008 onwards. This means that they will presumably also try to prompt the rail transport companies to use quieter vehicles, particularly because improvements to vehicles have an overall impact and are usually cheaper than sound insulation measures along the track itself. The EU has already issued standards for noise emissions from new vehicles in the high-speed transport sector on the so-called interoperative network, which will soon be followed by standards for conventional rail vehicles. In Austria and Switzerland, standards are also in place that also have to be adhered to by foreign vehicles that are newly admitted for being used in the country. An overview of the specifications in effect will be available on the Pro-Rail Alliance website.

As a consequence of the fact that no standards had been specified up until now, many rail transport companies do not have any, or only insubstantial, information about the noise emission levels of their vehicles. These have not always been made available by the industry up until now either. This is particularly true for older vehicles, but also for modernised ones because individual emission measurements are very expensive. As expected, the competition highlighted that even rail transport companies that operate in line with environmentally friendly policies were not always able to provide measurements and that the measurements available for different companies were not necessarily able to be compared with one another because of differences in measuring standards.

Reduction of Noise Emissions / Vehicle Measures (Procurement / Refitting)

A rail enterprise that orders new vehicles essentially has two possibilities for giving manufacturers guidelines for noise emissions. The first possibility is to prescribe more or less ambitious standards. These can be in line with standards that are already legally binding or about to become legal, or even go beyond these if those responsible for procurement set specific priorities or if the regional passenger rail transport authorities demand certain emission standards. Two of the competition winners, the Bayerische Oberlandbahn (BOB) and the S-Bahn Berlin were confronted with such requirements from their contracting body and therefore ordered vehicles that met these standards. Both rail transport companies operate in congested urban areas (Berlin and Munich), the BOB also operates in noise-sensitive recreational and residential areas in the alpine upland.

Other rail transport companies also require the adherence to noise standards at the procurement stage. Especially the companies that are part of the Deutsche Bahn AG usually form a large part of this group of rail transport companies, due to the fact that their predecessors - the Deutsche Reichsbahn and the Deutsche Bundesbahn - were intensely involved in the development of vehicles as well as in the development of immission legislation specific to the rail sector. Nowadays, with the new distribution of tasks between industry and rail transport companies since the railway reform, it is predominantly the task of the rail vehicle manufacturer to measure the emission levels of their own products, to improve these levels and to make this information available to the procurer of the vehicle.



Measuring noise on a Swiss railway line

EU noise standards are on their way

Up until now the noise emission levels of non-federally owned rail enterprises have only been available in rare cases. The railway industry will make the respective data available in the future and the rail transport companies will do good to acquire this data and to specify emission levels at the procurement stage. The EU will soon be stipulating standards for conventional rail transport on the interoperative network as well (in the Technical Specifications for Interoperability - TSI). The levels are based on technical measurement according to the ISO Norm 3095 in the version of the draft from 2001, although some additional regulations have been added. Rail transport companies that order new vehicles should already be taking the future standards into consideration because it is firstly doubtful whether the non-compliance permit for older vehicles will be maintained for a longer period; secondly because it is possible in the mid-term that railway infrastructure companies in Germany and abroad will stipulate more advanced standards or reward the use of particular quiet vehicles in order to meet noise-reduction plans on main lines and in congested urban areas that will be stipulated in the future; and thirdly because the orderers of the regional passenger rail transport may stipulate emission levels that exceed those of the TSI, again to meet noise-reduction plans or to protect particularly noise-sensitive areas.

In principle it is easier for rail transport companies to specify noise standards to vehicle manufacturers and to then leave the construction part to them. The rail transport companies should nevertheless know about the technological options and the possible operational effects. Third octave levels should also be considered alongside overall noise levels, which provide information on the particularly disturbing melodic or whistling noises produced by trains. This is a particular problem in the case of accelerating procedures of electric trains with three-phase current engines. Additionally, those enterprises ordering vehicles can stipulate certain fitting features that have a noise-reducing effect. Those fitting features that were existing or the relevant guidelines for them were positively assessed in the First Comparison of Environmental Performance of Rail Transport. The issue of such fitting features in modernised vehicles is unavoidable because modernisations often mean individual features or small series where the effort required to measure noise emissions cannot normally be justified.

Different types of noise are dominant depending on the speed

When planning vehicle fittings it should be clear to those involved that different types of noise are dominant depending on the speed and therefore the area of operation: Up to approxi-

mately 60 km/h the engine and support units can be heard particularly loudly. Between 60 and 200-250 km/h the rolling noises dominate. Aerodynamic noise dominates at even higher speeds than this. The limits are not fixed. Rather, they are indications and reflect the current technological status. The dominance of a type of noise in a particular speed range does not mean that the other types of noise cannot be heard either. High-speed trains have to brake, stop and accelerate as well.

The ICE trains of the DB Fernverkehr AG (winner in the First Comparison of Environmental Performance) are significantly quieter in the "conventional" speed range than the older locomotive-hauled IC trains, and are among the quietest trains in the high-speed range over 200 km/h in Europe.



ICE-T in the Saale valley, Germany. New trains have to be quiet, particularly on conventional rail tracks as they often travel within close proximity of residential housing.

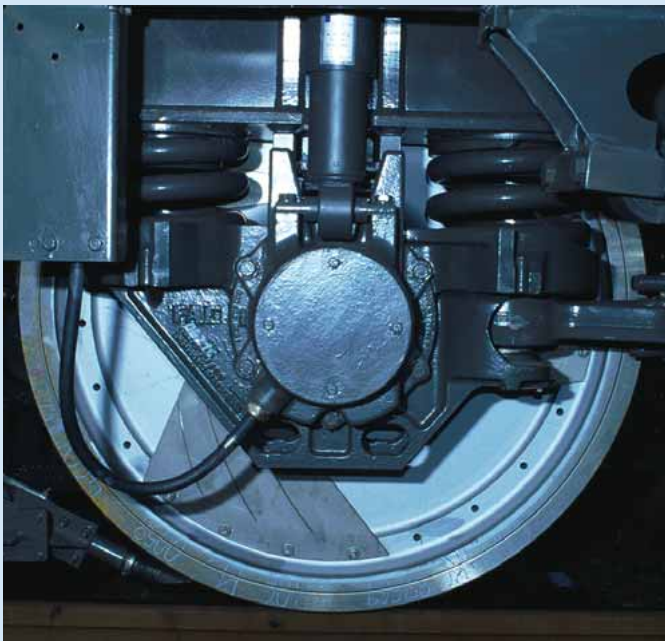
Engine noise

Almost all of the competition participants that operate by diesel use exhaust silencers. The engines can be cast-iron-clad to stop the noise from penetrating outwards. In BOB trains the exhaust gas pipes were laid in such a way that noise from the body was no longer transferred to the coach body, having previously amplified this noise. The noise from ventilators is a particular problem in diesel and electric operations. Noise-reducing ventilators can counteract this. Compressors for generating compressed air also make noise. These can also be designed to reduced noise levels. One option is to attach compressors to the vehicle (usually on the floor or on the roof in the case of motor carriages) in such a way that noise bridges to the coach body can be avoided and to make sure that this body does not act as a resonance body amplifying the unit noise. Unpowered train carriages also have units such as ventilators and compressors. Above all, air-conditioning systems can cause noise problems.

In addition to the actual volume of the unit, its controls also play a decisive role: Does it run on a continuous basis or only upon demand? Can they be turned off on noise-sensitive sections of the track, so long as the heat transfer from the engine permits it? Will these additional units be restricted during longer standstill periods, e.g. when a suburban train is parked overnight in a residential area? The type of operation in the case of longer standstill periods was assessed above all under the action field “Operation” in the First Comparison of Environmental Performance. Vehicles nevertheless have to be equipped with the relevant controlling technology.

Rolling noises

Rolling noises are generated by contact between wheels and the track, on the moving parts of the undercarriage and as a result of the transfer of fluctuations and vibrations to the other parts of the vehicle which can amplify the undesirable noise under certain circumstances like the resounding body of a musical instrument. Although the condition of the track, in terms of the track superstructure and substructure, is a significant factor for the noise emission levels of rail transport, but was nevertheless not taken into consideration in the First Comparison of Environmental Performance because the focus was rather on the efforts being made by the train operating companies.



Wheel noise absorbers on DB AG electric locomotive

“Whispering brakes” halve the level of noise

Rough wheel contact surfaces that cause noise can be prevented by fitting vehicles with disc brakes or composite brake pads. These composite brake pads roughen the wheel contact surfaces much less. Disc brakes do not make contact with them at all. A freight train where the waggons are equipped with composite brake pads causes to approximately 10 dB(A) less noise, which is perceived by the human ear as almost half the volume. Railion and the Swiss Federal Railways (SBB), as well as several private waggon rental companies are pioneers here in only procuring new waggons with composite brake pads. Most European state-run railways have now made the voluntary decision to equip their trains in the same way. There is no legal requirement to fit freight trains with composite brake pads in Germany. At the procurement stage the composite brake pads are not more expensive than traditional grey cast iron brakes, on a limited scale even savings can be made in maintenance expenses. The refitting of older waggons that often have a lifespan of 30 to 40 years nevertheless costs several thousand euro for each vehicle, which is the reason why the freight rail companies consider themselves unable to re-fit their older vehicles with composite brake pads without public funding. In Switzerland, the refitting of all trains with a certain minimum lifespan remaining is funded by the state noise reduction program, which in turn saves considerable financial sums for such noise protection measures as noise barriers. Such funding schemes have yet to be successfully implemented in EU countries, whereby legal competitive arguments counteract the arguments for money-saving potential.

So long as not all goods waggons are fitted with composite brake pads, their effect is only audible if the vehicles are mostly used in trains with a minimum of 80-85% quiet waggons. Vehicles used in block trains, such as those that travel according to fixed timetables in combined transport, are deployed far more intensely than waggons in single-waggon transport, meaning that the noise-reducing effect of the “whispering brakes” becomes overproportionally effective.

It nevertheless had to be taken into consideration when assessing the contributions to the First Comparison of Environmental Performance that only a few rail transport companies in freight transport use their own waggons or dispatch hired vehicles on their own. Waggon rental companies and loaders are just as important players in the use of waggons with composite brake pads. Train operators in the local freight business handle almost exclusively waggons that have been given over to them by long-distance train operators or by loaders. These rail transport companies rarely deploy their own goods waggons and when they do then often just at low speeds. In this latter case, and provided they are not used in mainline transport,



Goods waggons are deployed all over Europe. The Swiss railways are one of the pioneers of the refitting of the synthetic composite brake. This image shows a freight train with a “whispering locomotive” Re 460 (“Lok 2000”).

noise-reducing measures in the locomotives are more important because the engine noises dominate in the lower speed range.

Experts are still not agreed as to whether the employment of disc brakes in freight transport is of use in the conventional speed bracket, i.e. up to 120 km/h for goods trains. The rolling noise is also minimised by disc brakes but they are more expensive to procure than composite brake pads. They nevertheless involve lower costs for planned and unplanned maintenance. In 2005 a project group, which the Swiss HUPAC and the Technical University of Berlin are involved in amongst others, is starting testing of a “quiet, light-weight bogie for freight waggons” (LEILA-DG), conceived according to new principles, that is fitted with disc brakes. The aim of reducing noise was taken into consideration from the outset of construction and elements have been built in which prevent the transfer of noise from the wheel to the bogie frame and from there to the waggon body. Its lightweight construction could also mean that the specific energy consumption levels are reduced. This innovative bogie was nevertheless not available in time for the first round of the comparison of environmental performance.

Other options for minimising rolling noises are available by optimising the profile of wheel contact surfaces, which nevertheless have to be adjusted to the rail profile, and by fitting the wheels with noise absorbers. Competition participants have fitted above all trainsets and electric locomotives with wheel noise absorbers.

The “Integrals” of the Bayerische Oberlandbahn and the class 481 trainsets of the S-Bahn Berlin have a radially adjustable undercarriage, which reduces noise caused when travelling around curves. The ICE-T trainsets with tilting technology of DB Fernverkehr AG are also equipped in the same way.

Avoiding noise bridges

To operate quiet vehicles it is important to actively prevent “noise bridges” via which vibrations in the undercarriage (or from the engine) are transferred to the vehicle body. Absorbing materials and spring elements can also absorb the noise and other vibrations along the sound transmission path. Until recently the reduction of noise was not constructively taken into consideration from the outset in the construction of new locomotives.



Class 101 electric locomotive of DB Fernverkehr AG: has become quieter as a result of reconstruction at a later stage.

Vehicles that are already in operation can only be drastically improved in terms of noise reduction with a significant amount of investment. But the DB Fernverkehr AG proved with the class 101 that later improvements can be successful if the sources of the noise and the transmission paths are systematically investigated beforehand. The installation of wheel noise absorbers and noise-reducing elements on the locomotive frame reduced the noise level by 3 to 4 dB, and when accelerating even by 20 dB. Also with the remotorisation of diesel locomotives that is usually linked with substantial alterations to the engine noise emissions can audibly be reduced, such as Railion and the Verkehrsbetriebe Peine-Salzgitter have shown with different models.



Noise reduction actively taken into consideration from the outset: Class 182. Railion ordered this class to meet the Austrian permit specifications that also stipulate noise standards. This model is now used by numerous rail companies in Germany and abroad.

Aerodynamic design in high-speed transport

The aerodynamic design of trains in high-speed transport is important in order to avoid noise emissions. The design of the front of the vehicle as well as the side panels and the transitions are decisive factors for the level of energy consumption, but “small features” can be responsible for the level of noise emission although they are not really important when it comes to energy consumption, e.g. hand rails. The new ICE trainsets are aerodynamically perfected, but the DB Fernverkehr AG is experimenting with further possibilities for improving the noise levels, particularly in terms of the pantographs. Even though the aerodynamic noises only dominate at very high speeds, the noise from the pantograph can be considerable on railway lines with noise barriers even at medium speeds, because these barriers reduce the rolling noise by 15 to 20 dB on average.

Consider internal noise as well!

Particular attention was paid in the First Comparison of Environmental Performance of Rail Transport to noise emissions generated on the exterior of rail transport. The internal noise level is important as well though because loud noises can impinge about the travelling comfort of passengers. The health of the train crews must be considered above all else, because they are exposed to noise in passenger compartments or in the driver's cab on a daily basis for hours. The situation in some diesel locomotive driver's cabs is most problematic and has already resulted in other countries to industrial disputes. Noise reduction is also of direct operational interest to rail transport companies here, to avoid the absence of highly qualified drivers due to illness.

Countermeasures against internal noise focus on the one hand on the same sources as the measures undertaken for external noise. On the other hand, additional insulation measures, acoustically optimised design and the use of sound-insulating materials in the passenger compartment and driver's cab are useful.

Reducing noise can save costs

Noise-reducing vehicle constructions have up until now only had a limited direct positive impact on the financial situation of a rail transport company. Reducing vibrations can avoid wear and maintenance costs to a certain extent in the same way as the application of composite brake pads and disc brakes. Increasing the comfort of passengers and improving working condition for staff also make good business sense. Partially, there are some synergy effects with measures employed to reduce energy consumption. There have not yet been any united statements from the railway supply industry and the scientists about what percentage of additional costs would be entailed in the construction of rigorously noise-reducing vehicles. It is true though that even relatively low additional costs are enough to implement relevant improvements if acoustic problems are considered early on in the construction process. Noise-reducing vehicles have already been sold successfully on the market. Those who do not wish to have these additional costs have to remember that noise limits are already law in some other countries and that these limits will be gradually introduced to large parts of the European railway network over the next few years. Acoustically optimised vehicles can therefore be operated more universally and have a longer product lifespan from a manufacturer's point of view, meaning that they can be produced and sold over a longer period of time if they are already oriented now to requirements faced in the future. The additional costs are therefore also countered by savings made from large-scale production, more unreserved operational potential and therefore a higher resale value. These are important considerations for rail transport companies, due to the fact that the terms of transport contracts in the regional passenger rail transport sector are significantly shorter than the lifespan of an operational vehicle. In the freight transport sector with its short-term and irregular transport contracts this is even more vital.

Reduction of Energy Consumption / Vehicle Measures

There are a whole series of approaches for saving energy in the railway transport sector. The energy consumption required to overcome train resistance can be reduced if the rolling, air and acceleration resistance are minimised. The aerodynamically optimised design of high-speed vehicles as well as measures undertaken on the undercarriage such as radially adjustable wheelsets have already been outlined above because they contribute to noise prevention. The lightweight construction of vehicles provides a large potential for saving, above all in the regional passenger transport sector with its high frequency of acceleration and braking sequences.

Benefit of braking energy

It is advantageous when kinetic energy from braking is not converted in heat and therefore wasted, but rather when it is recovered. Traction motors in electric operations can be used as generators to feed energy back into the network. In DC operations this has been possible for longer. When it comes to AC operations, all German trains with three-phase asynchronous engines that have been newly developed since the 1990s have been constructed to incorporate this element. With multiple units a larger proportion of the kinetic energy might be recovered than with locomotive-hauled trains because more axes are usually driven meaning that a large proportion of the braking power can be taken over by driving units used as generators. But braking energy fed back in as electricity can only be used if the network is receptive and if the energy can be received simultaneously from other trains. It is therefore an advantage if it is additionally possible to store the energy temporarily or use on the train such as ventilation, lighting, air-conditioning, etc.



Energy is becoming scarcer and more expensive. Rail transport companies can contribute considerably to reduce consumption.

High performance capacitors, with which the acquired energy can be used for start-up and acceleration sequences at a later stage, are being tested at the moment on tramlines, but are not yet available for rail transport.

Two methods of recovering braking energy have so far been used and tested in diesel operations. With electric power transmission in more modern diesel locomotives - the diesel motor drives a generator which provides the traction motor with energy - braking energy can be recovered in the same way as with electric locomotives. But only a limited proportion of this energy can be used by supplementary users or stored in batteries because the overhead contact line is not available for taking up.

In the case of the “Leichter Innovativer Regionalexpress“ (“Light Innovative Regional Express“, LIREX), which DB Regio is testing in the regional passenger operation in Saxony-Anhalt in Germany, it has been envisaged that braking energy can be stored with a flywheel the kinetic energy of which can be used in accelerations. Such units are not yet in production.

Foresighted ways of driving

Driving crews can save a significant amount of energy by driving in a foresighted way (see p. 33f. for more information here). Energy meters are required on locomotives (so-called “TEMA boxes”) to ensure that energy consumption is transparent. These are necessary in any case, due to the fact that network and operation are separate now and that the company-specific (virtually vehicle-specific) invoicing of energy consumption is therefore required.

Minimising supplementary energy consumers

Units such as ventilators that are necessary for the engine to function properly come under the category of “supplementary energy consumer”. But this group also includes above all appliances in passenger trains that serve the comfort of passengers: air-conditioning and heating, lighting, buffet service as well as door opening and closing mechanisms. In extreme weather conditions their energy consumption can amount to a third of the overall consumption. Operational measures were named most often in the environmental competition entries as measures employed to reduce these “supplementary consumers” - measures that are discussed below (operational action field). In the case of pressure-tight trains, high-speed transport rail enterprises had also set guidelines for manufacturers concerning heat insulation of the external shell of the vehicle.

CO₂ Emissions

CO₂ emissions are one of the main causes of the greenhouse effect. Levels of these emissions are directly linked to the burning of fossil fuels such as crude oil, natural gas and coal. CO₂ emissions in diesel operations were therefore considered together with energy consumption in the First Comparison of Environmental Performance of Rail Transport. The participating companies were nevertheless permitted to point out the use of biogenous fuels in their operations. When viewed as a single issue, biogenous fuels do not affect the climate because the CO₂ emitted has already been absorbed in the growth process of plants. The possibly problematic consequences of the land surface needed for their cultivation and their transportation must not be forgotten however.

In terms of electric traction, the level of CO₂ emissions depends decisively on how the electricity is generated. There have, up until now, not been any relevant scope for rail transport companies to use more environmentally friendly ways of generating energy than other rail transport companies, such as from solar, wind or hydraulic power, because the energy supply to rail transport has so far been managed by the infrastructure company. The German traction network works at a frequency of 16.7Hz and can therefore not be connected with the general 50Hz national network without making any changes. DB Energie regulations for the third party access of electricity via the electric rail network have been laid down and the safeguarding of this access is expected in new power industry legislation. The mix of electricity used by rail transport companies may play a role in the second round of the comparison of environmental performance.

Reduction of Toxic Emissions

Exhaust gases are produced from the operation of diesel motors that are harmful to health. Above all, nitrogen oxide (NO_x) and sooty particles represent a serious problem. The specific toxic emissions per pkm or tkm (per person and kilometre or per tonne and kilometre) are usually lower than with other modes of transport, in line with the lower level of rail transport's energy consumption. Rail transport nevertheless contributes to the general harmful impact of emissions, and to the regional peak levels in agglomerations. There is still considerable potential for improvement in rail diesel operations as well, which is in the interests of residents, passengers and railway-men - some of whom are exposed to exhaust fumes on a daily basis - to take advantage of.



Modernised diesel locomotive belonging to Verkehrsbetriebe Peine-Salzgitter. A systematic approach has meant that noise and exhaust emissions as well as energy consumption levels have been reduced. A drip tray prevents the ground from being contaminated.

The measures implemented in operations to reduce energy consumption (e.g. energy-saving ways of driving, motor shut-down in standstill mode, etc.) also contribute to the reduction of toxic emissions.

Electric operation is more favourable

Generally, electric operation is more favourable, even if the electricity is generated from fossil fuels, because environmentally friendly incineration technologies and effective filter systems are used in modern power stations. The equipping of rail tracks with overhead traction lines or live rails nevertheless involves considerable investment and is not the responsibility of train operating companies. It is a general point of criticism though if diesel trains are operated along electrified lines over longer distances of track. This seems to be an increasing problem, particularly in freight transport, because the starting and destination stations (or sidings) of a transport are often not electrified, whilst most of the track is running over electric tracks. It is often impossible for smaller private rail enterprises to hold out locomotives of both traction types in suitable locations. In regional passenger rail transport with diesel traction it should be considered that it nevertheless makes sense in terms of transport and environmental policy to drive continuous tracks with trainsets, even if sections of the track are electrified. The rail transport companies that took part in the comparison of environmental performance were asked about the use of diesel vehicles under overhead traction lines for control purposes.

Motor manufacturers are working on new technologies to reduce the level of emissions and to meet future standards. Unfortunately, there is sometimes a conflict of objectives, i.e. the price for the reduction of one emission type (e.g. sooty particles) can mean deterioration in terms of other emission

types (e.g. nitrogen oxide, NO_x). Certain procedures used to prevent toxic emissions can in turn have a negative effect on energy consumption, for example as a result of unfavourable repercussions for the combustion process or because the mass of the vehicle increases. The technical details of new combustion processes would go beyond the scope of this documentation. Many of these projects are still in the trial stage. But it is clear to the motor manufacturers and locomotive builders that the emission standards envisaged by the EU for 2012 will not be met without new technological developments and not without the use of exhaust gas treatment systems such as particle filters. There are four important issues relevant to decision-making in this context for operators of diesel traction units, which were also focused on by the Pro-Rail Alliance in the “First Comparison of Environmental Performance of Rail Transport”. They apply to both the procurement of vehicles and to remotorisation, although there might be limitations in an existing vehicle construction, e.g. to use a particle filter:

- the emission levels of the engine or the adherence to the required standards;
- the fitting of particle filters or other exhaust gas after-treatment systems;
- the use of fuel additives or alternative fuels;
- the active involvement in new developments and trials.

Emission levels and legal requirements

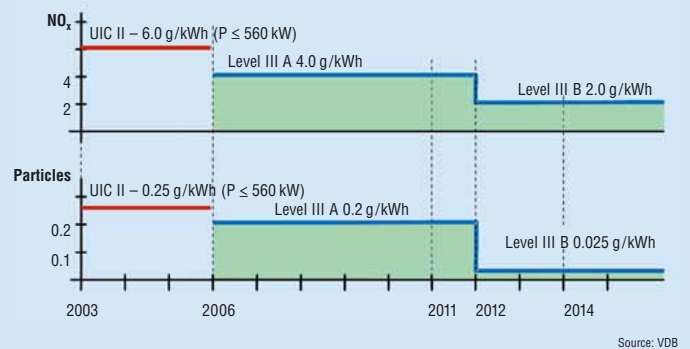
The emission levels of a traction unit show the result of efforts made by the motor or vehicle manufacturers and the rail enterprises to reduce environmentally harmful exhaust gases by further developments in the field of motive power engineering. Since 2003, the standards of the UIC that have previously been in the form of recommended guidelines have to be adhered to by its members. This applies to new vehicles and new engines in old vehicles. EU legislation (guideline 2004/26 EG) will make even more stringent standards a legal requirement and will become effective in 2006 (motor coaches), 2007 (locomotives up to 560 kW) and 2009 (locomotives above 560 kW) for the new traction units and new engines of all rail transport companies. From 1 January 2012 even more advanced standards will be legal requirements. These regulations will effect emissions of carbon monoxide (CO), hydrocarbon (HC), nitrogen oxides (NO_x) and particles (PM).

NO_x and particle standards for motor coaches with combustion engines

Hitherto: UIC standards (UIC II since 2003)

From 2006: EU directive level III A

From 2012: EU directive level III B



The diagram above shows the development of standards for motor coaches. The table below represents the actual emission data of vehicles currently in operation in comparison with the development of standards for the most important types of emissions (NO_x and particles) based on the example of a diesel locomotive performing at about 1.000 kW. It should be noted here that there is a technologically determined conflict of objectives: Measures within the engine itself to reduce NO_x increase the level of particle emissions and vice versa. Even if current engine models adhere to particle emission levels, the particle emission levels of the respective engine models can increase again if NO_x is reduced further, meaning that adherence to both standards at the same time may only be possible with the help of exhaust gas after-treatment units.

Limit level regulations/ Locomotive model	NO_x in g/kWh	PM in g/kWh
Diesel locomotive Year of construction 1970	11.9	0.28
UIC Voluntary adherence (compulsory from 2003)	9.5/9.9	0.25
Diesel locomotive remotorised 2002/3 or newly constructed locomotive	7.1	0.115
RL 2004/26/EG Level IIIa (from 2009)	6.0	0.2
ditto. Level IIIb (from 2012)	4.0*	0.025

* cumulative standard for HC and NO_x .

An overview of existing standards and recommendations will be available on the Pro-Rail Alliance website.

Planned non-compliance permit is no cause for complacency

It has been envisaged up until now that non-compliance is permitted for vehicles already in operation, meaning that a vehicle that, e.g. does not meet the new standards by 2012, may still be allowed to continue operating. The rail transport companies should nevertheless try to go beyond these standards if possible when procuring vehicles. There are several reasons for this:

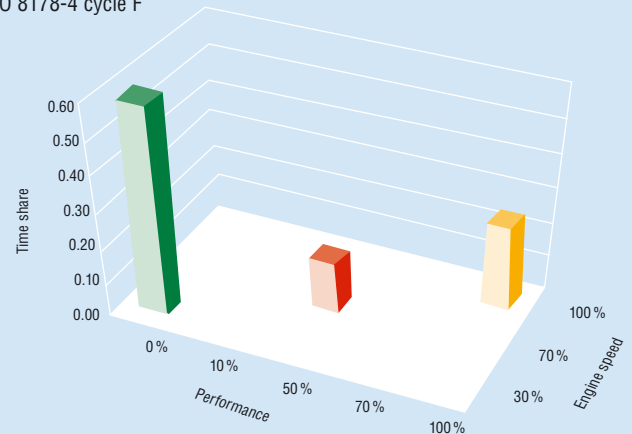
- Firstly, national legislators may exceed European law and limit non-compliance permits in their territorial jurisdiction.
- Secondly, it cannot be known for certain whether the non-compliance permit will still be in place after 15 or 20 years - a complete normal lifespan for railway vehicles and engines.
- Thirdly, it is to be expected in the mid- and long-term that the decision makers in the regional passenger rail transport sector will stipulate emission levels in new transport contracts that will not permit the operation of older vehicles.
- Fourthly, public transport authorities abroad can impose stricter regulations in the future than those that have been customary in Germany up until then.
- Fifthly, a rail transport company that operates its locomotives in other EU countries and wishes to sell them there must allow for the fact that these old vehicles will be treated like new vehicles there. They may then have to meet the standards that apply for new vehicles.

Take measurement cycles into consideration

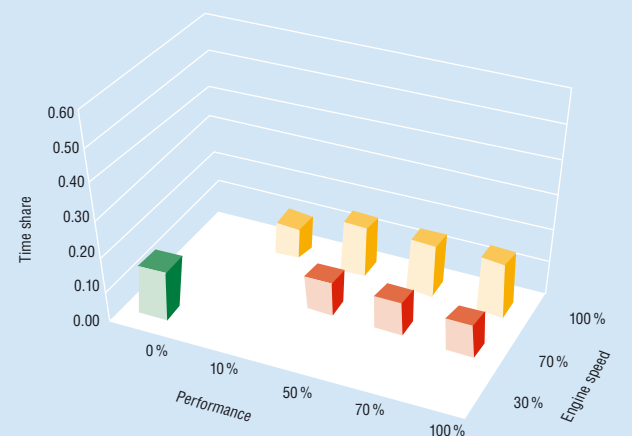
Emission levels are only meaningful if the standards according to which they are measured is also stated alongside them. Besides the actual measuring system used, these standards also specify above all the share of particular engine load conditions in a measurement cycle, i.e. the share of no-load times, partial load times and full load times ("load collectives"). In real operations, the "load collectives" in rail and road transport differ considerably. And even within the rail transport sector there are major differences, such as between freight and passenger transport, long-distance traffic and shunting operations. Current new diesel trainsets meet the EURO 3 standards for commercial road vehicles. For trainsets operating up to 560 kW, the EURO standard was asked for in the questionnaire on the comparison of environmental performance. The EURO standards at least enable a comparison between different generations of engines but are not all that meaningful for engine operating at a higher rate and does not indicate the optimisation of engine combustion and exhaust gas procedures for

Comparison of relevant measurement cycles

ISO 8178-4 cycle F



NRSC cycle



Source: DB Systemtechnik/Ponholzer

rail transport. The ISO Norm 8178-4, cycle F is more meaningful when it comes to emissions in rail operations. The NRSC cycle (NRSC = Non-Road Steady Cycle) can also be considered as another standard, which is stipulated by EU guideline 2004/26 for trainsets. The differing "load collectives" of both of these cycles are shown graphically in the diagram above.

A rail transport company that procures new vehicles or new engines should demand the measured values in accordance with specified EU measuring methods from the manufacturer. But the measurement cycles ISO 8178-4 F und NRSC that are more appropriate to railway operations also abstract from the individual rail transport companies' actual operational conditions. With legal regulations that refer to vehicles and engines that can be used in very different areas of operation, another line of action hardly makes any sense either. A rail transport company could nevertheless go beyond this and demand specific values for the individual load conditions prescribed

in the measuring standards. In this way, the (environmental) management of a rail enterprise would receive more precise information about the actual emission levels under their own operational conditions and would therefore have the option of optimising engines with respect to the own operational conditions. No additional measurements would be necessary for this method. Rather, another form of data preparation would be required from the manufacturer. The appropriate suggestions for future procurements of diesel vehicles have been compiled as part of the PROSPER project¹, which are due to be adopted in autumn 2005 by the UIC as a recommendation. A similar procedure is also suitable for calculating energy consumption.

Particle filters and other exhaust gas after-treatment systems

In principle it is also possible to reduce the emission of contaminants with exhaust gas after-treatment systems if the reduction of toxic emissions by means of measures taken within the engine is not possible or is insufficient.

Besides the particle filter, oxidation and reduction catalytic converters are also examples of so-called exhaust gas after-treatment systems. Whereas a particle filter catches (sooty) particles and burns them off at regular intervals, the exhaust gas components HC (hydrocarbons) and CO (carbon monoxide) are oxidised to CO₂ and H₂O (water) in classic oxidation-type catalytic converters. An even more modern procedure involves the reduction catalyst. This reduces NO_x (nitrogen oxide) to N₂ (nitrogen) and H₂O. The main toxic components in diesel engines are NO_x and sooty particles. Much attention is being paid to this latter procedure because the reduction of these components using measures within the engine itself only has a limited effect and involves an increase in fuel consumption. An additional operating material is needed to operate a reduction catalyst e.g. urea, for which a special supply system and storage containers are necessary.

Some exhaust gas after-treatment systems are already in operation or are soon to come into operation in commercial road vehicles. The railway industry is still in the beginnings of its development however. The lower number of vehicles is the major reason for this, meaning that the funding of such exhaust gas after-treatment systems in rail transport complicates the process.



Margareta Wolf, Parliamentary State Secretary in the Federal Ministry for the Environment, christens the first diesel locomotive in the engine-power class 2,700 kW with a particle filter, at the InnoTrans trade fair (Berlin, 23 September 2004).

Since the end of 2003, the company Vossloh has manufactured a series of 79 diesel locomotives from the Am 843 series (1,500 kW power) that are equipped with particle filters for the Swiss Federal Railways (SBB), the Sersa AG and the BLS Lötschbergbahn AG. Operational reports up until now have been positive and the SBB plan to re-fit some of their old locomotives with particle filters as well. At the InnoTrans in September 2004, a diesel locomotive of the engine power class 2,700 kW with particle filters was presented for the very first time.

Filter technology is thus available, but the integration of this technology into the layout of a locomotive and the fulfilment of requirements specific to rail transport is still a constructive challenge. The procurement costs of a new locomotive increase if fitted with a particle filter by approximately 3 to 8%. In the case of remotorisation, particle filters have even a greater effect on costs in percentage terms, but they cannot always be integrated subsequently into locomotive construction processes.

Short-term view of costs is a risk

Any company that is reluctant to pay additional costs in the procurement or remotorisation of a locomotive or a motor carriage - in view of the economic situation of many rail transport companies, particularly in freight transport, this is at first glance an understandable decision - should nevertheless consider the following counter-arguments:

¹ | "Procedures for Rolling Stock Procurement with Environmental Requirements", project commissioned by the UIC.

- The non-compliance permit for old vehicles with unfavourable exhaust gas levels is not guaranteed forever.
- The vehicle may possibly not be operated without restrictions in other countries or sold or leased abroad after its use on the domestic network. The counter-argument to this is for the time being that sulphur-free fuel (<10 ppm sulphur) must be used for vehicles with particle filters and that this is not yet available all across Europe. From 2009 onwards EU legislation (RL 2003/17/EG) envisages that only this type of fuel will be allowed to be used throughout the EU.
- A vehicle with a particle filter can be operated without limitations in areas where, e.g. very strict air quality levels have to be adhered to due to employment protection regulations. These can be tunnel construction sites or tracks inside private siding owners' workshops, for example. Unlimited operation can result in considerable rationalisation effects. Being able to renounce own shunting devices can make railway dispatching more attractive for some connectors.
- Some regional passenger transport authorities may stipulate stricter exhaust gas levels for vehicles put into operation under their contract in the future - particularly in areas with a high level of particle contamination, where measures for reducing load levels are compulsory according to the EU fine dust guideline.
- Unlimited operations and re-sale value are particularly crucial when it comes to vehicle pools (locomotive rental companies) and leasing companies.
- Remotorisation may be necessary after a lifespan of 16 to 20 years, for which the emission levels that will apply from 2012 onwards will be compulsory. With today's level of knowledge, these levels can only be met with the help of high-performance, modern exhaust gas after-treatment systems. The space required means that the refitting of filter systems or similar systems is only possible with a justifiable degree of investment if the vehicle construction provides sufficient scope, which should definitely be planned in procurements made at the present time.

The Deutsche Bahn AG has now announced that it will only procure new diesel locomotives with particle filters, provided this is economically viable.



The class Am 843 belonging to the Swiss Federal Railways (SBB), the first locomotive class equipped with a particle filter as standard. Being able to operate this locomotive on tunnel tracks and construction sites, as well as inside workshops on private sidings provides the SBB with rationalisation benefits that outweigh the additional costs involved with particle filters.

Fuel additives, alternative fuels

The use of low-sulphur diesel fuels is already standard and results in a lower level of particle emissions as well as sulphur dioxide emissions when compared with the diesel previously used. Natural gas operations are much more favourable than diesel operations in terms of toxic emissions, but are still in its infancy in the rail transport sector. With gas locomotives with higher-engine power classes the larger tank volumes would be a larger disadvantage, as well as being an environmental disadvantage due to the extra weight. In the case of buses, natural gas has already been successfully applied and also has the effect of reducing the noise of the engine considerably. Trials with trains at the Usedomer Bäderbahn (UBB) and with a shunting locomotive (DB AG) have not yet led to successful long-term operations however.

More recent considerations are concentrating on whether exhaust gas levels can be improved by a part of the diesel fuel being substituted by natural gas or bioethanol. The involvement of environmentally friendly rail transport companies is required here to test such procedures. Diesel-water emulsions could enable a drastic reduction in nitrogen oxide emissions in connection with novel combustion procedures, but would nevertheless also mean a larger tank volume and a high mass of fuel, meaning that the possibly negative effects on energy consumption need to be considered. The admixture of water may also be beneficial in the reduction of particle emissions.



On 21 June 2005 the first train with a biogas engine was presented in Sweden - reconstructed out of a diesel train built in 1981. From September 2005 onwards it will be tested in regular passenger service between Linköping and Västervik.

Active involvement in new developments and trials

The involvement of rail transport companies is needed from the point of view of the environment, vehicle and engine manufacturers and the rail industry as a whole, in order to test new engine and combustion technologies in daily operation. The Verkehrsbetriebe Peine Salzgitter (VPS), one of the winners of the comparison of environmental performances, were operating the world's first engines with common rail fuel-injection technology in a diesel locomotive. In order to adhere to future standards, several new techniques and components need to be tested. A rail transport company that becomes involved will certainly have earned itself points in the next round of the environment comparison.

Operational Options

The large impacts on improving the environmental performance of rail companies can be made in the action fields of procurement and refitting (modernisation). Such investments, particularly in the case of smaller companies, are not made very often, however, due to the long lifespan of vehicles and essential units such as engines. They also only have as much choice as the railway industry offers them in terms of vehicle models and environmentally friendly equipment variations. In this respect, the scope for action of many rail transport companies in both of these action fields is limited.

But rail transport companies also have many opportunities to employ environmentally friendly measures in their daily operations. Their emission-reducing effect is low in comparison, but only requires either no or very little investment. In relation to noise and particle emissions, the reduction of local immissions can be crucial, for example at outdoor stabling and workshop facilities. Investments in control units or the respective software or the expansion of workshop buildings may possibly have to be made for this.

Most of the measures outlined here have a positive effect in several or all impact categories (noise emissions, energy consumption, exhaust emissions), even though one of these three categories often formed the focus in the conception stage. Toxic emissions increase with energy consumption. If the engine of a diesel locomotive is turned off for short periods to save energy then fewer harmful substances are produced from the exhaust and the noise level for residents is also reduced.

Dispatch, maintain and warm up in an environmentally friendly manner

In principal it makes sense and is often possible to operate low-emission vehicles more intensively than other vehicles that are often older and to relegate these older vehicles to a reserve or for reinforcements in peak periods. Sometimes loud vehicles can be withdrawn from operation at night if quieter vehicles are available. It makes sense in the freight transport sector to use waggons fitted with "Whispering breaks", firstly particularly intensively and secondly, in block trains, so that improvement is also audible to the residents affected.

The depots and workshops of rail transport companies are often located either in or near to residential areas. Shunting, maintenance work with running units, warm-up phases and the route from and to the refuelling station all cause noise. The rail enterprises can reduce the level of disturbance by relocating these processes to inside the workshop buildings as far as possible and by avoiding work at night. The Hohenzollerische Landesbahn bought a noise-insulating two-way Unimog especially for shunting work, for example, in order to minimise the noise arising from the outdoor area of the workshop.

Diesel engines of railway vehicles have to be warmed up in lower outdoor temperatures, or be kept warm overnight, so that they can be started. This often happens by engines being periodically turned on for a certain period (e.g. 30 minutes) during the night, which causes noise and exhaust emissions as a result. There are other ways around this problem though:

If there is not a warm workshop available, special heating facilities can be installed that are supplied with energy from the vehicle battery or external power connections (electrants). Various DB companies introduced this facility in autumn 2004. The Häfen und Güterverkehr Köln AG (HGK) has already been applying the external power connections to provide energy for the on-board power supply in some of their diesel locomotives for some time now.

The “stand-by mode” is also relevant

Passenger trains, particularly of the regional passenger rail transport, often remain unused or on standby ready for operation for an extended period of time, due to turnaround times at terminal stops, outside of operational hours or as part of the vehicle reserve. In such cases there is often a relevant potential for reducing energy consumption and noise emissions. The inner temperature may be lower or higher during these stand-by periods than during passenger operation. An environmentally friendly “optimisation” of the “stand-by mode” is also possible with respect to other onboard appliances. If a train is in stand-by mode for an extended period of time at the platform of the terminal station, it can be ensured that the doors automatically close at regular intervals if they are not needed so that no unnecessary loss of heat occurs. It is also a sensible measure to warm trains up in a time-controlled way, such as is the procedure on the Ostmecklenburgische Eisenbahn (OME), amongst others.

In diesel operations it is very often useful to shut down the engine when trains are waiting in a station for more than a few minutes. A conflict of objectives arises here, however, because turning the engine on and off very regularly can lead to a high level of wear on starting motors and control units. The relevant instructions for rail staff or the automatic controls that are installed therefore need to be adjusted to the specific situation at hand. The Bayerische Oberlandbahn instructs its staff to shut down the engine during stops that last for longer than five minutes. The Verkehrsbetriebe Peine-Salzgitter have built in a self-developed automatic start-stop function in their diesel locomotives which shuts down the engine after a certain time, even if the engine driver does not do anything, and simplifies the start-up procedure.

Increasing efficiency and avoiding empty runs

Increasing efficiency in passenger transport and avoiding empty runs in freight transport represent two more ways of reducing specific energy consumption. If the occupancy level of trains increases then profitability is also improved, meaning that it may be possible to improve services by offering additional train



Bayerische Oberlandbahn: “Integral” in front of the Wendelstein mountain.

runs, thereby winning over more passengers for environmentally friendly rail transport. The timetable itself could not be assessed in the comparison of environmental performance because it is mainly determined in regional passenger rail transport by the public transport authorities and not by the rail transport company. In the long-distance transport sector the general framework of the few rail transport companies that operate there also differs too much to allow for a meaningful comparison. Logically, it is also a similar case when it comes to tariffs. The competition documentation therefore inquired about specific service attributes and customer loyalty instruments:

- The option of being able to take a bicycle onto the train;
- Online timetable information;
- Company magazine for passengers;
- Complaint management / regular passenger monitoring;
- Passengers as quality testers.

Several train operating companies in the passenger transport sector that took part in the competition apply several or all of the instruments listed above.

On the other hand, train capacities can be oriented towards the actual passenger numbers by means of cutting off or adding carriages, e.g. on outer branches of suburban railway networks. Care should nevertheless be taken not to discourage travellers by operating overcrowded trains.

The most important indicator on this issue in the “First Comparison of Environmental Performance of Rail Transport” was the actual development of energy consumption per

person kilometre during the past few years. A rail transport company should be familiar with and know its specific energy consumption per person and tonne kilometre, and whether and why this decreases, stagnates or increases with the passing of time. In the comparison of environmental performance, the specific energy consumption levels in a particular year were not compared with one another, as different rail transport companies are not really comparable with one another in this respect. Instead, the development over the past few years was investigated. Special features should be considered here. The S-Bahn Berlin, which has very precise data on their emission and consumption levels, can report a continuous reduction in specific energy consumption over many years. In 2002, consumption rose for a short period however. The explanation for this was that a line that had been cut off due to the Berlin Wall was re-opened in that year. This additional train service was only gradually discovered again by passengers, meaning that occupancy was reduced for a short period.

Drive Intelligently and Save Energy!

Ways of driving have an effect on energy consumption in all modes of transport. This is also true for rail transport. The railway has tangible advantages in comparison to other modes of transport: The low rolling drag enables rail staff to let a train roll along large sections of track with no engine running, without reducing the speed noticeably. Trains only have to travel at maximum speed if they are delayed or have to make up leeway, due to the fact that railway transport companies operate according to timetables and that these timetables have to plan for certain journey time reserves in any case.

Energy costs money and is becoming increasingly expensive, meaning that the rail enterprises have to take notice of energy-saving ways of driving for their own financial interests. The greenhouse effect is also slowed down by energy-saving ways of driving (CO₂ emissions). Toxic emissions and even the development of noise are also reduced.

Energy-saving driving

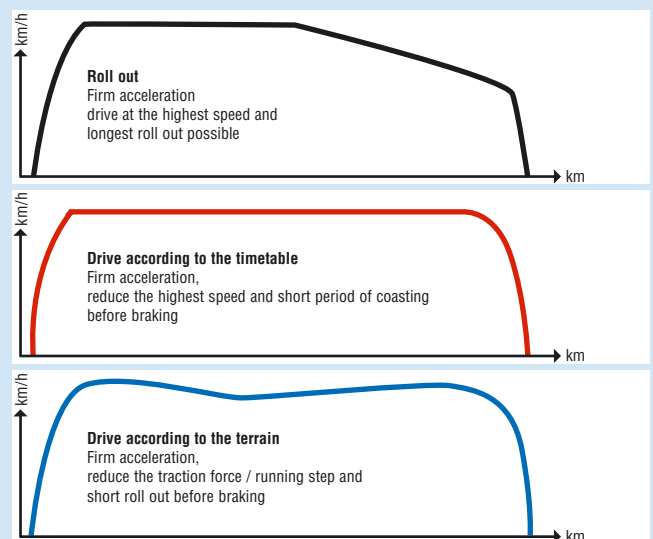
The principle of energy-saving ways of driving in electric operation is: Bring the vehicle up to speed without interruption and accelerate until at the highest speed desired, in order to be able to let the train roll for a long distance. A good knowledge of the line also helps when adapting the ways of driving to the current journey time reserves and the terrain. This means that downward slopes are used for rolling whilst the traction force is reduced on upward slopes in comparison to traditional ways of driving (see diagram). An ICE can easily roll for

55 km at 200 km/h without the engine working. With diesel vehicles that are often not technically suitable for free coasting, it is best not to drive at the highest speed - as much as journey time reserves allow - because punctuality remains the top priority. The ideal scenario is when the train travels in the most uniform way possible.

Energy-saving project by the DB AG

The DB AG subsidiaries that took part in the "Comparison of Environmental Performance of Rail Transport", train their drivers in energy-saving ways of driving with advanced training events or practical sessions. The Deutsche Bahn AG has made 14,000 drivers in the company's passenger transport sector aware of energy-saving driving, by means of theoretical training sessions, driving simulators and accompanied journeys. All electric vehicles were equipped with electricity meters during the course of the opening of the rail network for third parties. The consumption measurements communicated by the electricity meter are fed into a self-developed database. They are used, amongst other things, to inform drivers about the consumption levels of their own driving. Technical assistance systems are also being developed for driver's cabs presently to provide support in energy-saving driving. Firstly, energy consumption measurements should display the current consumption during the journey. Secondly, driving recommendations give notice of recommended shut-down points in short-distance and long-distance transport.

Three basic ways of energy-saving driving



Source: DB AG

Train drivers are incited to improve their ways of driving by the energy-saving competitions that are taking place a second time, as well as by comparative train and track data.

Large saving potential

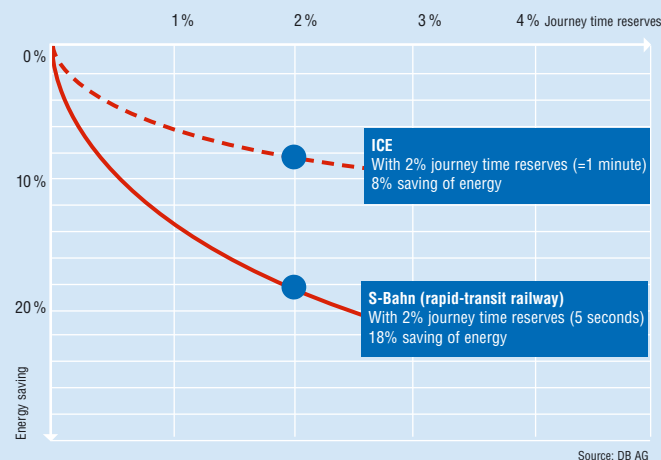
Energy consumption can be reduced with improved ways of driving by up to ten per cent in general and by up to twenty per cent in individual train runs. The DB AG has been able to save 32 million euro in this way since 2002. The DB AG project started first of all with passenger transport but has now been introduced to freight transport at the Railion Deutschland AG as well. Consumption value comparisons are more difficult here because train masses can fluctuate significantly, but the principle of energy-saving driving nevertheless remains the same for freight transport.

Other rail transport companies, such as the metronom Eisenbahngesellschaft and the Verkehrsbetriebe Peine-Salzgitter, also train their drivers now in energy-saving ways of driving.

Journey time reserves and savings

1st Priority: punctuality

2nd Priority: When journey time reserves permit: energy-saving driving



General - Stationary parts of the train operating business

A rail transport company's consistent environmental strategy should also incorporate the consideration of stationary parts of the train operating business such as workshops, control stations, stations (in so far as this lies within the train operating company's control) and administrative buildings. The most important aspects that were examined in the First Comparison of Environmental Performance of Rail Transport were water consumption and water usage, waste disposal and waste recycling statistics, and energy consumption in the stationary parts of the train operating business. In outdoor areas of workshops the reduction of noise is especially relevant, and was investigated in the action field "operations" (see above).

Rail vehicles are cleaned on a regular basis, especially in the passenger transport sector. Fresh water hardly has to be used at all in the washing plant. Almost all participants in the competition with passenger transport, as well as the Häfen und Güterverkehr Köln AG (HGK) in freight transport, use rain water or recycle some of the water after one use. Water that has already been used can also be used for the preliminary purification of very dirty units (e.g. bogies) before it is disposed of.

Waste is a relevant issue in stationary parts of the train operating business. The operation of rail vehicles even causes hazardous waste. It is a positive sign if the rail transport company knows the figures for its recycled and hazardous waste. The amount itself was not assessed as this is partly dependent on general conditions that are beyond the rail transport company's control. It was nevertheless the case that some rail transport companies have a very high rate of waste recycling.

Rail enterprises can save energy even in the stationary parts of their business. The saving potential of vehicle operations in absolute amounts is considerably larger, meaning that a detailed examination of the stationary parts was not carried out in the comparison of environmental performance. It would also be difficult to compare the energy consumption of different rail transport companies in the stationary parts with one another because the facilities are often used for other vehicle sectors as well, e.g., for buses or trams. It should, however, been pointed out on a positive note that individual companies also compile data on their stationary energy consumption, as well as the development of consumption, thereby checking the success of energy-saving measures that have been introduced.

Environmentally friendly auxiliary and operating materials

In addition to vehicles rail enterprises procure also operating materials, varnish and items of equipment. Several rail trans-

port companies procure biogeneous lubrication solvent. This should be standard, particularly with wheel flange lubricants that can easily drip down into the ground. Water-based varnishes and paints are also advantageous and are used by several companies. Recyclable products or materials made from renewable raw materials, e.g. for the interior furnishing of vehicles, are not very commonly used however.

Environmentally conscious rail transport companies can demand the adherence to certain environmental standards from suppliers and sub-companies. The adherence to legal requirements should go without saying. But in addition to this, existing environmental reports or environmental management systems, as well as a contractor's environmentally friendly procurement can be criteria for placing an order.

Other areas that are clearly regulated in terms of legal emission standards (e.g., soil protection in depots) were not looked at in any closer detail. Individual measures in the actual area of administration (e.g. use of recycled paper, energy-saving electric appliances and heating units, etc.) were not investigated individually because their relevance when compared with driving operations is low and possible measures available are not specific to the railway. These areas are also covered by the consideration of general energy consumption in the stationary parts. They are best processed by companies with the help of a certified or validated environmental management system.

Environmental Officers, Environmental Management Systems for Rail Transport Companies

Every company, meaning every rail transport company as well, can set itself environmental targets, can inform customers and the general public about the environmental effects of the company's own activities and can systematically incorporate the protection of the environment into their own company policy.

Environmental reports give the wider general public an insight into the operations of a company that relate to environmental protection. The existence of an environmental report shows that the company has broached the issue of environmental protection and recognised it as an important part of its activities and communication strategy. The compiling of an environmental report also allows a company to critically assess their environmental performance so far and to recognise further potential for improvement. Companies reported that they had compiled environmental reports in approximately 60 per cent of competition entries.



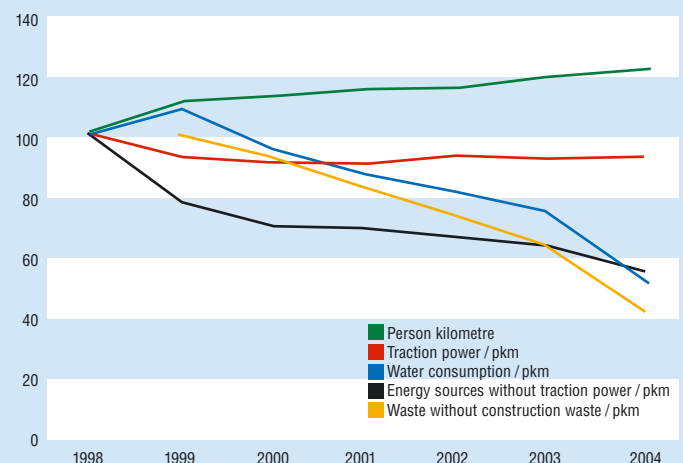
Taking bicycles onto the S-Bahn Berlin: a sensible opportunity to increase the occupancy of rail transport and to systematically bring to bear the environmental advantages of the railway.

There is no standardised form for environmental reports however. And they can only be checked to a limited degree by the general public as well.

Many companies have also appointed an authorised environmental agent whose tasks usually include working out and responsibility for laying down the environmental targets and policies of the company. What the environmental officers can achieve depends very much on their personalities, their competence within the company and the significance given to the environment at management level.

Development of important environmental performance indicators in the S-Bahn Berlin GmbH

Annual consumption in per cent



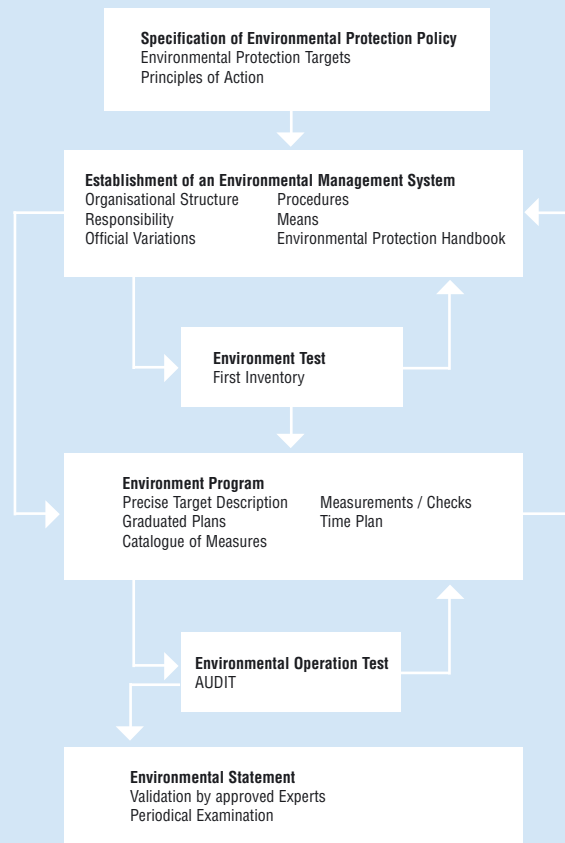
Source: S-Bahn Berlin

Environmental Management Systems minimise Risks

An environmental management system - which can be introduced for a company or individual areas - is far more binding. Environmental targets and procedures for production processing are specified in this system, which should in turn be able to minimise damage and risks to the environment. It involves a systematic analysis of the adverse effects on and damage to the environment by the company. A certified environmental management system must meet a certain standard, e.g. the EMAS (Eco-Management and Audit Scheme) introduced by the EU, or ISO 14.001. If such an environmental management system is certified by an external auditor then they have checked that the defined procedures meet the requirements that form the standards. Such certifications have long been used in industry and administration. The procedures developed there can easily be applied to the stationary parts of the train operating business (workshops, depots, administration). But it is still something special if a rail enterprise introduces an environmental management system for its driving operations, especially if specifying procedures for procurement and the modernisation of vehicles as well as for operational processes. The competition participants (S-Bahn Berlin, Kölner Verkehrsbetriebe, Railion), that have certified environmental management that incorporates driving operations, were awarded lots of plus points from the jury. But: a certified environmental management system guarantees that particular standards are adhered to. These standards are defined by the company itself, however, and can differ blatantly from case to case. In the First Comparison of Environmental Performance of Rail Transport, the actual procedures such as procurement, modernisation and operation were assessed first and foremost, and not the environmental management itself. It was revealed though that rail transport companies with a certified environmental management system achieved particularly good results in many areas, meaning that the systematic and serious approach to the environmental policy of a company pays off for the environment and in the environmental competition, although the introduction of a certified environmental management system is associated with costs for a company. Firstly, risks are uncovered and then eliminated or reduced, so that potentially high costs for the company may be avoided. Consequences can be kept to a minimum with clearly defined and practised plans of action in the case of failures, e.g. leakage of oil. Secondly, saving potential is opened up, e.g. with respect to energy and water consumption. Thirdly, loaders in freight transport that wish to become certified receive data about the environmental impact of transports that is assured by the rail transport company. Fourthly, the systematic analysis of internal company processes that are linked to the introduction of the environmental management system also helps to remove quality problems, meaning

that the company profits in all respects. There are important parallels and synergy effects between environmental and quality management systems.

Procedure according to the Eco-Audit-Regulation



Source: Blick durch Umwelt und Wirtschaft, 1995
quoted in: http://www.bayern.de/ifu/umwberat/data/basis/audit_2002.htm

Outlook

Hardly any other industry is so dependent on political decisions to such an extent like the railway industry. The environmental benefits of rail transport are one of the most important arguments for supporting it. For every rail enterprise it is a question of credibility and corporate foresightedness not to neglect the issue of environmental protection in their own company.

The Allianz pro Schiene (Pro-Rail Alliance) therefore intends to continue the „First Comparison of Environmental Performance of Rail Transport“ with more comparisons of environmental performance in the future. A good level of participation and qualitatively high-grade entries from rail transport companies can be expected from previous experience. Those rail transport companies then have the best chances of being amongst the winners if they systematically implement an environmental policy, and understand this as an important challenge and not as an obstacle to business operations. Environmental management systems with which operational processes, consumption levels and emissions are assessed and planned can encourage environmentally friendly operations, quality assurance and corporate success - whether with or without a certificate. In the First Comparison of Environmental Performance, companies that comprehensively work through the environmental effects of their company were especially successful. It is not about perfectionism but rather about looking for environmentally friendly alternatives when making any decision about investments or the form of operational processes. It is also important to make decisions with foresight: The way to subsequent improvements should not be blocked. And above all: measures that seem to cost unnecessary amounts of money in the present could be crucial for the business success in a few years time!

General managers and environmental officers from rail transport companies can also plan ahead for taking part in the next “Comparison of Environmental Performance of Rail Transport“, e.g. by finding out about the emission data for their vehicles or demand the relevant information from the manufacturers. The questionnaire from the First Comparison of Environmental Performance will be gladly made available by the project management. It will also be accessible on the Pro-Rail Alliance website (please click on “Umweltvergleich”). Other documents will gradually be made available to download there (see the back page of brochure).

The project has shown that many rail enterprises and responsible rail transport company employees view the improvement of their company's environmental performance as an important task and are therefore prepared to undertake these additional

measures. On the other hand, the legal and political environmental challenges rail transport will face in the next years also need to be communicated and explained. These include above all the consequences of EU environmental guidelines and TSI noise, as well as air protection plans and exhaust gas standards as stipulated by EU legislation. The technical and economic potential for reducing emissions is not yet known to all players and should be approached together as an entire industry. The Federal Ministry for the Environment has authorised the extension of the project until June 2006 in order to move forward the dialogue process started with the First Comparison of Environmental Performance of Rail Transport between rail enterprises, the train industry, environmental organisations and scientists. Publications, expert forums and a series of workshops are planned.

The public authorities responsible for regional rail passenger transport have the chance to influence the noise emissions and exhaust gas emissions of rail transport companies operating under their contract, by offering tenders to bid and by signing transport contracts. An event outlining how these public transport authorities could make regional rail transport companies more environmentally friendly therefore forms a prelude to the workshop series.

Other events are planned on emission-reducing technologies in combustion operations, in the environmentally friendly procurement of rail vehicles and the use of environmental management systems. All rail transport companies registered in Germany, public transport authorities of regional rail passenger transport and companies from the rail industry will be invited to these events.



The model to serve as an example? Particle filter as part of a Swiss model railways manufacturer (for the SBB Am 841)

The Project Team



Nicolas Wille
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Studies in Transportation Engineering (with specialisation in vehicle technology) at the Technical University (TU) of Berlin. Afterwards scientific assistant at the professorship for rail vehicles at the TU Berlin and from 1998 to 2000 in the research laboratory "Rail vehicle and Aircraft Concepts" at DaimlerChrysler AG in Frankfurt am Main. Since 2000 Senior Consultant at the SCI Verkehr GmbH. Since 2002, head of the Cologne office and since September 2004 authorized representative of the SCI Verkehr GmbH. Wille has been consigned in the past to manage a variety of projects from the areas of market analytics, valuation expertises and system studies in rail technology and is known as a designated industry insider.



Sven Kleine
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Studies in Geography at the University of Münster and Urban Planning specialising in transport planning at the Technical University of Hamburg-Harburg. From March 2001 to March 2005 he worked at SCI Verkehr GmbH in Cologne as a scientific officer and Project Manager for consultancy and research work in city and regional transport, as well as market analyses and knowledge management in the rail sector. As of 1 April 2005 change to the administration union SPNV (regional rail passenger transport) Rheinland-Pfalz Nord in Koblenz. Responsible there for the coordination of transport and urban enhancement of stations and their surrounding areas, as well as involved in the planning of infrastructure and passenger rail services.



Ulrich Höpfner
Dr. rer. nat.
born 1946

Studies and doctorate in Chemistry at the University of Heidelberg. In 1977/78, founding member of the IFEU-Institut. Temporarily (1979/80) he worked in the scientific staff of the German Parliament for the challenges of the Enquête commission "Future nuclear energy policy". Since 1983, specialisation in "Transport and the Environment"; establishment of a specialist area accordingly. From 1978 to the present, Chairman of the IFEU association as well as General Manager and associate of the IFEU gGmbH. Member of international ("European Energy and Transport Forum" at the EU Commission, DG TREN; deputy member) and national bodies (e.g. Baden-Württemberg Sustainability Board).



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Studies in Environmental Protection Technology, specialising in transport at the University of Stuttgart, scientific researcher at the IFEU-Institut since 2003, working areas: ecological comparisons of transport modes, emission and transport modelling, measure-taking policy.



Projekt Manager
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Dipl.-Ökonom
born 1964

Studies at the University of Marburg and the Carl von Ossietzky-University of Oldenburg, scientific researcher at the University of Bremen (Institute for European Economy and Economic Policy), later at a post at Arbeitsstelle DIALOG, Knowledge and Technology Transfer Agency for Oldenburg University and Polytechnic. Project Leader of the Pro-Rail Alliance Comparison of Environmental Performance of Rail Transport.

“Even if the railways are the most environmentally friendly mode of transport, there is potential for improvement. And each improvement, each reduction of noise and toxic emission is good for residents, passengers, employees and the environment. It is a myth that environmental protection in itself is too expensive. Each and every measure has to be checked. Some really are expensive, other are either affordable, cost-neutral or even cost-saving, because fewer resources will be used and risks will be avoided.

The Pro-Rail Alliance wants to present examples and exemplary measures with the project “First Comparison of Environmental Performance of Rail Transport“ and the documentation available, to incite imitation and demonstrate options. We thank all participants, and those who were involved and supported the project for their dedication.”

The association members of the Pro-Rail Alliance



The Pro-Rail Alliance e. V.

An alliance with the aim of bringing more transport onto the railway tracks. The Pro-Rail Alliance is dedicated to forward-looking transport policies, which reinforce rail transport as the safest and most environmentally friendly mode of transport.

The pool of 15 non-profit organisations, including environmental organisations, transport clubs, passenger organisations, trade unions and professional associations, represents over 1.5 million individual members. The rail alliance is supported by 58 companies from rail-related sectors.

The association members of the Pro-Rail Alliance

Chairman: Norbert Hansen, TRANSNET trade union

- ACE – Auto Club Europa e. V.
- ACV – Automobil - Club Verkehr Bundesrepublik Deutschland
- BDEF – Bundesverband Deutscher Eisenbahnfreunde e. V.
- BF BAHNEN – Bundesverband Führungskräfte Deutscher Bahnen e. V.
- BUND – Bund für Umwelt und Naturschutz Deutschland e. V.
- GDBA – Verkehrsgewerkschaft
- GDL – Gewerkschaft Deutscher Lokomotivführer
- LBU – Landesverband Bürgerinitiativen Umweltschutz Niedersachsen e. V.
- NABU – Naturschutzbund Deutschland e. V.
- NaturFreunde Deutschlands e. V.
- Pro Bahn e. V.
- TRANSNET – Gewerkschaft
- VBB – Vereinigung für Bildung bei den Bahnen e. V.
- VCD – Verkehrsclub Deutschland e. V.
- VDEI – Verband Deutscher Eisenbahn-Ingenieure e. V.
- econex verkehrsconsult gmbh
- Erfurter Industriebahn GmbH
- EVS EUREGIO Verkehrsschienenennetz GmbH
- Franz Kassecker GmbH
- GSG Knappe Gleissanierungs GmbH
- Gutehoffnungshütte Radsatz GmbH
- H.F. Wiebe GmbH & Co. KG
- HERMANN KIRCHNER Bauunternehmung GmbH
- Hessische Landesbahn GmbH
- HGK Häfen und Güterverkehr Köln AG
- Innovationszentrum Bahntechnik Europa e. V.
- Knorr Bremse Systeme für Schienenfahrzeuge GmbH
- Leonhard Moll Betonwerke GmbH & Co. KG
- LEONHARD WEISS GmbH & Co. KG
- LNVG Landesnahverkehrsgesellschaft Niedersachsen mbH
- Martin Rose GmbH & Co. KG
- metronom Eisenbahngesellschaft mbH
- msNeumann Elektronik GmbH
- Neun Consulting Group
- On Rail Gesellschaft für Eisenbahnausrüstung und Zubehör mbH
- Radsatzfabrik Ilseburg GmbH
- REGIOBAHN GmbH
- RSE Rhein-Sieg-Eisenbahn GmbH
- Rurtalbahn GmbH
- Schwebbau GmbH & Co. KG
- Sersa GmbH
- Siemens AG Transportation Systems
- Spitzke AG Infrastrukturunternehmen für Schienensysteme
- Stadler Pankow GmbH
- Thalys International SCRL
- ThyssenKrupp GfT Gleistechnik GmbH
- Tiefenbach GmbH
- TSTG Schienen Technik GmbH
- UNION Deutscher Bahnhofsbetriebe
- VDV Verband Deutscher Verkehrsunternehmen e. V.
- Verband der Sparda-Banken e. V.
- Verband Deutscher Eisenbahnfachschulen e. V.
- Verkehrsbetriebe Peine-Salzgitter GmbH
- Voith Turbo GmbH & Co. KG
- Vossloh AG
- ABB AG
- Actima AG transport & telecommunication consultants
- AKN Eisenbahn AG
- Alcatel SEL AG – Transport Automation Systems
- Alstom LHB GmbH
- Arriva Deutschland GmbH
- BahSIG Bahn-Signalbau GmbH
- Bilfinger Berger AG
- Balfour Beatty Rail GmbH
- Bombardier Transportation GmbH
- BSR – Bodensanierung und Recycling GmbH
- BUG Verkehrsbau AG
- Bureau Veritas Rail GmbH
- BWG Gesellschaft mbH & Co. KG
- Connex Cargo Logistics GmbH
- Connex Verkehr GmbH
- Deutsche Bahn AG
- DEVK Versicherungen Sach- und HUK- Versicherungsverein a. G.

In addition to this brochure the following documents are also available for download (PDF) on our website "www.allianz-pro-schiene.de". Click on "Umweltvergleich" ("Comparison of Environmental Performance") to be taken to the appropriate page.

- Analysis brochure, German version, as PDF
- Compilation of other individual measures and projects for environmental measures in the rail sector
- Overview of noise standards in the railway sector
- Overview of exhaust emission standards for railway vehicles with combustion engines
- Competition documentation (questionnaire) of the First Comparison of Environmental Performance of Rail Transport (2004)
- Event references to workshops that form part of the project.

Please let us know your email address if you would like to be informed on a regular basis about the work of the Pro-Rail Alliance, about current events as part of the "Comparison of Environmental Performance of Rail Transport" project or about new documents on our website.

A printed German version is also available and can be ordered from the Pro-Rail Alliance.