INTERNATIONAL UNION
OF RAILWAYS

Railway Noise in Europe

A 2010 report on the state of the art

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1. SUMMARY

Railways are a sustainable and climate friendly means of transport. Nonetheless, railways do influence the environment. The most important effect is noise, especially the noise emitted from freight trains. In comparison to road traffic, railway noise is less of a problem. Also, the relevance of railway noise varies from one geographic region to another. It is greatest in Western Europe and along the main freight corridors.

European Union policy supports noise reduction and has addressed the issue in interoperability directives and corresponding technical specifications. The Environmental Noise Directive (END) requires member states to submit noise maps and action plans. The EU is mostly responsible for noise creation aspects, while member states may additionally enact specific legislation for noise reception. In these cases, noise reception values usually concern only new and upgraded lines; however some countries such as Italy or Switzerland also have noise reception limits for existing lines.

The railways have a long history of noise control. Numerous projects have developed and analysed different abatement possibilities. The noise control measures most often implemented are noise barriers or insulated windows. The largest potential, however, lies in silent vehicles. Technical Specifications for Interoperability (TSIs) therefore require new rolling stock to be silent. The existing freight fleet can also be made silent by removing cast-iron brake blocks and retrofitting the wagons with composite brake blocks. There are two types of composite brake block: the K-block is available, though a more expensive solution than the LL-block which has not yet been homologated due to technical difficulties. Finally, in specific cases, special solutions such as track and wheel absorbers or acoustic rail grinding are possible.

In order to encourage retrofitting the European Union is considering noise differentiated track access charges as an incentive. This approach is supported by the governments of some member states. Since the railway business is complicated and many different players are involved, it is unclear if this incentive will have an effect. The railway sector therefore proposes either direct subsidies as an alternative, or that wagon owners can claim a mileage-based bonus instead of the operators. Several individual countries are also studying or implementing different means of promoting retrofitting. The Netherlands have introduced noise differentiated track access charges. Switzerland directly subsidises the retrofitting of the freight fleet in addition to using noise differentiated track access charges.

Many activities promoting silent railways are currently ongoing. The immediate challenges are to complete the homologation (certification of a product or specification to indicate that it meets regulatory standards) of the LL-brake block, to find suitable incentive schemes as well as appropriate funding for these without harming the railway sector as a whole.

2. INTRODUCTION

Railways are a sustainable and climate friendly means of transport:

The risk of climate change and other environmental aspects are becoming topics of ever increasing importance. Railways are the most environmentally-friendly mode of transport both for freight and passenger traffic. It is therefore necessary to promote the development of rail traffic, as recognised by EU policy as well as many national governments.

Noise is the major environmental issue of the railways:

The most significant environmental effect of the railways is noise, mostly caused by freight wagons with cast-iron brake blocks. These brake blocks roughen the wheel surface, causing the wheel to vibrate and thus emit noise. Furthermore, poor track maintenance can cause rough rails, further increasing noise levels. Railway lines often pass through densely populated areas, especially in central and western parts of Europe. The problem is compounded by the fact that freight trains in particular are mostly operated at night.

The railways have a long history of noise reduction:

The rail sector acknowledges noise as a problem and has put much effort into understanding noise creation and propagation and into finding solutions to the problem. As a consequence, significant progress has been made in noise abatement over the past 50 years. The systematic study and research of the issue has led to the introduction of disc-braked passenger vehicles, new freight wagons with K-blocks, or the construction of noise barriers along major lines. Not all issues have been solved yet, mainly because of remaining freight wagons with cast-iron brake blocks, their low renewal rate, plus the ever increasing levels of traffic and speed. Some specific questions such as curve squeal, stand-by noise or noise from steel bridges also require further study. Several technical possibilities, which will be discussed in this report, may alleviate these issues. The main focus of the railway sector lies with the retrofitting of the freight rolling stock from cast-iron brake blocks to composite brake blocks. The main challenges in this endeavour are solving technical difficulties and finding appropriate incentives.

Effects on traffic modes must be considered:

Since the railways are a sustainable and climate friendly means of transport, it is important that noise control measures do not change the modal split of transport to favour other modes, thus also increasing the noise emissions of other modes. This risk must be considered, since the railways operate in a very competitive market. It is therefore in the interest of society as a whole to finance railway noise control from outside the system.

Time to bring things together:

The large interest in the topic and the recognition of its importance have led many players into the field. It is generally acknowledged that retrofitting the freight fleet is the best path towards silent railways. Incentives must therefore be put in place to promote silent vehicles and further technical developments must be supported in this area. These efforts must now be coordinated as much as possible. This report is part of this effort and summarises the developments in Europe with the idea of promoting compromises that lead to viable solutions. The report considers only EU countries as well as Switzerland and Norway. Vibrations and ground borne noise are not addressed. Finally, this report summarises and continues a series of previous reports published by UIC[1].

1 CER and UIC: Noise Reduction on the European rail infrastructure, a 2007 state of the art report, May 2007

CER and UIC: Noise Reduction in Rail Freight, a 2007 report on the state of the art, March 2008

UIC: Status report and background information on noise related track access charges (2007)

3. NOISE SITUATION

3.1 The big picture

Noise is a side effect of all major modes of transport. When comparing the two main modes of land transport – railway and road traffic – we can note the following:

- Railway noise less annoying than road noise: Most studies indicate that people consider railway noise to be less annoying than road traffic for the same noise levels. This has led to the introduction of a “noise bonus” in the legal calculation schemes in many countries. This noise bonus is under discussion in some countries because the frequency of train pass-bys means that railway noise disturbance may reach levels similar to those of road traffic noise.
- Railway noise restricted to narrow corridors: Railway noise is limited to areas around railway lines. In comparison, roads cover all areas (compare Figure 3.1).
- Railways produce less noise per journey than road: Comparisons of modal split versus noise show that railway noise affects significantly fewer people per transported person or tonne carried[2].

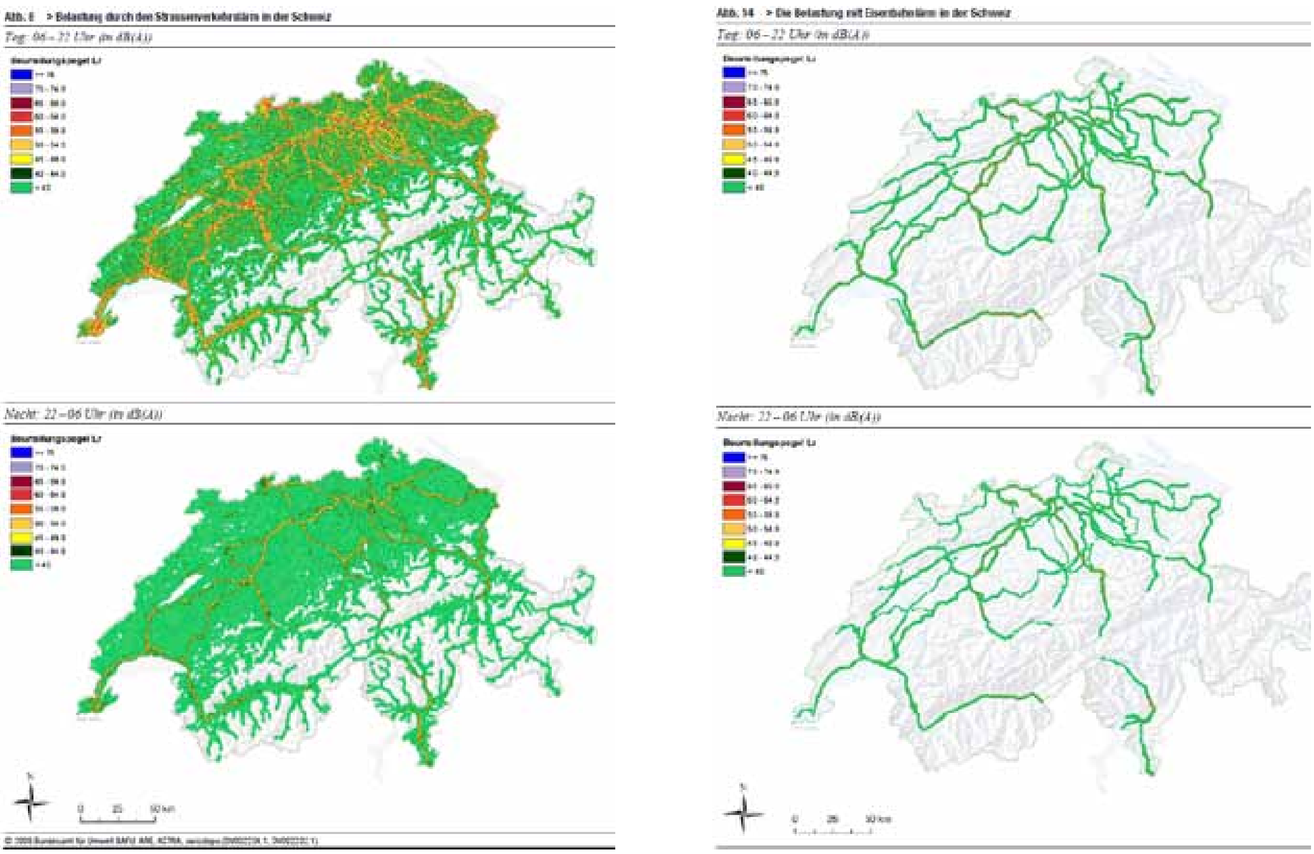


Figure 3.1: Road noise (right) and railway noise (left) distribution in Switzerland. Despite the fact that Switzerland has one of the highest densities of railway traffic, road noise covers a much larger area[3].

2 In the EU 44 % of persons are exposed to noise levels above 55 dBA from road traffic while 7 % of the population are affected by the same levels of railway noise. The corresponding modal split in the EU is 73 % versus 17% for freight traffic. The ratio for noise traffic is 60 % while for railway noise it is only 41 %. Compare Eurostat 35/2008.

3 Source: Noise Pollution in Switzerland, Swiss Federal Office of the Environment, 2009

Environmental Noise Directive (END) mapping gives picture of overall noise situation:

The END noise mapping results are available on the European Environment Agency's website[4]. Figure 3.1 summarises the results. The graph shows that road noise is much more significant than rail noise. Also, for both modes of transport, more people are affected by noise during the day than at night. Nonetheless, noise is still a problem for both modes during the night.

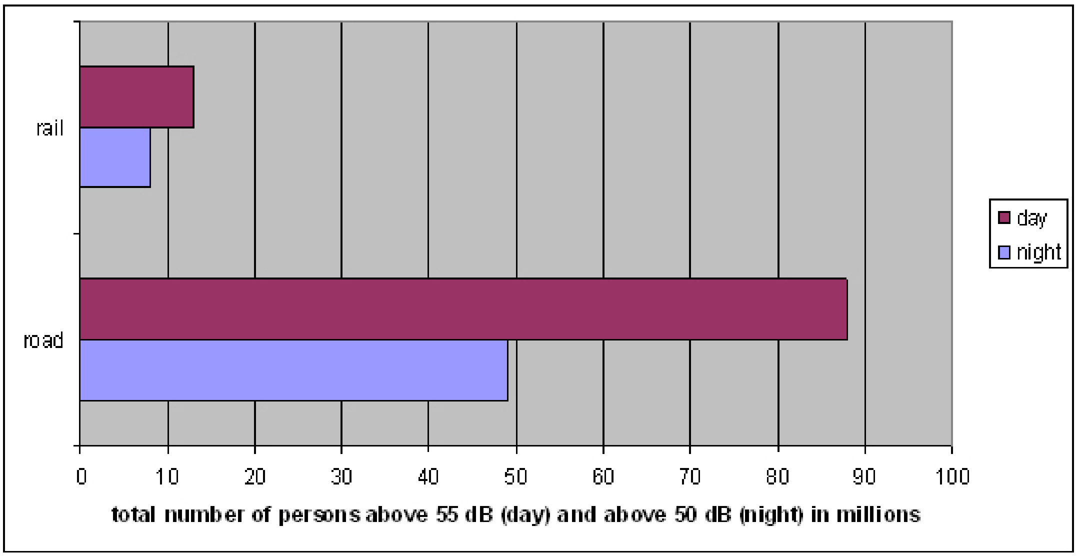


Figure 3.1: Number of persons affected by rail and road traffic.

3.2 Regional picture

The railway noise picture varies in the different European regions:

Western Europe including Italy:

Because of the high population density and the volume of transit traffic, railway noise is an important issue in these areas. Extreme levels are reached next to north-south corridors such as Rotterdam-Genoa, or along alpine crossings. In many countries the lineside inhabitants are no longer willing to accept the current noise situation, especially the noise resulting from freight traffic. As a consequence there is strong pressure on authorities at all levels to either guarantee a decrease in railway noise or to decree operational restrictions such as limits in speed, operational times or train cadences. Much of the traffic in this area is international, therefore common solutions concerning rolling stock must be considered throughout the region.

Central Europe:

This area is also characterised by significant rail freight transport. The rail freight market share is much higher in this area than in EU-15 (25 % compared to 15 % on average). A potential retrofit of the freight rolling stock is complicated by the fact that many freight vehicles have tyred wheels which prevent composite brake blocks being fitted due to overheating of the wheels. East-west railway traffic is also expected to increase in the future in parallel to the economic development of these areas.

Northern Countries:

Freight noise is less of a problem in northern Europe. Denmark and Norway have little freight traffic and a large part of Swedish freight traffic passes through areas with very low population densities. Also, railway noise abatement programmes are well advanced so there is less focus on railway noise in comparison to Western Europe.

North-eastern Europe:

Finland as well as Estonia, Latvia and Lithuania have a wide gauge (1524 mm) railway network that is linked with Russia. Solutions for these areas must therefore include Russia which is outside the scope of this report. Also, population densities are comparatively low, so railway noise is perceived as a smaller problem than in Western Europe.

United Kingdom:

Railways in Britain operate under special technical specification because until the opening of the Channel Tunnel, no direct links to the continent were available. As a result, much of the freight traffic in Britain is already silent using either composite brake blocks or disc brakes, which does not comply with the specifications in the rest of Europe. As a result, railway noise is not as big an issue as in the rest of Europe.

4 http://noise.eionet.europa.eu

Spain and Portugal:

Spain and Portugal both have a wide gauge (1668 mm; with the exception of the high-speed network), so they are not affected by cross border traffic from the rest of Europe. This result is that no freight wagons from other parts of Europe circulate in these countries – nor do wagons from these countries circulate elsewhere in Europe. Spain and Portugal can therefore choose a braking system without European homologation. This has led to the widespread introduction of composite brake blocks which do not comply with the requirements necessary for the rest of Europe. The main reason for fitting composite brake blocks was to prevent sparks igniting fires, but they have proven to be economically viable as well.

Other areas:

Other areas of the EU such as Greece, Cyprus or Malta either have little rail freight activity or no railways at all and are therefore not considered in this report.

4. POLICY AND LEGISLATION

General principle of noise legislation:

Noise creation is legislated at European level, while noise reception is submitted to subsidiary principles and legislated at national level. Under the Environmental Noise Directive (END) the European Commission (EC) seeks to get an overview on the existing noise situation (noise mapping) as well as the possible noise reduction within its member states (action planning).

4.1 European Policy

European policy supports noise reduction:

Minimising environmental damage is high on the European Commission's political agenda. As many environmental threats are linked to traffic emissions, environmental policy is linked with traffic policy. A recent activity in this field is the Greening Transport Package published in July 2008. It consists of five elements:

- Greening Transport Communication: The communication summarises the entire package and describes the new initiatives the Commission intends to launch.
- Greening Transport Inventory: This inventory describes the EU action already taken to promote green transport which forms the basis of the package.
- Strategy to internalise the external costs of transport: The focus of the strategy is ensuring that transport prices better reflect their real cost to society so that environmental damage and congestion can be reduced while promoting the efficiency of transport and ultimately the economy as a whole.
- Proposal for a directive on road tolls for trucks: This proposal enables member states to reduce environmental damage and congestion through more efficient and greener road tolls for trucks. Revenue from the tolls would be used to reduce the environmental impact and cut congestion.
- Rail Transport and Interoperability Communication: This communication describes how the perceived noise from existing rail freight trains can be reduced by 50% and the necessary future measures the Commission and other stakeholders must take to achieve this aim. This communication focuses on the retrofitting of the existing freight wagons using synthetic brake shoes and proposes several instruments to provide incentives to promote this process.

More details on the European policy are given in chapter 7.

4.2 European noise legislation

Elements of legislation:

European legislation on railways and noise is usually addressed in interoperability directives and further specified in TSI (Technical Specifications for Interoperability) under the responsibility of DG MOVE (Directorate-General for Mobility and Transport) or specific directives such as the Environmental Noise Directive under the responsibility of DG ENV (Directorate-General Environment).

5 http://ec.europa.eu/transport/strategies/2008_greening_transport_en.htm

Relevant interoperability directives in terms of noise are:

Type of traffic	Relevant EU directive	Corresponding TSIs
High speed traffic	Interoperability of the trans-European high-speed rail system, Directive 96/48/EC	• Technical Specification for Interoperability (TSI) relating to high-speed rolling stock – Commission Decision 2002/735/EC and • Technical Specification for Interoperability (TSI) relating to high-speed railway infrastructures – Commission Decision 2002/732/EC
Conventional speed traffic	For conventional speeds: Interoperability of the conventional Trans-European rail system - Directive 2001/16/EC	• Commission Decision 2004/446/EC of 29 April 2004 specifying the basic parameters of the 'Noise', 'Freight Wagons' and 'Telematic Applications for Freight' Technical Specifications for Interoperability referred to in Directive 2001/16/EC (OJ L 193 p. 1) • Directive 2004/50/EC of 29 April 2004 amending Council Directive 96/48/EC and Directive 2001/16/EC (OJ L 164, 30.4.2004) • Commission Decision 2006/66/EC adopted on 23 December 2005 concerning the Technical Specification for Interoperability relating to the subsystem «rolling stock - noise»

The TSI for railway noise

In the Technical Specifications for Interoperability (TSI) the EU enacts noise creation limits for railway vehicles, both for new rolling stock as well as for renewed or upgraded rolling stock. Different values are defined for the various types of rolling stock (i.e. freight wagons, locomotives, multiple units, coaches) as well as for different operating situations (i.e. pass-by, stationary, starting and interior noise). For conventional railways the limit values for pass-by noise came into force in June 2006. This TSI includes noise emission limits for wagons with retrofitted braking systems. In 2002 a TSI for high speed trains came into force, which also includes noise regulations. A smaller revision, mostly concerning measurement conditions, was concluded in 2010. A major revision will take place 2011/12. The most relevant examples for limits values in the TSI are:

Wagon Type	Limit value
New freight wagons pass-by noise at 80 km/h	82 – 85 dB(A) depending on number of axles per length
Renewed freight wagons pass-by noise at 80 km/h	84 – 87 dB(A) depending on number of axles per length
Passenger coaches pass-by noise at 80 km/h	80 dB(A)
Locomotive pass-by noise at 80 km/h	85 dB(A)
Stationary noise of locomotives	75 dB(A)
Stationary noise of Electric Multiple Units (EMU)	68 dB(A)
Stationary noise of Diesel Multiple Units (DMU)	73 dB(A)
Stationary noise for high speed trains	< 65 dB(A) continuously or < 70 dB(A) intermittently
Noise levels in high speed service	< 87 dB(A) at 250 km/h, < 91 dB(A) at 300 km/h and < 92 dB(A) at 320 km/h at 25 m and a height of 3.5 m

Environmental Noise Directive:

The main aim of Directive 2002/49/EC of 25 June 2002 is to provide a detailed picture of the extent of the noise problem as a basis for tackling the noise problem across the EU. The underlying principles are similar to those for other environmental policy directives:

- Monitoring the environmental problem, by requiring competent authorities in member states to draw up "strategic noise" maps for major roads, railways, airports and agglomerations, using harmonised noise indicators L_{den} (day-evening-night equivalent level) and L_{night} (night equivalent level). These maps will be used to assess the number of people exposed to different noise levels throughout Europe.
- Informing and consulting the public about noise exposure, its effects, and the measures considered to address noise, in line with the principles of the Aarhus Convention[6].
- Addressing local noise issues by requiring competent authorities to draw up action plans to reduce noise where necessary and maintain environmental noise quality where it is acceptable. The directive does not set any limit value, nor does it prescribe the measures to be used in the action plans, which remain at the discretion of the competent authorities in member states or regions.
- Developing a long-term EU strategy, which includes objectives to reduce the number of people affected by noise in the longer term, and provides a framework for developing existing community policy on noise reduction from source. The results of the mapping and action planning may result in further steps including noise reception limits.

4.3 European policy instruments and incentives concerning noise abatement

Several instruments and incentive systems are available to the EU for enforcing and supporting railway noise reduction which could be part of existing or additional directives and TSIs. Ideas are differential track access charges, noise ceilings or restrictions on the use of cast-iron brake blocks. These instruments and incentives are discussed in Chapter 7 of this report.

6 The Aarhus Convention grants the public rights regarding access to information, public participation and access to justice, in governmental decision-making processes on matters concerning the local, national and transboundary environment.

4.4 National legislation

General principle – noise reception values for new and upgraded lines: At national level, all European countries have noise reception limit values for new railway lines, and in almost all countries limit values are also in force for upgraded railway lines. Most countries also include a noise bonus in their calculation schemes or threshold values, thus including the basic observation that railway noise is less annoying than road noise. It is therefore state-of-the-art procedure to include noise protection measures (mostly noise barriers) in projects for new or upgraded lines. In some countries there are additional elements to the legislation, of which a few examples are given here:

- Noise reception values for existing lines: Some countries, notably Italy, Switzerland and Norway, also have noise reception values for existing lines.
- Reception limits for additional areas: Usually noise legislation affects noise levels outside of windows. Some countries such as Norway also have thresholds for indoor noise or for gardens.
- Legislation providing for financing or incentives: In some countries legislation includes financing or incentive schemes. For example Dutch legislation includes noise differentiated track access charges as an incentive. In Switzerland the financing of the noise abatement programme is regulated as part of a package to promote public transport and is largely financed by taxes on the road sector. In addition, Switzerland has noise differentiated track access charges. In Italy, noise abatement is financed by a fixed percentage of the infrastructure budget.
- Noise abatement not stipulated by legislation: Many countries such as Germany, France, Austria, Denmark or Sweden spend considerable amounts on providing noise abatement for existing lines even though there are no specific legal requirements. In some cases, i.e. Denmark, the noise abatement of existing lines is regulated in voluntary agreements.
- Other legal pathways towards noise abatement: In Sweden noise abatement measures for existing lines are based on parliamentary decisions. There are also limit values for existing lines based on court decisions.
- Specifications for rolling stock: The TSIs (see box) regulate the noise emitted from rolling stock. A few countries have additional national regulations.

5. NOISE REDUCTION TECHNOLOGY

5.1 Noise control possibilities

Different possibilities exist for controlling railway noise:

Traffic noise, including railway noise, can be controlled at several different locations:

- At the source: Rolling noise is caused by small irregularities on both the wheel and the track in the contact area between the two. Noise reduction at the source can be achieved by either reducing this roughness and/or by preventing its growth. This is usually attained by either improving the contact surface between the wheel and rail.
- Between the source and neighbouring buildings: A further possibility to reduce noise is by preventing its propagation. Noise barriers are the most common method of noise abatement in this case.
- Near the neighbouring buildings: Finally, noise can be reduced in the immediate vicinity of the inhabitant, i.e. on the buildings itself. This is usually done with insulated windows or with façade insulation.

Railways have a long history of noise control:

In numerous projects the railway sector has studied the possibilities and effects of different noise control possibilities. The UIC has overseen and coordinated many of these activities with its various expert groups. Some of the major international projects are summarised in Table 5.1.1.

Project[7]	Timeframe (years)	Participation	Content	Results
Selection of European projects (UIC, ERRI[8], EU)				
TWINS (Track-Wheel Interaction Noise Software)	Basic components since 1992, continuous improvements	ERRI and others	Models for silent freight and silent track	Basic models available, continuous validation and improvement with additional elements
Optimised Freight Wheel and Track (OFWHAT)	1992 – 1994	ERRI	Tests on test track in Velim with test train	The largest reduction was obtained with wheels with absorbers on optimised track with absorbers
Eurosabot (Sound Attenuation by Optimised Tread Brakes)	1996 – 1999	Consortium of railways, industry and ERRI	Theoretical models for the wheel roughness generation process	Basic knowledge on brake block and wheel interaction, however failed to find LL-block
Silent Freight	1996 – 1999	EU, Industry, railways, research	Tests on possibilities to reduce noise from wheels	Development of an optimised wheel shape, tuned absorbers inside wheel, ring dampers, perforated wheels and bogie shrouds
Silent Track	1996 – 1999	EU, Industry, railways, research	Optimised rail pad Rail damper Modified rail cross-section Low barriers	Low barriers in isolation with little effect, requires combination with bogie shrouds, has little effect
UIC Cost Benefit Study	1998 – 1999	ERRI	Cost benefit analysis of different measures along two freight corridors	Retrofitting the freight fleet with composite brake blocks has the best cost-benefit ratio

7 Where not otherwise noted, this table is based on: Thompson, David, 2009, Railway Noise and Vibration, Mechanisms, Modelling and Means of Control, Elsevier

8 ERRI: European Rail Research Institute (no longer in operation)

STAIRRS[9] (Strategies and Tools to Assess and Implement Noise Reducing Measures for Railway Systems)	2000 – 2002	EU, UIC, CH	WP1: Decision support tool for cost and benefits of different noise abatement measures WP2: Separation tool for wheel and track noise WP3: Consensus building workshops	WP1: Retrofitting existing rolling stock has highest cost benefit ratio, noise barriers have poorest cost benefit ratio. WP2: Separation tools WP3: Several consensus building workshops still continued to this date.
ERS (Euro rolling silently)	2002 – 2005	Railway and industrial collaboration	Development of LL-type brake blocks	Pre-homologation of three prototypes
Curve Squeal	2002 – 2005	UIC	Tool box Tests on friction modifiers	Partially modelled in TWINS
Harmonise and Imagine[10]	2001 – 2005 2003 – 2007	EU together with public and private partners	Noise modelling to develop calculation methods for railways	Provides harmonized calculation methods and guidelines, examples and databases to facilitate their use, based on STAIRRS project.
Silence[11]	2005 – 2008	EU together with public and private partners	Implementation of European noise policy objectives	Study of annoyance and noise perception. Development of new technological solutions. Tools for city planners. The VAMPASS tool determines best combinations.
Q-City[12]	2005 – 2009	EU together with public and private partners	Develop integrated technology infrastructure for road and rail noise based on representative cities	Case studies concerning railways are steel bridge noise reduction, rail damping and noise mapping.

Table 5.1.1: Summary of major international railway noise projects

9 http://www.stairrs.org

10 http://www.imagine-project.org

11 http://www.silence-ip.org

12 http://www.qcity.org

Several technical possibilities are available for railway noise control:

The many years of research and engineering have led to a package of solutions. These are summarised in Table 5.1.2. Please note that regular maintenance procedures such as the removal of corrugation of grinding or track renewal are not mentioned. Poor maintenance may lead to noise increases of up to 20 dB. Note also that many additional methods are used for specific situations such as friction modifiers against curve squeal or absorbers against steel bridge noise.

Noise abatement method	Overall noise reduction potential	Noise abatement effect	Comment / status
Retrofitting with K-blocks	8 – 10 dB	Network wide	K-blocks are homologated however require adaptation of the braking system
Retrofitting with LL-brake blocks	8 – 10 dB	Network wide	LL-brake blocks are only provisionally homologated
Wheel absorbers	1 – 3dB	Network wide	Effect strongly dependent on local conditions. Wheel maintenance difficulties may occur
Track absorbers	1 – 3 dB	Local	Track maintenance difficulties may occur, effect strongly dependent on local conditions, not homologated in most countries
Acoustic rail grinding	1 – 3 dB	Local	Effect strongly dependent on local rail roughness conditions, smooth wheels are a precondition for effect
Operational	variable	Local	Negative effect on operations and railway capacity. Method hinders railway traffic and therefore not in line with efforts to promote sustainable transport
Noise barriers	5 – 15 dB	Local	Effect dependent on height and local geography, negative effect on landscape, influence on railway maintenance procedures
Noise insulated windows	10 – 30 dB	Local	Effect is only achieved when windows are closed

Table 5.1.2: Most common railway noise abatement solutions

5.2 Technology and costs of retrofitting with composite brake blocks

Smooth wheels on smooth tracks result in less noise:

Railway rolling noise is the result of roughness on both the wheel and the track in the contact area between the two. Both the wheel and the track vibrate, when the train is in motion, thus creating noise. A significant portion of the noise can be eliminated if the contact area between the wheels and the track is smooth. The use of cast-iron brakes causes rough wheels. On the other hand, wheels remain smooth using composite brake blocks. The choice of brake block therefore has a large effect on rolling noise.

Two types of composite brake block:

Currently two types of composite brake block are being developed and implemented: The K- and the LL-block. K-blocks have a higher coefficient of friction than cast-iron blocks and friction has a different velocity dependency. Because of this they require an adaptation of the braking system. LL-blocks simulate the braking performance of cast-iron brake blocks and therefore only minor adaptations of the braking system are necessary. The reason for the difference in braking performance lies in the variation in the coefficient of friction at different speeds for different brake blocks. Both solutions must safeguard a similar braking performance for the entire train. Currently (mid-2010) two types of K-block are available and the homologation of LL-blocks is in progress.

Cost of retrofitting with composite brake blocks:

Costs are incurred by the retrofitting itself (retrofitting costs) and by additional costs during operation (life cycle costs, LCC). In 2010 it is possible to give cost data based on practical experience for retrofitting and operation of K-blocks. For LL-blocks the retrofitting cost can be derived from the costs of retrofitting with K-blocks, while almost no experience on the operation of LL-blocks is available. The operating costs of LL-blocks are likely to be similar to K-blocks.

Current cost data:

Cost data has been gathered in several studies and by several consultants. Table 5.2 provides a summary of these estimates and investigations.

Year	Source	Retrofitting costs K-blocks (€/wagon)		Retrofitting costs LL-blocks (€/wagon)		Additional LCC using K-blocks (€/wagonkm)	Additional LCC using LL-blocks (€/wagonkm)
		2-axled wagons	4-axled wagons	2-axled wagons	4-axled wagons		
2001	UIC Steering group noise reduction freight	3756 – 5961	5471 – 9981	418 – 2623	836 – 5246		
2004	ERRI report					0.007 – 0.025	Not investigated
2004	AEAT assessment	3812 – 6678	5471 – 11,110	418 – 2623	836 – 5246	Not quantified in €/wkm	Not quantified in €/wkm
2007	PWC DG TREN assessment	7022 (average value used in the study)		1360 (average value used in the study)		0.004	0.0041
2008 / 2009	UIC NRTAC report	3000 – 10'000		1000 – 5000		only dealt in qualitative matter due to lack of data	
2009	KWC DG TREN Study	3000 – 6000	6000 – 10,000	250 – 4800	500 – 6600	0.0053	0.0054
2010	German Rail sector data (Leiser Rhein)	Not investigated	5650 – 7450	Not investigated	1250 – 2280 No ss-wagons	0.020 – 0.026	0.017 – 0.020
2008 / 2010	Whispering Train Programme NL	Not investigated	7110 (30 wagons type Tapps)	0 (costs included in €/wagonkm – no ss wagons)		0.002 – 0.007	0.003 – 0.030

Table 5.2: Summary of known costs to date

Homologation of the LL-brake block

Definition:

Homologation is the certification of a product or specification to indicate that it meets regulatory standards.

Purpose:

The purpose of LL-brake block homologation is to develop and approve a brake block that has similar braking characteristics as the cast-iron brake blocks. This should enable a low cost retrofit because no adaptation of the braking system is required. The brake block must fulfil all safety requirements in mixed train traffic.

Problems:

The currently (2010) developed brake blocks cause excessive wheel wear. In particular the limit value for “equivalent conicity” is reached after low mileage. Equivalent conicity is a measure for the interaction of wheel and rail and must remain under a certain value to achieve a proper running behaviour and to prevent derailment. The increased wheel wear leads to higher life cycle costs that defeat the original purpose of this brake block.

Ongoing work:

The UIC has recognised this problem and the relevant technical committees are working on a solution at three levels:

a) Adapt the contours of the brake blocks so that the shape of the block remains intact for more kilometres thus reducing the life cycle costs.

b) Evaluate the limit value for equivalent conicity. Adaptation and review of higher limits could allow more mileage before expensive re-profiling of the wheels becomes necessary. Safety levels must be safeguarded however.

c) A dedicated test train termed “Europetrain” should reduce the time needed for in service testing and therefore promote LL-block homologation.

Other efforts:

Aside from the UIC, other European and national efforts to homologate and develop the LL-brake block are:

- EU framework programme: The project DECIBELL undertaken by Faively Transport intends to develop a brake block for homologation.
- German projects Leiser Rhein (Silent Rhine) and LäGiV (Lärmarmer Güterverkehr mittels innovativer Verbundstoffsohlen) promote the development and homologation of the LL and K brake shoes.

Current state:

LL-brake block development and homologation is a difficult undertaking. Increased coordination is necessary. At the same time, it is unclear whether the effort will be successful. Therefore a back-up scenario with K-blocks is being envisaged throughout the process.

5.3 Economics of railway noise control

Cost-Benefit Analyses:

Anticipating the need to optimise noise control strategies at European level, both the railways and the EU have undertaken cost-effectiveness analyses. One of the first studies was undertaken by the UIC on two freight corridors. This study was followed by the most comprehensive study to date, the STAIRRS[13] project, co-financed by the EU fifth framework programme and by the UIC. In this project the acoustically relevant geographic, traffic and track data were collected for 11,000 km of lines in seven European countries. Standard cost-benefit methodologies were adapted to fit the requirements of the project. An extrapolation mechanism allowed studies to be made on Europe as a whole and more approximate ones on each individual country or region of interest.

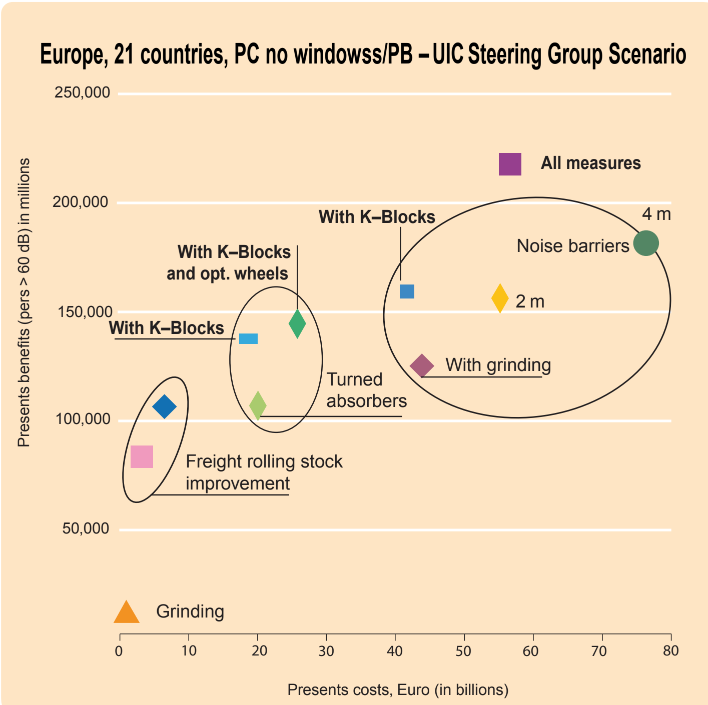


Figure 5.3.1: Main results of the STAIRRS project. The graph shows that solutions using composite brake blocks save considerable amounts of money in comparison to noise abatement with only noise barriers.

Retrofitting has best cost-benefit ratio:

The main conclusions of the STAIRRS project were:

- Retrofitting freight rolling stock has the highest cost-effectiveness both on its own and combined with other measures.
- Noise barriers, in particular high ones, have low cost-effectiveness.
- Combining noise barriers with retrofitting improves overall cost-effectiveness.
- The conclusions for Europe as a whole are also true for individual countries.

In summary, STAIRRS showed that solutions using composite brake blocks save considerable amounts of money (billions of euros in Europe) in comparison to noise abatement with only noise barriers (compare also Figure 5.3.2). These conclusions were supported by studies undertaken in Switzerland, the Netherlands, France and Germany.

13 Strategies and Tools to Assess and Implement noise Reducing measures for Railway Systems

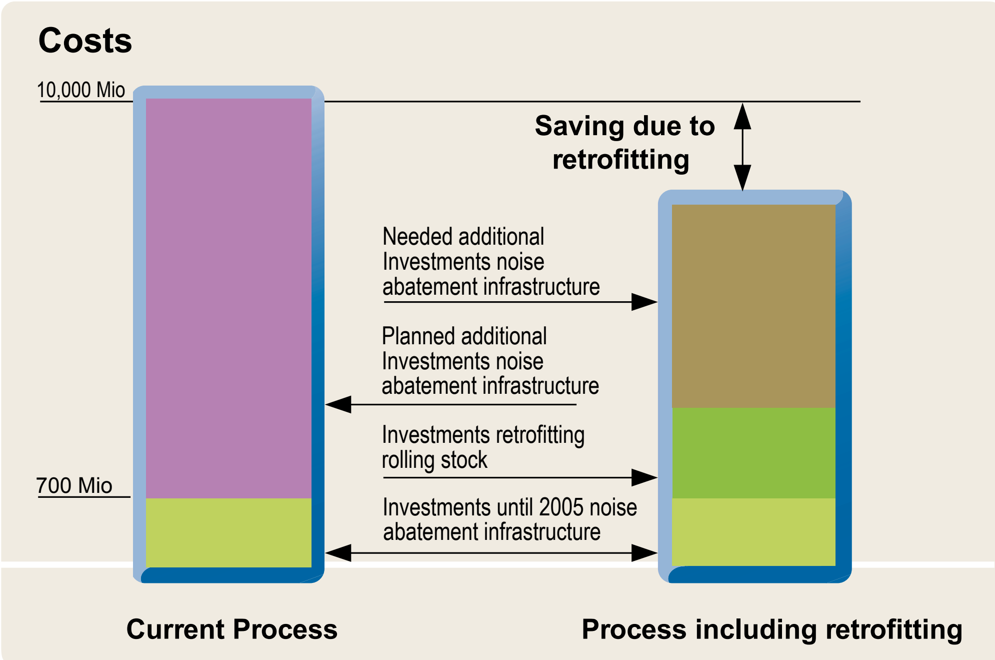


Figure 5.3.2: Potential savings in Europe by retrofitting the freight fleet with composite brake blocks

5.4 Research conclusions concerning railway noise abatement

The years of research in railway noise abatement have led to the following conclusions:

- Smooth wheels on smooth tracks result in less noise: Railway noise is the result of roughness on both the wheel and track in the contact area between the two. Both the wheel and the track vibrate when the train is in motion, thus creating noise. A significant portion of the noise can be eliminated if both the wheels and the track are smooth.
- Smooth wheels can be achieved with the use of composite brake blocks: Both K- and LL-blocks achieve a noise reduction of 8 – 10 dB. Where in use, K-blocks demonstrate a considerable decrease in noise.
- Smooth track mostly a question of maintenance: Smooth tracks can be achieved with proper maintenance and perfected in certain cases with acoustic grinding. Proper maintenance is considered a given for the purposes of this report. Acoustic grinding, while used in certain countries, still has an unclear noise reducing potential because the mechanisms of roughness growth are still largely unknown.
- Noise barriers provide the most used method of noise control in the propagation path. Also, unquestionably, noise barriers are a tested means on noise control and are currently the most used. Correspondingly, if the number of noise barriers could be reduced by noise reduction at the source, considerable savings could be made.
- Other technical possibilities such as track absorbers and wheel absorbers have a potential of 1 to a maximum of 3 dB. There are numerous other technical possibilities to reduce noise; however these usually have a smaller potential than composite brake blocks or noise barriers. It must be noted that as a rule noise reduction is noticed if it is greater than 2 dB.

6. NOISE CONTROL STRATEGY OF THE RAILWAYS

Based on many years of research and experience, the railway sector's noise control strategy is the following. A precondition, of course, is proper maintenance of the track.

Noise control strategy of the railways:

1) Reduce the noise of all new freight vehicles by introducing TSI limit values.

2) Promote the retrofitting of existing freight vehicles with composite brake blocks.

3) Build noise barriers and install noise insulated windows.

4) Pursue further solutions in special cases such as acoustic rail grinding, rail absorbers, wheel absorbers, friction modification against curve squeal and many more. The precondition is regular maintenance.

In the following we describe the current situation and status of these measures in more detail:

1) New vehicles must conform to TSI standards: The TSI noise calls for limit values on new vehicles as well as for high speed trains. For new vehicles this is currently typically done with composite blocks or with disc-brakes. This has led to significantly more silent freight vehicles. In mid-2010, a total of 10,000 new wagons were estimated to be in circulation on the standard gauge network, fitted for the most part with K-blocks. This number is expected to rise steadily in the coming years and, taking a life expectancy of 40 years for freight wagons into account, the entire freight fleet could be silent by about 2030 if no other measures are taken. For passenger traffic the TSI are a state of the art which has resulted in a mostly silent passenger fleet in Europe. The only exceptions are parts of the national traffic of certain countries.

2) Promote the retrofitting of the existing freight fleet with composite brake blocks: Retrofitting the freight fleet with composite brake blocks is a key priority of the railways. The main focus is currently on homologating the LL-brake shoe as well as achieving a suitable incentive scheme. Also, on a limited scale retrofitting with K-blocks is in progress: all in all there are about 10,000 freight wagons in operation which have been retrofitted with K-blocks. With 6,000 wagons, Switzerland has retrofitted the largest number to date. Other countries have retrofitted wagons as well or are planning to do so. Among these are pilot projects in Germany or the retrofit of the RER passenger fleet in the Paris metropolitan area.

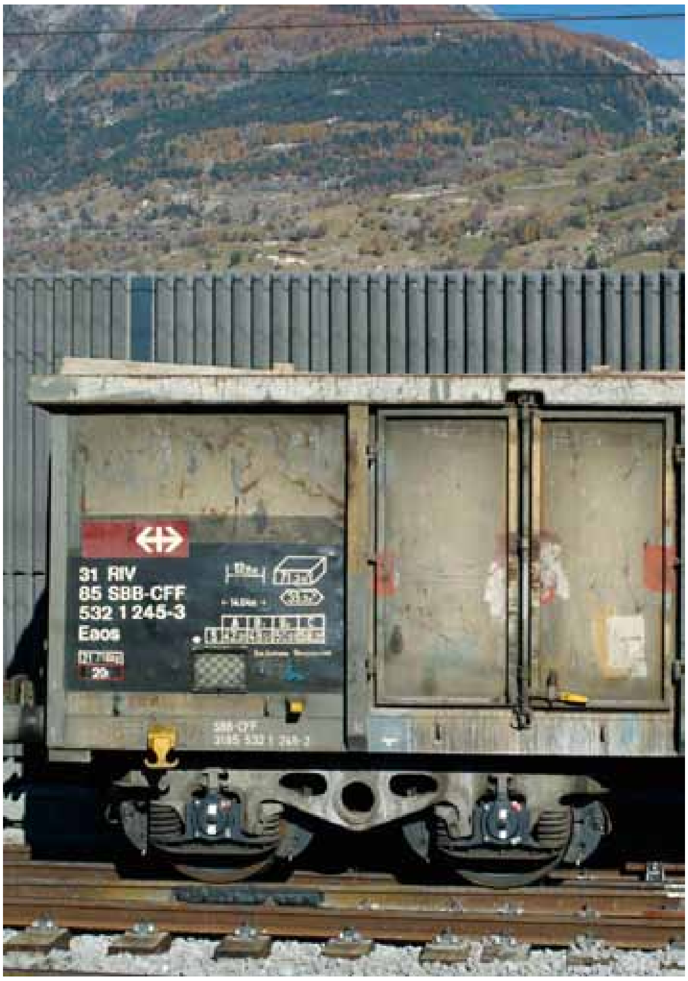


Figure 6.1: Retrofitted freight wagon

3) Construction of noise barriers and insulated windows: The construction of noise barriers has continued in the past years. Several countries have dedicated programmes. Among these are Germany, which spends €100 million each year; Italy, where a fixed amount of the infrastructure budget is reserved for noise barriers; Switzerland, which has a government-funded programme for noise barriers, or the French noise plan which also includes the construction of noise barriers. Individual examples are given in Table 6.1. A survey by the UIC showed that in Europe more than 1,000 km of noise barriers were constructed and additionally about 60,000 buildings were protected with noise insulation by the end of 2005[14]. In total more than one million Europeans have noise protection through windows and a quarter million with insulated windows. An estimated total of € 150 – 200 million is spent annually in Europe on noise barriers and insulated windows. These numbers have increased in the mean time; however no results are currently available for Europe as a whole.

14 CER and UIC: Noise Reduction on the European rail infrastructure, a 2007 state of the art report, May 2007

Country (examples)	Noise barriers (and windows)
Austria	Until 2009 450 km of noise barriers for € 355 million
Czech Republic	Until 2010 about 115 km of noise barriers
Denmark	Until 2009 46 km, windows in 8300 houses, total cost € 65 million until 2019
Finland	Some noise barriers
France	Noise plan, € 193 million for noise barriers and rail dampers
Germany	€ 100 million per year, total cost of 2.3 billion until 2030 includes noise barriers and windows.
Netherlands	€ 430 million for noise barriers, windows and rail dampers.
Sweden	Noise abatement programme including insulated windows and local barriers for a good acoustic indoor environment and noise protected patio area
Switzerland	Until 2009 111 km of noise barriers and windows, until 2015 300 km of noise barriers planned for € 1 billion.

Table 6.1: Examples of noise barrier and other infrastructure measures in various countries

Figure 6.2 Noise barrier

Country	Topic	Description
Netherlands	Shunting yards	Lubrication, removing rail joints, noise barriers and window insulation
	Research projects	Friction modifiers against curve squeal, influencing rail roughness
	Management of noise ceilings	Monitoring noise ceilings and capacity management
Germany	Testing innovative infrastructure measures	Rail dampers, friction modification, low height barriers, absorbers for steel bridges, under sleeper pads
	Work on realistic rail/wheel contact	Improvement of wheel/rail contact, wheel vibrations and acoustic optimisation of pavement
France	Wheel and rail dampers	Combined optimisation of rail and wheel dampers. Homologation of wheel dampers (STARDAMP project)
Denmark	Research and Testing programmes	Optimisation of track construction, acoustic rail grinding, noise partnership with the inhabitants and noise communication management
Switzerland	Additional measures	A cost-benefit analysis should show which additional measures will be taken: rail grinding, stand by noise, rail dampers, steel bridges are among the issues studied.
Sweden	Noise abatement programme and special topics	Acoustic grinding, tests of special measures such as rail absorbers and low height barriers
Norway	Research and tests	Rail grinding planned but not yet implemented, noise from freight terminals, tonal noise from accelerating and decelerating trains

Table 6.2: Examples of further solutions being implemented or studied in various countries

In addition, many railways are studying and implementing solutions to further specific problems such as curve squeal, stand-by noise or the noise of shunting yards. Among the solutions being considered are friction modifiers for curve squeal, external compressors for stand-by noise or special surface coating for the brakes in shunting yards.

7. INCENTIVES AND POLICIES FOR IMPLEMENTING RETROFITTING

Although there is common agreement that retrofitting is the most effective means for noise control, various pathways are being pursued to achieve this goal. This chapter describes the approaches at both European and national level.

7.1 European Commission

Activities commence with Green Paper on noise:

Starting point of the Commission's activities concerning noise reduction was the Green Paper on Future Noise Policy (COM(96) 540) adopted and published by the Commission in November 1996. It was the first step in the development of a noise policy with the aim that no person should be exposed to noise levels which endanger health and quality of life.

EU working group railway noise proposes strategies and priorities:

In 1998 the Commission created an EU noise Expert Network, whose mission was to provide assistance in the development of the European noise policy. Within this framework, a set of working groups comprising representatives of all the interested stakeholders – member states, local authorities, supply industry and NGOs – was also established, and among them a railway noise working group. This WG delivered a position paper in 2004 on strategies and priorities to reduce railway noise. This document localised the retrofitting of existing freight rolling stock and noise limit values for new rolling stock as the most efficient methods to reduce railway noise; the position paper formed the basis for all further developments and initiatives of the European Commission.

Impact assessment analyses possible incentives:

In 2006/7 an impact assessment[15] confirmed that retrofitting the existing railway freight fleets formed an effective and cost-effective measure to reduce railway noise. Analysing the implementation of retrofitting this assessment concluded that combinations of policy instruments are more suitable and effective than single measures. Two combinations of policy options have been assessed in detail regarding their economic, environmental and social impact and compared to the 'no policy change' option:

- «SOV»: Subsidies for retrofitting, Operating restrictions for noisy wagons and Voluntary commitment;
- «DEV»: Differentiated track access charges (financial incentives for silent wagons), Emission ceiling for railway lines and Voluntary commitment.

Both policy options (DEV and SOV) demonstrated their effectiveness in achieving the objective of noise reduction. The study concluded that noise emissions of freight trains could be reduced by almost 50% by 2013/2014 if a new type of low-noise brake blocks – not yet fully available on the market (so-called LL-blocks) – were used. The Commission then decided to give priority to the "DEV" scenario for its further policy[16].

Noise as part of communication in "Greening Transport Package":

In July 2008 the Commission published its "Greening Transport Package", an initiative to drive the market toward sustainability. Part of this package formed the communication[17] on rail noise abatement addressing the existing fleet. Part of this communication also contained more details on the intended implementation of noise related track access charging, as foreseen in the mentioned "DEV" scenario.

Recast of Directive 2001/14/EC provides legislative basis for noise differentiated track access charges:

Basic elements of the noise related track access charging formulated in this communication are that it should form a bonus system and that it should be harmonised Europe-wide. The EU intends to use the recast of Directive 2001/14/EC as a legislative platform for the implementation. The Commission also recommends an early voluntary implementation of noise related track access charging by its member states as well as voluntary commitments of the railway undertakings to forward the bonus received from the infrastructure manager to the wagon owners.

Implementation study of noise differentiated track access charges:

To give additional insight into the process of implementation and harmonisation of noise related track access charges, the Commission launched a study[18] in 2009. This study recommends the implementation of noise differentiated track access charges as a bonus system over a limited period of either 6 or 12 years. The study was presented by the Commission and the consultants to the public and stakeholders at a workshop in spring 2010. During this workshop the railway sector presented its concerns about some results of the study, especially regarding the much too low cost assumptions related to the use of composite brake blocks. These assumptions combined with too high an estimate of the average annual mileage may lead to a differential track access charge which is insufficient for promoting retrofitting.

15 DG TREN's Impact Assessment Study on Rail Noise Abatement Measures Addressing the Existing Fleet, 10 December 2007

16 The railway sector disagrees with the cost basis used in this study and expects the costs for retrofitting to be much higher

17 Communication from the Commission to the European Parliament and the Council – Rail noise abatement measures addressing the existing fleet {SEC(2008) 2203} {SEC(2008) 2204}. /* COM/2008/0432 final */

18 Analyses of preconditions for the implementation and harmonisation of noise-differentiated track access charges, by KCW, Steer Davies Gleave, TU Berlin October 2009

Next steps planned by Commission:

The Commission intends to start a dedicated working group to study the implementation of noise differentiated track access charging by the end of 2010. This group will write the required annexes of Directive D2001/14/EC. The EU expects noise differentiated track access charges to be introduced and retrofitting of the European freight fleet to start by 2013 or 2014.

7.2 Railway sector

Support of noise abatement:

Reduction of rail noise is a common goal of all players in the sector in order to ensure that the environmentally-friendly aspect of the railways is maintained. The sector therefore supports the efforts with strategic studies, technological developments and information including annual workshops. However, the efforts of the sector must remain proportionate among all transport modes. Therefore an impact assessment must be made before decisions are made. Such assessments should include the effects on the modal split. As mentioned previously, the sector regards retrofitting freight wagons as the most effective method to reduce rail freight noise.

Incentives must take railway situation into account:

Due to fierce competition wagon owners do not have sufficient resources to finance the retrofitting of their fleet. Any incentive system should neither weaken the overall market share of the freight sector nor disadvantage any freight market player. Therefore, the level of complexity and administrative costs must be kept at a minimum. A system of “self-declaration” should be implemented rather than costly and sophisticated technical applications for data collection on mileage and routing to enable noise billing.

Incentives proposed by the railway sector:

Because of the complexity of rail freight business processes, direct funding is considered easier, cheaper and quicker to introduce in comparison to noise differentiated track access charges. If NDTAC are implemented, the sector proposes the following system: national authorities should fund the retrofitting of freight wagons by means of a noise reduction bonus. The start of the programme would be when LL-brake blocks are ready for serial production and economically viable and would end when the vast majority of eligible freight wagons are retrofitted after about eight years. The noise reduction bonus would be granted based on the mileage travelled on lines of the respective national networks. The bonus would compensate the investment costs as well as the additional operating, transaction and administrative costs.

7.3 Noise Differentiated Track Access Charges[19]

As seen in the previous chapters, noise differentiated track access charges (NDTAC) are one of the main incentives planned by the EU and by various European countries. Therefore the processes and conditions that must be taken into account when discussing the introduction of NDTAC are summarised here:

Track access charges are imposed on all European rail networks:

The basis for track access charging is EU Directive 2001/14/EC. These charges differ greatly in amount and type between the different rail networks. The charges are imposed for whole trains, not for individual wagons, with the type of vehicle or its equipment being of practically no relevance.

Rail freight traffic is a complex business:

Liberalisation of the railways has led to a multitude of transport undertakings being established in place of the former state railway in practically all countries. This has led to a large variety of parties in clearly defined roles operating the railway transport system. Among these are wagon owners, operators or infrastructure owners. In addition there are logistics companies which offer entire transport chains. When introducing NDTAC an allowance must be made for this complexity.

Existing NRTAC applications are pragmatic:

There are two existing pragmatic implementations of NDTAC (in Switzerland and the Netherlands) as well as some existing pilot applications to monitor existing noise in the Netherlands. In both countries NDTAC were not used by any company as an incentive to retrofit freight vehicles, either due to the bonus being too low or the mileage being too small to be achieved in these two countries (Swiss rolling stock is being retrofitted until 2014 by direct state subsidies). Other tools such as RFID[20]-technology, TAF-TSI[21] regulations, GPS etc. have been shown to be to costly, complicated or not developed enough.

19 Compare UIC: Summary report, documentation on NDTAC, 2010

20 Radio Frequency Identification

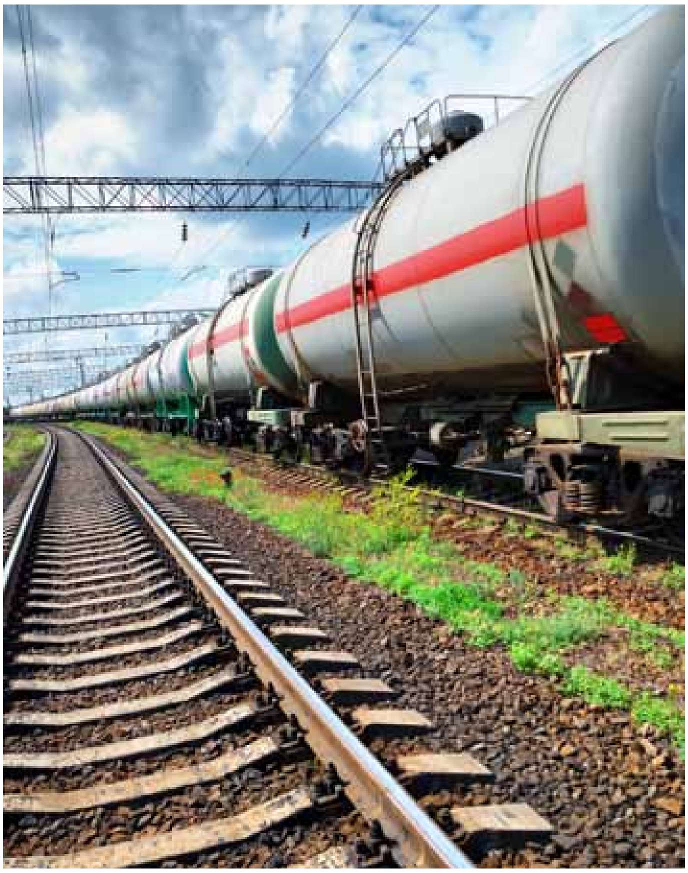
21 TAF: Telematic Applications for Freight

Retrofitting, operational and transaction costs must be considered:

The introduction of NDTAC may prove costly for the railways. Costs are incurred by the installation and maintenance of the recording system chosen, the billing process as well as the retrofitting itself. The magnitude of implementation and transaction costs depends on the chosen solution and ranges from zero (self-declaration) to about € 300 million plus yearly operating costs of at least € 100 million/yr (GPS-Technology). These costs must be placed in relation to the retrofitting costs of about € 650 million. Therefore a system of self-declaration using wagon registers and general contract information is the most efficient system of data collection.

Further remarks:

NDTAC can function as an incentive if the bonus levels and the data collection schemes are harmonised throughout Europe. The availability of the LL-brake block is also a prerequisite, since the bonus levels would be too high and therefore unrealistic to finance a retrofit with K-blocks.



Switzerland: The longest running practical example of noise differentiated track access charges

Background:

In order to support the Swiss noise abatement programme[22] Swiss legislation on railway noise abatement[23] stipulates that all (including foreign) railway vehicles which meet the new noise standards will be accorded preferential treatment when calculating the marginal contribution. Since 2002 the infrastructure manager has awarded a bonus of CHF 0.01 per axle kilometre travelled by vehicles which are not fitted with cast-iron brake blocks. The noise bonus was a political decision taken by the parliament mainly to encourage foreign wagon owners to retrofit their rolling stock. Retrofitting of Swiss rolling stock itself is paid by the government as part of the Swiss noise abatement programme. This rolling stock also benefits from the bonus in the noise differential track access charging because of the higher operational costs.

Implementation:

Practical implementation of the differential track access charging is based on a system of audited self-assessment. The railway undertaking (RU) must submit a detailed application[24] for the noise bonus to the Federal Office of Transport (FOT). Following confirmation of entitlement by the FOT, the RU may submit an application for a refund to the respective infrastructure manager. Although this reduces the income of the infrastructure manager, the taxpayer meets all the costs of infrastructure which are not covered by revenue, including revenue lost because of the noise bonus. Whether and how the RUs have to pass on the bonus to the wagon owners is not specified in the legislation. The sole criterion for the refund is the type of brakes. For example, eight-axle low-platform wagons with disc brakes obtain an attractive refund due to their high number of axles. The refund is less attractive for mixed trains. In Switzerland, the entire process is facilitated because both the RUs and the infrastructure managers use the same software and the same databases for wagon data: the Cargo Information System (CIS).

22 The programme consists in retrofitting all Swiss rolling stock, constructing noise screens according to a cost-benefit ratio and installing noise insulation windows in cases where the other noise reduction means are not successful enough

23 Article 5.2 of the Federal Act on Railway Noise Abatement of 24 March 2000

24 Stating the type of vehicle, actual sound levels and distance travelled (proportion of axle kilometres of that category of train)

7.4 National Initiatives

Most European countries have national incentives and policies to promote implementation of retrofitting. The following describes some of the more prominent examples:

Switzerland:

Perhaps the most advanced railway noise abatement system can be found in Switzerland. All Swiss rolling stock is in the process of being retrofitted with K-blocks. This programme is financed by the government, which in turn receives the funds mostly from road traffic. This noise control policy is part of an effort to promote rail traffic. In addition to the direct subsidy for retrofitting, Switzerland has introduced noise differentiated track access charging (see box).

The Netherlands:

The Netherlands are very active in promoting retrofitting. Some of the activities include:

- Launching of numerous studies and pilot projects to test composite brake blocks. In the “Noise Innovation Programme[25]” several trains (the so-called ”fluistertrein” or whispering train) were retrofitted with LL- and K-blocks. In addition to studying the noise reduction which was found to be between 7 and 10 dB, life cycle costs are being investigated.
- Introduction of noise differentiated track access charging by the Netherlands, based on a specific interpretation of article 11 of EU Directive 2001/14 on performance schemes. Since the use of silent freight vehicles is considered an improvement to the railway network, a bonus can be applied. The bonus is fixed at € 0.04/wagon-km and is applied to both passenger and freight vehicles with a maximum of € 4,800 over two years. The bonus is granted on a system of self-declaration. To date, two passenger operators have claimed the bonus; however freight operators state that the level of the bonus is not high enough to act as an incentive.
- Under the Innovation Programme, RFID (radio frequency identification) was tested to record the number of kilometres run by individual wagons. Pre-existing systems for detecting weight in motion (Quo Vadis) and wheel defect detection (Gotcha) were used. Forty stations were able to record the data of 95 % of all trains. The investments are considerable, however, and costs of € 100,000 per station are mentioned.

Germany:

Although the larger part of the financing for noise control measures consists of infrastructure measures (see chapter 6), due to public pressure along the Rhine corridor, the government has initiated the project “Leiser Rhein“ (Silent Rhine) to reduce noise at the source. This project has three main elements:

- Retrofitting of up to 5000 freight wagons with K- and LL-blocks. The approval of the notification was received from the EU in November 2009. Vehicle detection will occur with RFID (radio frequency identification) and with operational data.
- Definition of a practical approach for the use of LL-blocks. Main issues being studied are limit values for equivalent conicity, inspection intervals and measurement procedures.
- Definition and pre-evaluation of noise differentiated track access charging models with a focus on financing and costs. The subjects considered are the costs for the public and private sector, the efficiency of the measure, the effects on the modal split and compatibility with European efforts as well as a time frame for implementation.

With respect to noise differentiated track access charging, the German rail sector proposes an alternative: that wagon owners can claim the bonus based on the mileage of their wagons and on a system of self-declaration. The sector expects this system to promote a faster retrofitting of the freight fleet.

Czech Republic:

Several trains have been retrofitted with LL-blocks as part of a pilot project. The initial phase of the project is complete and the Czech Transport Office must decide if these wagons are allowed for normal operation within the country.

25 www.innovatieprogrammageluid.nl

7.5 Initiatives by groups of countries

Rotterdam – Genoa project[26]:

In addition to their respective national programmes, the governments of the Netherlands, Germany, Switzerland and Italy commissioned a study to analyse possibilities to promote retrofitting along the Rotterdam-Genoa freight corridor. The study recommends choosing harmonised solutions, incentives that cover entire countries and not only the corridor, benefits that go to newly retrofitted wagons only, a bonus and not a penalty system, an incentive period that ends after a given time and a self-declaration process for claiming the bonus.

26 NEA, Bridge, Burger and Partner, TU Berlin: Study noise on the railway corridor Rotterdam-Genoa

7.6 Funding issues

Prevent modal shift from road to rail:

Every type of incentive requires financial means. Requiring the sector to finance the retrofitting would lead to a modal shift in favour of road transport. Since this is not in the overall interest of the railways, outside financing of retrofitting is required. At the present time, however, it is unclear where this financing will come from.

EU funding proposal:

It is expected that the EU will introduce differentiated track access charges. The costs for the bonus should come from the member states. If and how the members pay for this bonus is unclear. As part of this, the EU will also allow member states to provide state aid in a non-discriminatory way, usually about 50 % of the costs. The Commission, however, is not supportive of this policy instrument.

Savings in infrastructure could be used for retrofitting:

As mentioned earlier in this report, retrofitting the freight fleet saves billions of euros throughout Europe. These potential savings could be used to fund the retrofitting process. This would require a transfer of funds from infrastructure to the wagon owners.

Funding issues must be addressed:

Although ideas for funding possibilities exist, they are still mostly unclear. Since adequate funding is a prerequisite for a successful retrofitting of the freight fleet, this issue must be addressed as a top priority.

8. FINAL REMARKS

Observing the current railway noise abatement situation, we note the following:

- The railway sector's strategy for noise control is well established and acknowledged by the stakeholders: It is recognised by all sectors that retrofitting the freight fleet is the most efficient way to control noise.
- There is a large amount of activity in terms of LL-brake block development and incentives for retrofitting: Several projects are studying the issues surrounding retrofitting, both at European and national level.
- A large number of stakeholders are involved in the process: The railway sector itself is composed of many different players such as infrastructure owners, operators and wagon owners. The government entities concerned are the European Union, individual member states and non-EU members. Additional stakeholders include the various manufacturers of brake block material.

In this process several challenges must be addressed:

- Coordination of noise control activity necessary: Because of the large number of stakeholders and their diverging interests, not much of the activity towards retrofitting is coordinated. This has reduced the efficiency of the process and may lead to situations that are difficult to reconcile.
- Promote LL-block homologation and keep K-blocks as a back-up solution: The technical difficulties surrounding LL-blocks especially concerning equivalent conicity are unsolved and at present it is unclear whether homologation will be successful within the next few years.
- Ensure that planned incentives are sufficient: There is a risk that the incentive systems will not achieve the intended retrofitting because they address operators and not wagon owners. Also, because the cost-basis used for retrofitting is too low, they might not be financially worthwhile. The effect will be accentuated if the LL-blocks cannot be homologated and a retrofitting must be undertaken with K-blocks.
- Choose pragmatic data collection schemes: There is a risk that the incentive systems will require complex data collection which cannot be implemented within a reasonable time. Also, cash-strapped infrastructure owners may not be able to finance the necessary technology.
- Develop financing schemes: All incentives require financial means. In order to prevent a change in modal split to favour road traffic and thus also increase road noise levels, this financing must originate from outside the sector.

Future outlook:

Considerable progress has been made in railway noise reduction technology and incentive schemes to provide for silent freight vehicles. The railway sector is confident that the remaining challenges can be met to achieve quieter railway traffic within the next decade, making railways both a sustainable and quiet means of transportation.

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