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Rail noise abatement measures addressing the existing fleet

Impact Assessment report

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GLOSSARY

Term	Explanation
Decibel	For the measurement of noise, the logarithmic decibel scale (dB) is used. An increase/ decrease of 10 dB is generally perceived as "twice as loud" respectively "half as loud". A person with average hearing would just barely perceive a difference of 3 dB. If two separate sound sources are producing the same noise level then the overall noise level resulting from the addition of these two sources will be 3 dB higher, e.g.: 90 dB + 90 dB = 93 dB. Unfortunately, this has also an effect on noise reduction: A train composed of 10 noise wagons emitting 90 dB and 10 silent wagons emitting 80 dB has an average noise emission of 87.4 dB, just below the threshold of perception of the noise reduction.
K-block	Brake block made of composite materials with different braking characteristics than traditional cast-iron brake blocks. If used for retrofitting existing wagons, a major adaptation of the braking system is required.
LL-block	Brake block made of composite materials with same braking characteristics as traditional cast-iron brake blocks. If used for retrofitting existing wagons, no major adaptation of the braking system is required.
Railway undertaking (RU)	Any public or private undertaking, the activity of which is to provide transport of goods and/or passengers by rail
Infrastructure manager (IM)	Any body or undertaking that is responsible in particular for establishing and maintaining railway infrastructure
Wagon owner (WO)	Any body or undertaking other than a railway undertaking that is technically or financially responsible for wagons
Net Present Value (NPV)	Standard method for the financial appraisal of long-term projects. Each cash inflow/outflow is discounted back to its value on a given date.

ACRONYMS

Acronym	Description
CO_2	Carbon dioxide
dB	Decibel (unit for noise measurements, see glossary)
DEV	Combined Option: differentiated track access charges + noise emission ceiling + voluntary commitment
DEV-79	Combined DEV option, wagons entering service from 1979 eligible for retrofitting
DEV-84	Combined DEV option, wagons entering service from 1984 eligible for retrofitting
EU	European Union
FTE	Full Time Equivalent person
IM	Infrastructure Manager
L_{den}	Day-evening-night noise indicator
MS	Member State
NO_x	Nitrogen oxides
NPV	Net Present Value
PM 10	Particulate matter smaller than 10 micrometres
RU	Railway Undertaking
SOV	Combined Option: subsidies for retrofitting + operating restrictions for noisy wagons + voluntary commitment
SOV-79	Combined SOV option, wagons entering service from 1979 eligible for retrofitting
SOV-84	Combined SOV option, wagons entering service from 1984 eligible for retrofitting
tkm	Tons x kilometre
tr·km	Trains x kilometre
TSI	Technical Specifications for Interoperability
UIC	Union internationale des chemins de fer (International Union of Railways)
WO	Private Wagon Owner

EXECUTIVE SUMMARY

This impact assessment prepares a Communication of the European Commission on rail noise abatement measures addressing the existing fleet. The aim of this policy is to promote retrofitting of freight wagons with low-noise brake blocks by providing financial incentives and/ or setting up legal requirements. Retrofitting has been identified by several studies as well as by an expert group advising the Commission as the most effective and cost-effective measure to reduce rolling noise emissions of freight wagons.

In the course of the analysis it has been 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 impacts and compared to the 'no policy change' option :

(1) "SOV": **S**ubsidies for retrofitting, **O**perating restrictions for noisy wagons and **V**oluntary commitment;

(2) "DEV": **D**ifferentiated track access charges (financial incentives for silent wagons), **E**mission ceiling for railway lines and **V**oluntary commitment.

Both policy options (DEV and SOV) demonstrate their effectiveness in achieving the objective of noise reduction. The noise emissions of freight trains could be reduced by almost 50% until 2013/2014 if a new type of low-noise brake blocks would be used that is yet not fully available on the market (so-called LL-blocks).

For all policy options and scenarios assessed, significant additional costs for retrofitting and maintenance can be expected in the range of 550 million € to 2.25 billion €. However, the results of the cost-benefit analysis show for all policy options considerable net benefits in the range of 2.72 to 9.46 billon €.

Due to lower costs and higher benefits, the use of LL-blocks which do not require the adaptation of the braking system always leads to significantly higher net benefits than the use of so-called K-blocks (the low-noise technology used today to equip new wagons) even if it has been assumed that LL-blocks would only be fully available as from 2011.

As overall result of this impact assessment, policy option DEV consisting of noise-differentiated track access charges with a bonus for silent wagons, noise emission ceiling and voluntary commitments has been identified as the most appropriate solution to achieve the objectives.. The main advantages of this option are the highest benefits in terms of reduction of number of citizens affected by rail noise (with a benefits-costs ratio of up to 10), lower costs than the SOV option, the direct link of this initiative to the policy objectives (to reduce noise by using silent wagons) and its easy application to wagons registered in different Member States or even outside the EU. As this policy option also has certain implementation requirements, solutions need to be elaborated for a harmonisation of differentiated track access charges at European level and for passing the noise bonuses to the wagon owners/ keepers bearing the costs of retrofitting.

Moreover high priority needs to be given to the further development and homologation of LL-blocks as the most economic viable technology for retrofitting. By implementing policy option DEV providing incentives to further reduce costs of retrofitting and following the positive examples of the United Kingdom and Portugal of cost-neutral retrofitting, it should be possible to reduce the additional costs of retrofitting to a minimum.

1. PROCEDURAL ISSUES AND CONSULTATION OF INTERESTED PARTIES

The Communication on rail noise abatement measures addressing the existing fleet has been part of DG TREN's work Programme 2007 as initiative nr. 41.

The impact assessment report has been drafted by DG TREN's Unit for rail transport and interoperability. The impact assessment process was steered by an Inter-Service Steering Group chaired by DG TREN and with members from SG, ENV, JRC, SANCO and ENTR. Furthermore, experts of the Economic Evaluation Unit of the European Railway Agency provided valuable input and advice for the impact assessment study.

Public consultation

In the course of the preparation of a Communication on rail noise which addresses abatement measures for the existing fleet, the Commission presented in its Consultation Paper[1] issued in May 2007 several policy options to the industry, in particular the railway undertakings, to other actors concerned (such as wagon keepers, infrastructure managers, freight shippers and forwarders), to associations representing the rail sector and others concerned (local and regional authorities, and NGOs) as well as to the Member States of the European Union.

Interested parties have been requested to give their opinions on the solutions presented in the Consultation Paper, in particular via the questions it sets. For this purpose, an online questionnaire has been made available during a consultation period of 8 weeks from 4 June until 31 July 2007. The Commission services also convened the interested parties on 23 May 2007 to get feedback. The presentations given at the workshop as well as a summary of the results of the consultation are available on DG TREN's website:
http://ec.europa.eu/transport/rail/environment/noise_en.htm

Therefore, it can be concluded that the Commission's minimum standards have all been met.

In the following, the results of the public consultation are summarised. A more comprehensive description of the results has been published on DG TREN's website[2].

During the consultation period 73 replies have been registered including written contributions. 60% of the replies have been provided by organisations/ companies and 40% by citizens. Among the organisations various types were represented such as associations, public sector bodies, private companies, governments at different levels and consultancy.

The vast majority of participants in the consultation process agreed on the approach of the Consultation Paper to focus on retrofitting of freight wagons and to provide the necessary political and legal framework. Furthermore, due to the expected growth of rail freight transport, short-term action would be urgently required in some European regions, mainly along the main rail freight corridors, where rail noise exposure is very high. In general, a preference for measures or at least harmonisation at European level was given.

The consultation confirmed in principle the initially proposed targets of the Consultation Paper. However, following the majority of the contributors the minimum remaining lifetime

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1 Consultation document of the Commission's services: Rail noise abatement measures addressing the existing fleet. May 2007.
http://ec.europa.eu/transport/rail/consultation/2007_rail_noise/doc/rail_noise_consultation_document_en.pdf

2 Public consultation on "Rail noise abatement measures addressing the existing fleet" - Summary of the contributions received.
http://ec.europa.eu/transport/rail/consultation/2007_rail_noise/doc/rail_noise_consultation_summary_071017.pdf

at the end of the retrofitting programme has been reduced to 5 years to ensure a significant noise reduction in mid-term. Furthermore, the target will be quantified as 97% of the axle-km performed by silent wagons (equivalent to retrofitting wagons with more than 10,000 km/a) as this definition is closer to the noise reduction objective.

Concerning the deadline for the completion of the retrofitting exercise, the majority of the participants preferred the completion of the retrofitting exercise before or by 2014. However, according to information received from various stakeholders, this is technically not feasible (lack of capacity of maintenance workshops and suppliers) or would lead to significant additional costs as the wagons could not be retrofitted within the normal maintenance intervals of about 6 to 8 years. Therefore, 2017 as the initially proposed target date can be regarded as well balanced between the need for immediate action to reduce rail noise and the feasibility/ the economic situation of the sector. As proposed by one contributor the noise mapping exercise in the framework of Directive 2002/49/EC[3] should be used to assess the success of the retrofitting programmes: Against the 2007 maps as baseline, first improvements should be visible by 2012 and for the 2017 exercise; a substantial reduction of rail noise is the objective of this initiative.

The proposed assessment criteria for the policy options have received a positive opinion of the majority of the participants. However, two changes have been made following the consultation results:

- A new assessment criterion "Effectiveness for hot spots" will cover the effectiveness regarding the noise reduction for the population affected and if a policy option allows differentiating regarding location and time of day/night.
- To clarify that potential negative impacts on railways' modal share are covered by "Impact on transport policy", this criterion will be renamed as "Impact on competitiveness of rail freight".

With one exception the policy options proposed by the Consultation Paper have been confirmed and will be further evaluated within the impact assessment. Tradable noise emission permits were refused by a majority of the contributors and have been excluded from the assessment.

It has been widely accepted that an integrated approach would be required as no single measure seems to be able to solve the problems. There was no clear indication about generally favoured policy options. Direct subsidies and differentiated track access charges have been in the focus of the discussion on the workshop, but also the use of legal instruments received a wide support of about 80% of the contributors to the online consultation.

The consultation identified a clear need for complementary measures, mainly research and demonstration projects for LL-blocks, the development of a harmonised classification system for wagons and their noise emission and of automatic wagon identification systems as well as studies on life cycle costs of retrofitting. These aspects are dealt with by the Communication.

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[3] Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise. OJ L 189, 18.7.2002, p. 12-25.

Use of external expertise

After the decision has been taken to carry out an impact assessment for this initiative, a request for services including the terms of reference of the study has been submitted to PriceWaterhouseCoopersAdvisory in the context of the Multiple Framework Contract for ex-ante Evaluation and Impact Assessment (reference TREN/A1/46-2005) on 29 March 2007. The results of this study (hereafter called "PWC study") serve as basis for the impact assessment.

After the signature of the contact on 7 July 2007 the kick-off meeting has been held on 12 July 2007. The interim report has been delivered on 10 September 2007 followed by the final report on 10 December 2007[4].

Recommendations of the Impact Assessment Board

Following the hearing on 20 February the Impact Assessment Board provided its opinion on 22 February 2008 with 4 main recommendations for improvement or clarification:

- The requested summary overview of who bears which costs has been integrated into section 6.
- Possible implementation problems associated with the preferred option have been further elaborated in section 5.7 addressing in particular the transfer of noise bonuses to the wagon owners bearing the retrofitting costs as well as interim actions.
- The explanation of the pre-selection and combination of policy options in section 4.2 has been more detailed by making better use of the assessment described in Annex II.
- The need for action at European level has been further explained in section 2 by better describing potential disadvantages of national measures.

In addition technical comments made prior to the hearing and in the course of the meeting have been considered for the final version of this impact assessment report.

[4] PriceWaterhouseCoopersAdvisory: Impact Assessment study on rail noise abatement measures addressing the existing fleet. Final report December 2007. http://ec.europa.eu/transport/rail/studies/index_en.htm

2. PROBLEM DEFINITION

Problem of railway noise

Noise is one of the most widespread public health threats in industrialized countries. Therefore, the abatement of noise is necessary not only for comfort but also because of other important health effects such as cardiovascular problems and cognitive impairment.

Rail transport is generally considered one of the most environmentally friendly transport modes. However, the contribution of rail transport to noise pollution is significant, though still lower than that of road transport or aviation. According to European Environment Agency figures for 2000[5], about 10% of the population in the EU-15 was exposed to significant noise from rail transport (as compared with a figure of 30% for road transport and 10% for air transport). This seems to be a relatively low figure, but when compared to the modal share of rail and road freight transport (17% for rail and 73% for road of land transport[6]), the specific contribution of rail is significant. More precise figures are an expected outcome of the 2007 noise mapping exercise according to Directive 2002/49/EC. The deadline for the submission of the first sets of strategic noise maps for major railways and large agglomerations was 30 December 2007.

In some European regions (e.g. parts of the Netherlands and the Rhine valley), there is substantial public opposition to rail noise demanding political initiatives to reduce it. If no remedial action is taken, this could lead to restrictions in rail freight traffic along the most important European rail corridors. Such bottlenecks would be likely to have adverse effects on European economies. Furthermore, a possible modal shift from rail to road on these corridors would lead to increasing environmental impacts, in particular greenhouse gas emissions as the specific CO_2-emissions of rail freight are significant lower than those of road haulage.

Freight wagons and their braking technology as most important source of rail noise

According to the Position Paper on the European strategies and priorities for railway noise abatement drafted in 2003 by the Working Group Railway Noise of the European Commission consisting of experts from Member States and the rail sector[7], rolling noise of freight trains has been identified as the most important source of rail noise. The braking technology used nowadays (cast iron brake blocks braking on the wheels' surface) leads to rough wheel surfaces and subsequently to a high level of vibration of rails and wheels. As freight trains often operate at night, their noise emission is even more critical.

Therefore, the Communication and the impact assessment are focussing on this particular problem. However, as a following step, other measures such as requirements for the track quality or measures addressing other sources of rail noise (high speed trains or noise from train horns) will be necessary to further reduce rail noise.

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5 European Environment Agency: TERM 2001. Indicators tracking transport and environment integration in the European Union. Copenhagen, 2001.

6 Of inland modes; DG TREN: Statistical pocketbook 2006, http://ec.europa.eu/dgs/energy_transport/figures/pocketbook/2006_en.htm

7 Working Group Railway Noise of the European Commission: Position Paper on the European strategies and priorities for railway noise abatement, Brussels 2003, http://ec.europa.eu/transport/rail/ws/doc/position-paper.pdf.

Noise barriers as an expensive measure

In response to rail noise problems, infrastructure-related rail noise abatement measures such as noise barriers are introduced at national level. Noise reduction of about 10 dB can be achieved. However, the EU-funded research project STAIRRS identified that noise barriers have very low efficiency due to the investment costs in the order of magnitude of 100 billion Euros if only 5% of the lineside population should have remaining noise above an L_{den} of 60 dB(A))[8].

Therefore, the Working Group Railway Noise recommended giving priority to measures at the source (vehicles and tracks) as they generally are more cost-effective. This would allow achieving a more sustainable situation of smooth running surfaces on the wheels and the rails ("smooth wheels on smooth tracks"). A recent meta-study[9] considering several studies at European and national level confirmed this strategy by demonstrating that measures at the source, e.g. the use of low-noise brake blocks to ensure the smoothness of the wheel surfaces, are significantly more cost-effective than noise barriers.

According to UIC figures[10], a total of 150 - 200 million € is spent annually in Europe on these programmes with cumulative expenditure as of end 2005 of over 600 million €. Considering the current practice and the pressing requirements to draw up action plans according to Directive 2002/49/EC aimed at reducing exposure to railway noise, there is a risk that non-cost-effective noise abatement measures will be implemented for most major railway lines, costing some billions of euros.

Certainly, noise barriers could be an effective element of noise abatement programmes where necessary. If measures at the source complement the barriers, the length and/ or height of barriers can be reduced leading to significant cost savings.

Measures at source taken are not sufficient

In December 2005, the Commission adopted technical specifications for interoperability relating to the subsystem "rolling stock — noise" (Noise TSI). This Decision introduced the first noise limits for rolling stock used in the European Union. These limits apply to new and renewed rolling stock including freight wagons. New freight wagons have to be equipped with low-noise brake blocks reducing the noise emission by about 50%.

However, the introduction of this low-noise technology will take several years due to the long lifetime of rolling stock (see Figure 1). Without additional measures, not before 2020 half of the freight wagon fleet will be more silent.

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8 Working Group Railway Noise of the European Commission: Position Paper on the European strategies and priorities for railway noise abatement, Brussels 2003

9 Oertli; Schwarzenbach: Cost-effectiveness analyses in railway noise. In: Conference Proceedings "International Workshop Railway noise in urban areas". Pisa, November 2006.

10 UIC: Noise Reduction in European Railway Infrastructure. Status Report 2007. http://www.uic.asso.fr/download.php/environnement/reductionbruitinfra_en.pdf

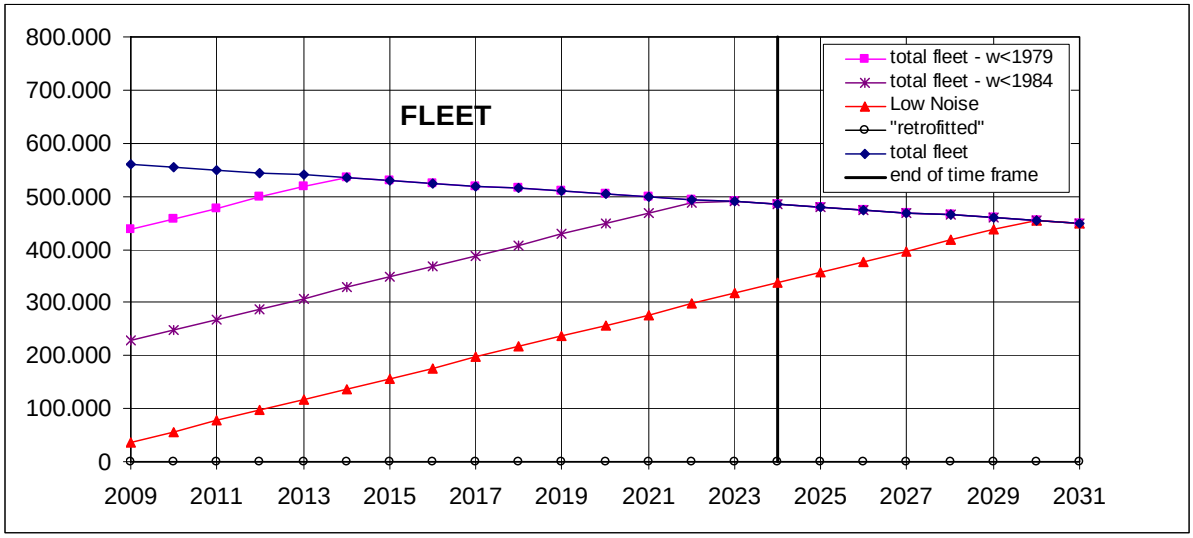

Figure 1**:** Predicted evolution of the freight wagon fleet (EU-27 countries with 1435 mm standard gauge)

The effective reduction of the noise emissions will be even slower due to the logarithmic nature of noise perception[11]. Half of the expected average reduction of 8 dB following the renewal of the fleet with low-noise wagons will only be achieved by 2025 (see Figure 2). Therefore, additional measures are required addressing the existing fleet. Retrofitting these wagons with low-noise braking technology would speed up the noise reduction significantly.

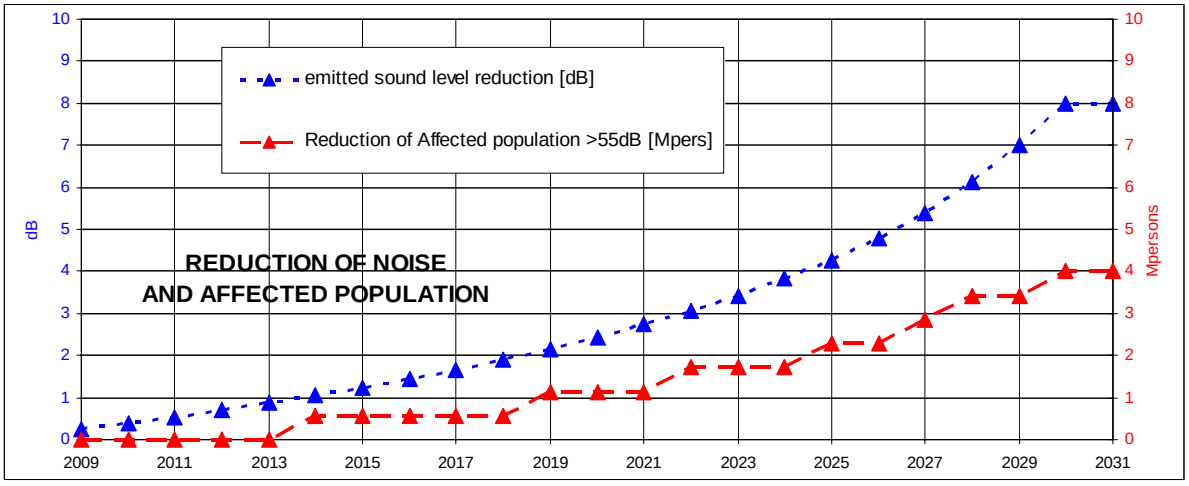

Figure 2: Predicted average reduction of emitted noise and affected population

[11] For the measurement of noise, the logarithmic decibel scale (dB) is used. An increase/ decrease of 10 dB is generally perceived as "twice as loud" respectively "half as loud". Further expiations are provided in the glossary.

Low-noise technology needs further development

The technology is now available to reduce rail noise significantly at its source. Several types of low-noise brake blocks have been developed by industry, tested and homologated by UIC (K-blocks in 2003) or provisionally homologated (LL-blocks in 2005). K-blocks are very effective in noise abatement (reduction of up to 10 dB) and are in general regarded as about cost neutral for new vehicles. However, as they demonstrate different braking characteristics compared to the conventional cast iron blocks, retrofitting requires adjustments in the braking system, leading to additional initial costs in the range of EUR 3000 to 12000.

LL-blocks are currently developed to be better suited to retrofitting because they do not require such adjustments. However, due to technical problems or missing practical experience they have not yet received the definitive homologation and most of the currently available types of LL-blocks consist of sinter metal, an expensive material leading to high costs per brake block. Currently, LL-blocks are expected to lead to an increase of maintenance costs.

Obstacles for retrofitting

The main obstacles to retrofitting freight wagons on a large scale are financial. Even if retrofitting is widely agreed to be the most cost-effective way of significantly reducing rail noise, stakeholders do not have sufficient resources or incentives to do it:

- Railway undertakings (RUs) and wagon owners/ keepers could simply decide to launch a retrofitting programme for their own wagons. However, they do not have sufficient incentives to do so as they have to bear additional costs (retrofitting and the risk of increased maintenance costs) and there are no economic short-term benefits. Furthermore, the rail sector is under high competitive pressure from other transport modes. Certainly, retrofitting would be an investment in the availability of network capacity (which otherwise might be reduced in the near future due to restrictions on noisy freight wagons) and the stability of track access charges, but the additional costs of retrofitting do impede any voluntary action.
- The infrastructure managers (IMs) are not responsible for the rolling stock. Moreover, the eventual savings in infrastructure maintenance costs due to less rail wear following the introduction of wagons with smooth wheels have not yet been determined and Member States are financing existing infrastructure-related noise abatement programmes.
- Member States could save money from retrofitting freight wagons, as costly infrastructure-related noise abatement programmes could be reduced. However, they have no direct influence over the RUs' decision on retrofitting freight wagons.
- Citizens living close to railway lines are affected by rail noise. They do not have any direct influence on decisions concerning noise abatement either at the source or by implementing infrastructure related-programmes.

To summarise, retrofitting freight wagons to reduce the need to build noise barriers would be the most efficient solution for all stakeholders. The lack of direct influence on the decision on retrofitting programmes (IMs, Member States) and/or the lack of short-term benefits and funds (RUs and wagon owners) are major obstacles to implementing the most cost-effective measures to reduce rail noise.

This can be regarded as a market failure and therefore, public intervention is required to overcome these obstacles by identifying and promoting the most effective and efficient measures to implement retrofitting at European level.

The EU's right to act

Article 174 of the Treaty establishing the European Community provides that Community policy on the environment shall contribute to protecting human health and to preserving, protecting and improving the quality of the environment. Moreover, Articles 6 and 152 of the EC Treaty links health and environmental protection to transport policy by stipulating their integration into all Community policies and activities.

Furthermore, Article 156 of the EC Treaty in accordance with Article 155 (1) gives the EU the power to take measures in the transport sector to ensure the interoperability of the networks. Based on Article 156 of the EC Treaty and Articles 6 (1) and 23 (1) of the Interoperability Directive for conventional rail[12], the TSI Noise has been adopted by the Commission introducing limit values for new and renewed rolling stock.

The issue of retrofitting the existing freight wagon fleet has been identified in section 7.4 of the Noise TSI, which states: *"Given the long life-cycle of railway vehicles it is also necessary to take measures on the existing fleet of rolling stock, with priority for freight wagons, to foster a noticeable reduction of the perceived noise level within a reasonable time period. The Commission will take initiatives to discuss options for retrofitting of freight wagons with the relevant stakeholders to achieve a general agreement with the industry."*

Today, about 50% of rail freight transport is international. For that reason, a large number of wagons run across national networks. As a small number of noisy vehicles can determine the noise impact, national abatement strategies cannot solve the problem sufficiently. Furthermore, national approaches could negatively impact on cross border corridors and give a competitive advantage to some players against others. In addition, by Community law and its harmonised implementation different national approaches can be avoided.

Therefore, it can be concluded that in accordance with the principle of subsidiarity as set out in Article 5 of the EC Treaty, the objective of reducing the number of people affected by rail noise significantly will be better reached by complementing the action already taken by the Member States by a Community action on rail noise abatement.

However, not all of the answers can be given at EU level. The Impact Assessment points out that various policy actions at EU and national level as well as actions taken by stakeholders are necessary; each have their role to play in realising the potential. It is essential that all these actors are actively involved.

[12] Directive 2001/16/EC of the European Parliament and the Council of 19 March 2001 on the interoperability of the conventional rail system. OJ L 110 of 20.04.2001; page 1.

3. OBJECTIVES

General objectives

EU transport policy, as recently reaffirmed in the 2006 Mid-term Review[13] of the White Paper of 2001[14], calls for effective and efficient transport systems offering high quality services, environmental protection, innovation and international connections. The development of a European Community rail area would meet these objectives in a sustainable manner, as it would ensure high energy efficiency and a low level of pollutants' emissions. However, the impact of rail noise might result in restrictions to rail freight traffic along the most important European rail corridors.

The environmental policy of the European Union "aims at a high level of protection" in particular regarding human health[15]. Article 7(1) of the Sixth Environmental Action Programme[16] sets the target of "substantially reducing the number of people regularly affected by long-term average levels of noise, in particular from traffic which, according to scientific studies, causes detrimental effects on human health". The renewed Sustainable Development Strategy adopted in 2006 by the Council sets out overall objectives, targets and concrete actions for seven key priority challenges for the period to 2010, one of which is sustainable transport. One of the operational targets set for this key priority is *'reducing transport noise both at source and through mitigation measures to ensure overall exposure levels minimise impacts on health*'.

In this context and in accordance with Directive 2002/49/EC, the European Commission develops and completes the existing set of Community measures concerning noise emitted by the major sources, in particular road and rail vehicles and infrastructure, aircraft, outdoor and industrial equipment and mobile machinery, and for developing additional measures, in the short, medium and long term.

In line with these policies, the overall target for rail noise abatement programmes addressing the existing fleet should therefore be to reduce the number of people regularly affected by rail noise, by means of abatement measures with the highest cost-effectiveness ratio and health benefits. Given that the lack of appropriate mitigating measures may be a serious threat to the development of rail traffic, the European Commission will prepare a Communication on rail noise which covers abatement measures for the existing fleet.

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13 COM (2006) 314 of 22.06.2006: "Keep Europe moving – Sustainable mobility for our continent – Mid-term review of the European Commission's 2001 Transport White Paper".

14 COM (2001) 370 of 12.09.2001: "European transport policy for 2010: Time to decide".

15 See the Consolidated Version of the Treaty Establishing the European Community, Article 174: "Community policy on the environment shall aim at a high level of protection […] It shall be based on the precautionary principle […] environmental damage should as a priority be rectified at source and […] the polluter should pay."

16 Decision 1600/2002/EC of the European Parliament and of the Council of 22 July 2002 laying down the Sixth Community Environment Action Programme, OJ L 242, 10.9.2002, p. 1.

Specific objectives

The retrofitting exercise should in principle include all European freight wagons with an annual mileage of more than 10 000 km and an expected remaining lifetime of at least 5 years. Wagons with a mileage of less than 10 000 km per year account for less than 3% of the overall transport performance of the freight fleet. Therefore, these restrictions could reduce the cost of retrofitting significantly without jeopardising the objective of noise reduction.

As additional indicator the number of axle-km run by low-noise wagons will be used, as this is more closely related to noise reduction than an indicator related to the number of wagons. The target is set as 97% of the overall European amount of axle-km (excluding wagons with low annual mileages of up to 10 000)), equivalent to the wagon-related target.

To maximise noise reduction at an early stage, priority should be given to retrofitting wagons with a high yearly mileage.

The proposed target date for completing the retrofitting exercise would be 2017. This assumes that retrofitting starts in 2009/2010 (one or two years after the intended adoption of the Communication) and that the normal maintenance cycle for freight wagons applies (about 6 to 8 years). Including retrofitting as part of the normal overhaul of wagons would avoid the additional cost of withdrawing wagons from service and moving them to maintenance workshops.

Furthermore, as an important milestone, against the 2007 noise maps (according to Directive 2002/49/EC) as baseline, first improvements should be visible by 2012. For the 2017 mapping exercise a substantial reduction of noise emission of freight wagons is the objective of this initiative.

4. POLICY OPTIONS

4.1. Description of policy options

Possible policy options and instruments to support/ promote retrofitting of the European rail freight fleet are listed below and briefly described. Beside, a 'doing nothing/ no policy change' option will be used as baseline scenario (policy option A). Annex I provides more detailed descriptions of the policy options.

The combination of different instruments is examined, as the problem is rather complex and rail freight and rail noise conditions vary greatly across the EU.

Policy option B consists of actions paving the way towards a **voluntary commitment** by the various stakeholders – railway undertakings, wagon owners and infrastructure managers. A voluntary commitment could include such components as commitments to individual objectives (e.g. individual retrofitting targets), to set up and implement appropriate retrofitting programmes to define priorities in order to get the best results and/ or to financial contributions from the sector.

To overcome the financing problem, which is the main obstacle to retrofitting, wagon owners could be given financial incentives (policy option C). In this context, it is important to underline that subsidies granted by Member States to economic actors should be regarded as state aids according to Article 87 of the EC Treaty. The EC Treaty generally prohibits state aid which affects competition between markets actors, unless it is justified by reasons of general economic development. The European Commission is in charge of watching over compliance of state aid with EU competition rules. For this purpose, the Commission services are preparing state aid guidelines for the rail sector. A draft of the guidelines[17] has been made available in December 2007 for consultation with the Member States and stakeholder. Following instruments to provide financial incentives have been examined in this impact assessment:

- **Differentiated track access charges (C1)**: This instrument addresses the existing financial flow between railway undertakings and infrastructure managers: the track access charge. The railway undertakings would receive a discount on this charge if using low-noise rolling stock. Based on Directive 2001/14/EC[18] harmonising charging principles two basic models of differentiated track access charges could be used as an incentive: a cost-neutral bonus-malus system or a bonus system where the infrastructure manager receives financial compensation from the Member State.
- **Subsidies for the use of low-noise wagons (C2)**: Another instrument for granting financial incentives to railway undertakings to use low-noise freight wagons is subsidies from Member States directly to the railway undertakings. The subsidy scheme could contain components similar to a discount on track access charges.
- **Subsidies for retrofitting (C3)**: This instrument consists of introducing noise abatement programmes with direct public financial support. The cost of retrofitting would be partly or

[17] Preliminary draft Community guidelines on State aid for railway undertakings. http://ec.europa.eu/dgs/energy_transport/state_aid/consultation_ms_en.htm

[18] Directive 2001/14/EC of the European Parliament and of the Council of 26 February 2001 on the allocation of railway infrastructure capacity and the levying of charges for the use of railway infrastructure and safety certification, OJ L 75, 15.03.2001, p. 29.

fully reimbursed. Subsidies for retrofitting could be granted by Member States or at European level.

- **Loans at preferential terms (C4)** could be granted to wagon owners to promote retrofitting, in particular to support the initial outlay.
- **Tax incentives (C5)** provide financial incentives by granting tax allowances for operators applying more environmentally friendly solutions. To support retrofitting, composite brake blocks could be excluded from VAT.

Beside economic incentives, **legal instruments (policy option D)** could be used to impose retrofitting of freight wagons. These instruments normally entail restrictions on the use of "noisy" wagons. They can be implemented at European, national or regional level:

- One approach would be to impose **noise limit values for existing freight wagons (D1)**, e.g. by extending the scope of the Noise TSI to the existing fleet while at the same time fixing a calendar for phasing out "noisy" wagons.
- **Operating restrictions for noisy freight wagons (D2):** On certain sensitive lines and/ or at certain times (at night), access for noisy vehicle types or train formations could be restricted.
- The **noise emission ceiling (D3)** limits daily average emissions at a certain location along the line. For example, current noise emission could be taken as a limit to prevent noise from increasing if rail freight transport grows. Under Directive 2002/49/EC, Member States are legally competent to set such limits to environmental noise. The noise emission ceiling leaves it to the rail sector to find optimal solutions: either to use low-noise wagons or to reduce speed or number of trains.
- Under a **tradable permit scheme (D4)**, a specific permit issued by public authorities must be obtained to produce emissions. A polluter who does not have enough permits can either reduce emissions or buy additional permits on the market. The number of permits would be reduced every year until the retrofitting target has been achieved.

4.2. Pre-selection and combination of policy options

A screening of the policy options against the criteria is leading to the identification of those policy options that are likely to meet the objectives the best. They are further assessed regarding their environmental, economic and social impacts. The screening is described in detail in Annex II.

As result of this evaluation, policy options B (voluntary commitment), C1 (differentiated track access charges), C3 (subsidies for retrofitting), D2 (operating restrictions for noisy freight wagons) and D3 (noise emission ceiling) will be further dealt with in the impact assessment.

The remaining policy options have been checked regarding possible combinations as according to the results of the public consultation, no single instrument is regarded as sufficient to achieve the objectives. Therefore, possible combinations of legal and economic instruments have been further analysed regarding complementarity aspects and possible synergies (see Annex II). It has been identified that a combination of legal and financial instruments is likely to be most effective and efficient because:

- legal options not combined with financial incentives would result in excessive burden on the rail sector, for the same reasons which led to the exclusion of policy option D1 (see Annex II);

- financial incentives not combined with legal measures could not guarantee alone a high retrofitting rate due to a lack of obligatory nature of these instrument. In particular at long term, accompanying legal measures could ensure the effectiveness of retrofitting programmes. Furthermore, possible double funding and/or a distortion of competition are two main disadvantages of combinations of financial instruments.
- Financial incentives combined with legal instruments put more pressure on the players concerned to retrofit. In exchange they receive the financial support necessary to avoid a negative modal shift from rail towards road.

The results of this analysis are summarised in Table 1, a detailed description is documented in Annex II.

Table 1: Summary of the possible combinations of the selected policy options: Assessment of the degree of complementarity

		Differentiated track access charges	Subsidies for retrofitting	Operating restriction	Noise emission ceiling
Financial incentives	Differentiated track access charges (C1)		Low	Med.	**High**
	Subsidies for retrofitting (C3)			**High**	Med.
Legal measures	Operating restriction for noisy wagons (D2)				Low
	Noise emission ceiling (D3)				

As the combined measures are regarded as superior to the single policy options, the detailed impact assessment will focus on the two following combinations:

1. "SOV": **S**ubsidies for retrofitting, **O**perating restrictions and **V**oluntary commitment (C3 + D2 + B):
   For this combination of instruments the effectiveness to address hot spots would be higher compared to subsidies as single instrument. In addition, negative economic impact on the rail sector caused by the introduction of operating restrictions would be compensated by the subsidies.
2. "DEV": **D**ifferentiated track access charges, **E**mission ceiling and **V**oluntary commitment (C1 + D3 + B):
   Noise emission ceilings could help to increase the effectiveness of track access charges as RUs/ WOs would have more incentives for retrofitting than in case of a stand-alone policy option. In addition, synergy effects could be used as both instruments require the implementation of monitoring systems to identify silent/ noisy wagons. Therefore, the administrative costs per individual policy option could be reduced.

A voluntary commitment by the sector is strongly recommended in any future scenario; it is considered as a part of all policy options assessed. As stand-alone measures it strongly lacks effectiveness (see Annex II).

4.3. Description of policy options selected for the detailed impact assessment

Status quo (baseline scenario)

The baseline scenario is based on the assumption of no EU action to provide incentive for the increase of wagons equipped with low-noise technology and of the kilometres run by these. A zero retrofitting rate is assumed.

Based on the existing legislation, the implementation of Directive 2002/49/EC and the Noise TSI is assumed to continue:

- Noise action plans leading to ongoing infrastructure-related rail noise abatement programmes with an annual volume of up to 200 M€;
- At the end of their lifetime, replacement of noisy wagons by new wagons equipped with low-noise technology complying with the limit values of the Noise TSI.

The other policy options are assessed against this baseline scenario. Costs and benefits of the baseline scenario are set to zero.

SOV (Subsidies for retrofitting, Operating restrictions and Voluntary commitment)

The SOV combined option is characterised as follows:

- **Subsidies** are granted on demand to cover retrofitting costs (on presentation of invoices and demonstration of eligibility by owner or with fixed rates per wagon type) and possibly extra administrative and maintenance costs (fixed percentage of retrofitting costs which also takes into account an extra margin to avoid penalising the owner) for a defined period after a wagon has been retrofitted.
- **Operating restrictions** are introduced for hot-spots at the earliest date which allows not to penalise the railway sector; the restrictions consist of prohibition for wagons not equipped with approved low-noise technology to circulate during the night time (22-6 h) on given lines/nodes/corridors already identified as critical by Member State authorities; wagons equipped with approved low-noise technology are identified by markings/ tags. Furthermore, the quality of track as influencing factor on noise emissions could be taken into account when defining operating restrictions.
- **Voluntary commitments** involve RUs (to monitor efficiency of low-noise wagon management: these wagons should be privileged in terms of load-factor, mileage, use at hot spots) and IMs (to enforce operating restrictions).

Following timetable is assumed for the option SOV:

- 2008/2009: Member States prepare legal bases for funding programmes and for operating restrictions, notification of state aids to the European Commission; RUs prepare retrofitting programmes (in particular engineering in case of K-block retrofitting), preparation of voluntary commitment to ensure noise-reducing fleet management (priority for high mileage wagons for retrofitting and use);
- 2010 – 2013 (K+LL-blocks) resp. 2010 – 2016 (K-blocks): Retrofitting period (retrofitting of wagons funded by Member States);
- 2014 (K+LL-blocks) resp 2017 (K-blocks): End of funding/ retrofitting programmes; operating restrictions in force.

DEV (Differentiated track access charges, Emission ceiling and Voluntary commitment)

The DEV combined option considered in this study is thus characterised as follows:

- **Differentiated track access charges** are put in place by IMs: a bonus is granted to RUs for each "wagon path" run by a low-noise wagon, automatically identified by tags. The level of the bonus is adjusted to a certain mileage of wagons to be retrofitted (10 000 km/y according to the objectives of the Communication). Transfer of funds from RUs to WOs is to be ensured by market forces (the rental prices for silent wagons will increase compared to those for noisy wagons) and by making the discounts granted to RUs "transparent" to WOs so that the latter feel entitled to claim a discount to the former.
- **Noise emission ceilings** are fixed at locations equipped with measurement stations ("noise traps"), on the basis of emissions measured before the date of ceiling-enforcement-start (end of retrofitting programme). Noisy wagons are automatically identified. Penalties are imposed by the IM on "noisy" RUs. Penalties are eventually transferred from RUs to WOs.
- **Voluntary commitments** by the RUs in particular to transfer funds to WOs through discounts on demand.

Following timetable is assumed for the option DEV:

- 2008 – 2011: IMs prepare implementation of differentiated track access charges (charging scheme, monitoring system); Member States prepare legal basis for noise emission ceiling; RUs prepare retrofitting programmes (in particular engineering in case of K-block retrofitting), preparation of voluntary commitment to ensure that WOs benefit from bonus grated to RUs;
- 2012 – 2014 (LL-blocks) resp. 2012 – 2018 (K-blocks): Differentiated track access charges implemented, retrofitting period;
- 2015 (LL-blocks) resp 2019 (K-blocks): End of funding/ retrofitting programmes; noise emission ceilings in force.

5. ANALYSIS OF IMPACTS

5.1. Basic assumptions for the impact assessment

This impact assessment is based on following assumptions:

- The geographical scope is limited to EU Member States with a 1435 mm standard gauge system. Within these interoperable networks action is needed at EU level as national measures are of limited effectiveness (see section 2). As result, of the EU-27 Member States, only the 18 countries needed to be considered accounting for 89.5% of the EU-27 freight fleet and 83.9% of the net tkm transported in the EU-27.
  Non-standard gauge countries are not considered since the wagons of their networks cannot run on the large European standard gauge network. The problem of noise emitted by these wagons could be addressed more effectively by the individual countries, not at European level. However, if required the methodology applied in this report can easily be extended to these wide-gauge networks, if the problems are to be addressed at the EU level.
  Non-EU countries are considered only qualitatively. It is not possible for them to be addressed directly by the Community. The countries sharing the 1435 mm network are mainly the Balkan countries (fleet of 4% of that of the 18 Impact Assessment countries), Switzerland (all wagons retrofitted by 2015 according to the ongoing retrofitting programme), Norway (share of 0.4% of the European 1435 mm fleet).

- LL-blocks are currently not fully homologated by UIC. However, as they are likely to be economically more viable for retrofitting that K-blocks, two scenarios are considered for the policy options:
  1. LL-Blocks will never be homologated and retrofitting is fully based on K-blocks ("Retrofitting with K-blocks");
  2. LL-blocks will be available at large scale as from January 2011 (before this date, K-blocks will be used; given the fact that at end of 2007, 3 different LL-blocks received a provisional homologation and that one of them passed all tests according to the UIC leaflet 541-4[19], this scenarios has a certain likelihood ("Retrofitting with K- and LL-blocks").

- Effects will be considered in the time-frame 2009 – 2024. The effects of the different policy options will be evaluated until 2030. The degree of uncertainty of the monetary values of costs and, most of all, benefits at later dates was reckoned to be too significant for a robust analysis. The standard discounting rate for Commission impact assessments of 4% has been applied.

- 100% compliance with all policy measures is assumed in order to compare the potential of the instruments. At a later stage, this assumption is subject to a critical review.

- A significant number of wagons has been built between 1979 and 1984. As it is likely to have a strong impact on costs and benefits of retrofitting, two scenarios are applied to the policy options:
  1. Limit birthdate 1979: all wagons built after 1979 are retrofitted;
  2. Limit birthdate 1984: all wagons built after 1984 are retrofitted.

- Wagon lifetime has been assumed to equal bogie lifetime (frame, major suspension elements), in average 35 years is used for the lifetime.

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[19] UIC leaflet 541-4 "Brakes - Brakes with composition brake blocks - General conditions for certification of composite brake blocks"

- Wagons equipped with low-noise blocks (K and LL) have an overall noise emission reduction of 8 dB on average track. This figure considers the noise emission reduction by K- and LL-blocks on smooth rail of about 12-13 dB according to measurements carried out in 2007[20] as well as factors limiting the noise reduction as average roughness of rails, switches, curves, braking noise and the noise level of locomotives that is assumed not to be reduced.

As result following scenarios are used for the comparison of policy options under different assumptions:

Table 2: Scenarios for the impact assessment

	K-blocks	**K- & LL-blocks**
Limit birthdate 1979	Retrofitting wagons put into service in 1979 or later with K-blocks	Retrofitting wagons put into service in 1979 or later with LL-blocks (as from 2011; use of K-blocks in 2010)
Limit birthdate 1984	Retrofitting wagons put into service in 1984 or later with K-blocks	Retrofitting wagons put into service in 1984 or later with LL-blocks (as from 2011; use of K-blocks in 2010)

5.2. Impacts of the policy options on the retrofitting programme

The different financial options act as incentives for retrofitting and thus have a significant effect on the retrofitting rate.

The selected range in terms of duration of the retrofitting programme with the K-block solution is 7 years; there is no point considering periods of less than 7 years (the nominal interval for periodic maintenance is about 6 – 12 years) since there would be costs for the unavailability of wagons and in addition a potential saturation of workshop capacity.

Since the retrofitting programme with LL-blocks is less expensive and workshop capacities are no constraint, the selected duration of the retrofitting period is 3 years.

The policy options considered have been differentiated according to specific characteristics and parameters in particular the ones listed here.

- Starting date: year in which the retrofitting programme will start. Both the SOV and DEV options necessitate a relatively long lead-in time. This leads to the consideration of a zero retrofitting rate for the first few years of the time frame.
- Retrofitting time frame: period between the first and the last retrofitted wagon.
- Annual retrofitting rate: average number of wagons retrofitted per year.
- Time for 100% silent wagons (years): number of years required to reach a fleet composed totally of retrofitted and new wagons (equipped with K-or LL-blocks).
- Wagons to be retrofitted: total number of wagons that have to be retrofitted within the period considered.

[20] Measurements have been carried out within the SILENCE project (http://www.silence-ip.org/site/) and within the Dutch noise innovation programme (http://www.innovatieprogrammageluid.nl/GBpage.asp?id=1071)

Table 3: Characteristics of retrofitting programmes for different policy options

	Scenario	Starting date for retro-fitting	Retro-fitting time frame	Average yearly retrofitting rate	% of silent wagons in 2017	Time for100% of silent wagons (end year)	Wagons to be retro-fitted
	Baseline	-	-	0	38%	2030	0
K SCENARIO	**SOV (1979)**	1-2010	7 years	45,700 w/y	100%	2016	320,000
	SOV (1984)	1-2010	7 years	27,400 w/y	75%	2021	191,000
	DEV (1979)	1-2012	7 years	38,600 w/y	73%	2018	270,000
	DEV (1984)	1-2012	7 years	27,100 w/y	64%	2021	190,000
K+LL SCENARIO	**SOV (1979)**	1-2010	4 years	99,500 w/y	100%	2013	397,400
	SOV (1984)	1-2010	4 years	50,000 w/y	75%	2021	191,000
	DEV (1979)	1-2012	3 years	124,000 w/y	100%	2014	372,000
	DEV (1984)	1-2012	3 years	64,000 w/y	75%	2021	191,000

Retrofitting rates for K-blocks of 50,000 wagons per year are still considered to be within the capacity of workshops. In fact, since roughly 560,000 wagons need to be inspected in about 6 years, workshops are currently capable of handling over 90,000 wagons per year.

Retrofitting with LL-blocks can be carried out at much higher rates since it simply requires brake block replacement which can be done outside the workshop.

The following graphs show the evolution of the total fleet and of its composition in terms of retrofitted wagons and low-noise wagons (new + retrofitted) as a function of time.

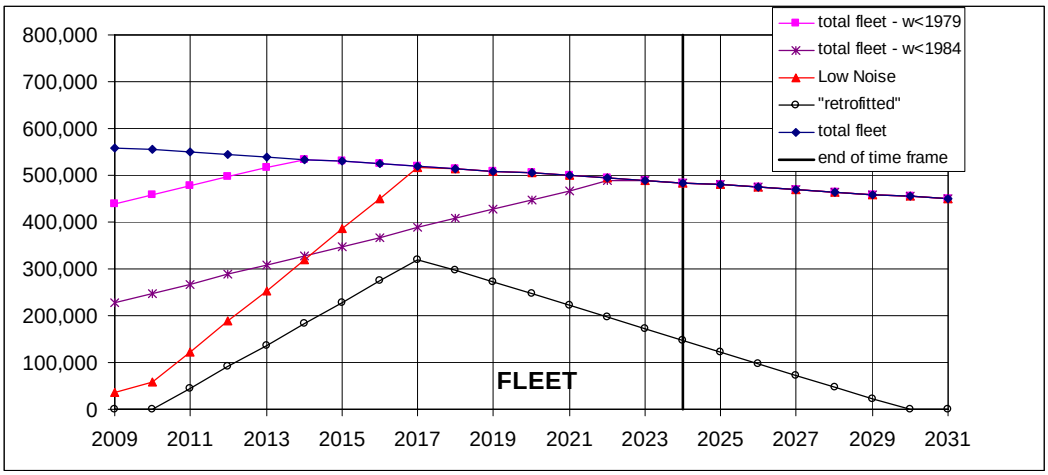

Figure 3**:** Fleet development under scenario K – SOV (1979)

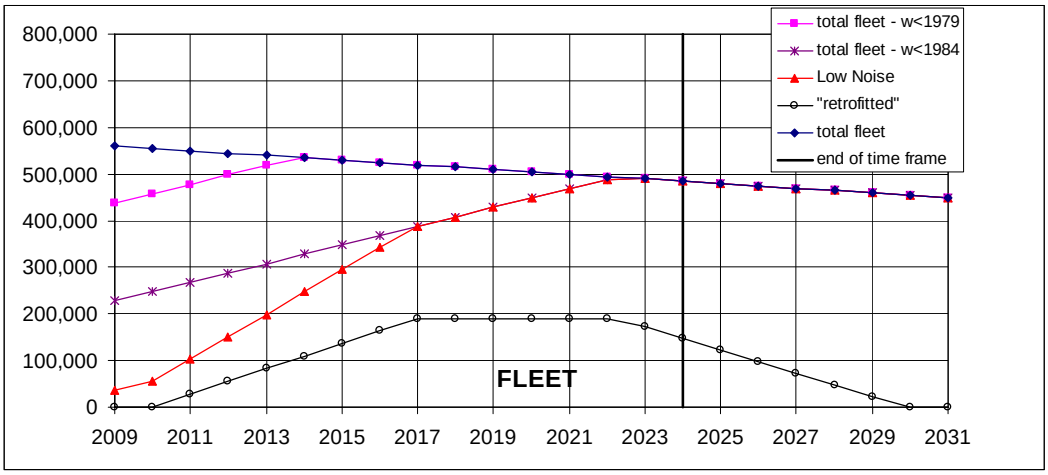

Figure 4**:** Fleet development under scenario K – SOV (1984)

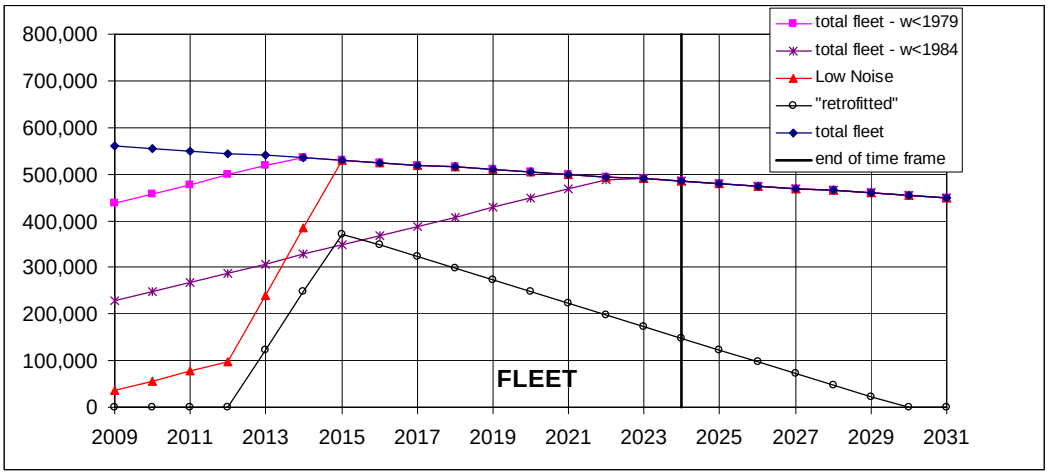

Figure 5: Fleet development under scenario K+LL – DEV (1979)

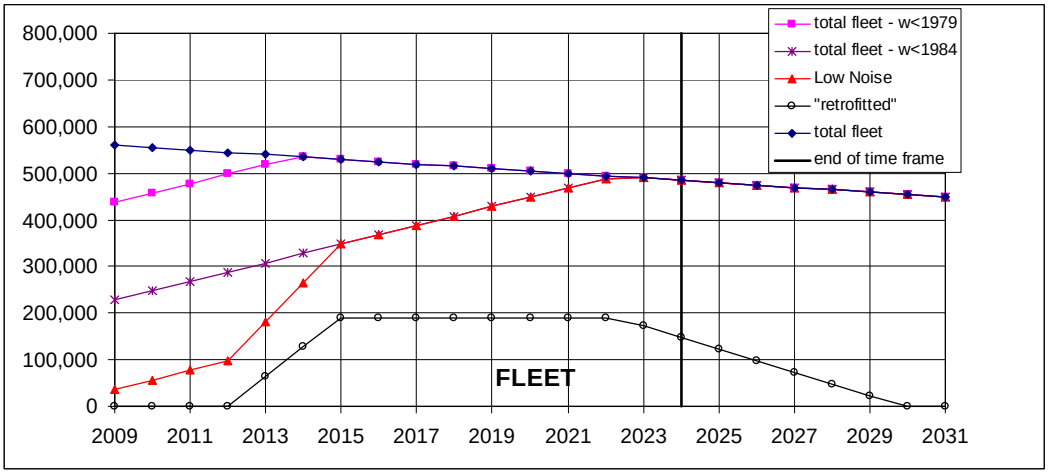

Figure 6: Fleet development under scenario K+LL – DEV (1984)

5.3. Identification of impacts

A set of impacts has been identified as possible effects of the proposed policy options. In accordance with the Commission guidelines for impact assessment the economic,

environmental and social impacts are briefly described in the tables of Annex III and further elaborated in sections 5.4, 5.5 and 5.6.

5.4. Economic impacts

5.4.1. Investment cost for retrofitting

Total costs for the retrofitting programme depend not only on unit cost of a retrofitted wagon but also on retrofitting time frame, speed of retrofitting, total number of wagons to be retrofitted and discount rate (see Table 4).

Table 4: Quantitative description of cost factor for retrofitting

Factors	**Assumption and quantitative description**
Number of axles and type of wagon	According to the most recent analysis carried out for UIC/UIPUIRR wagons, 30% of the EU-25 fleet has been considered made up of 2-axle wagons and 70% of 4-axle wagons.
Purchase of the components to be replaced	The price of a K block has been fixed at 23€ per shoe (accordingly with real cost figures given by different RUs) and for LL-blocks at 50 €. A yearly price decrease has been considered as a fully developed market could generate a price reduction. New brake cylinder: the purchase price of a brake cylinder could range between 700 and 1,000€; "empty-loaded valve" (replacement could be required replacement when cylinder is replaced): the valve could range between 900 and 1,350 € cost of the wheel: 800 €; it has been assumed , based on experiences from the Swiss retrofitting programme, that 15% of the wheels need to be replaced (K- and LL-block retrofitting)
Labour cost of the replacement	Level of labour cost is widely differing in EU; so it has been considered that cost per hour could range from 41 to 53€. Thus the total labour cost ranges between 950 and 2,500 €. For the Impact Assessment the value taken is 1,700 € per wagon with K-blocks; for LL blocks no labour costs has been included as the blocks need to be changed anyway.
Cost of testing and accepting retrofitted vehicle	According to an AEA Technology report[21], the testing cost has been considered only for K-block retrofitting and has been estimated at 400€ per wagon

Based on the assumptions described in the table before, for the purpose of the impact assessment the total cost for retrofitting has been considered:

– of 7.000 € per wagon with K-blocks solution;

– of 1.360 € per wagon with LL-blocks solution.

Thus retrofitting using LL-Blocks could be significantly less expensive: in the analysis, only direct costs, brake block cost and wheel reprofiling will be considered for LL-Blocks.

These investment costs per wagon lead to following total investment costs for retrofitting programmes for the different scenarios between 260 million Euros and more than 2 billion Euros (see Table 5). Obviously, the total investment strongly depends on the technology used

[21] AEA Technology: Status and Options for the reduction of noise emission from the existing European rail freight wagon fleet, January 2004. http://ec.europa.eu/transport/rail/studies/doc/aeat-final.pdf

and the question if wagons built between 1979 and 1984 are included in the retrofitting programmes.

Table 5: Investment costs for different policy options

	Scenario	Wagons to be retrofitted	Total investment costs
K	SOV (1979)	320,000	2,240 M€
	SOV (1984)	191,000	1,337 M€
	DEV (1979)	270,000	1,890 M€
	DEV (1984)	190,000	1,330 M€
K+LL	SOV (1979)	397,400	822 M€
	SOV (1984)	191,000	542 M€
	DEV (1979)	372,000	506 M€
	DEV (1984)	191,000	260 M€

5.4.2. Maintenance cost

There is only few data available regarding life cycle costs of K-blocks (and even fewer for LL-blocks). Therefore, the impact of retrofitting on maintenance costs can only be estimated. Some experiences from RUs or WOs show no impact on or even slightly reduced maintenance costs; however, others observed an increase. To ensure that all economic risks related to retrofitting are covered, conservative assumptions leading to an increase of maintenance costs have been made.

As considered in the PWC study, the life cycle costs per wagon depend mainly on the life span of the wheel and brake blocks. Different researches suggest that composite brake blocks would lead to higher wheel wear (in comparison with cast iron blocks) but would show lower block wear in similar operating conditions. Following assumptions have been made:

- The wheel changing rate with K- and LL-blocks is higher than for cast iron blocks (350,000 km to wheel change compared to 480,000 km);
- For K- and LL-blocks more wheel reprofiling is required (230,000 km to wheel reprofiling instead of 350,000 km for cast iron blocks);
- The wear rate for K blocks is 3 times less than that of cast iron blocks;
- The wear rate for LL blocks is 4 times less than that of cast iron blocks (however, there is no full confirmation on the matter).

This leads to a cost increase of 400 € per 100,000 wagon-km for K-blocks and 410 € for LL blocks, equivalent to 31% resp. 32%.

Table 6: Aggregated and discounted maintenance costs for different policy options

	Scenario	Wagons to be retrofitted	Discounted additional maintenance costs (2009-2024)
K	SOV (1979)	320,000	317 M€
	SOV (1984)	191,000	226 M€
	DEV (1979)	270,000	238 M€
	DEV (1984)	190,000	193 M€
K+LL	SOV (1979)	397,400	406 M€
	SOV (1984)	191,000	268 M€
	DEV (1979)	372,000	347 M€
	DEV (1984)	191,000	248 M€

Total maintenance costs strongly depend on the number of wagons retrofitting and to less extend on the technology used as LL-blocks are according to the assumptions used likely to lead to slightly higher additional maintenance costs than K-blocks.

5.4.3. Administrative cost

K-block retrofitting requires tests and authorisation procedures for retrofitted wagons to ensure safety as the braking characteristics of K-block are significantly different from those of cast iron blocks. The related costs – estimated at 400 € per wagon in average – are treated as part of the investment (see section 5.4.1). For the different K-block scenarios the total testing and authorisation costs are in the range of 76 to 128 M€.

In addition, the implementation of the different policy options will lead for the different stakeholders to added costs for the organisation, planning, development and management of the specific programmes and structures needed.

Moreover, the different policy options will generate the need (mainly for MS and IM) to create specific monitoring programmes to follow and understand the real effectiveness of the wagon owners' retrofitting programme and the RUs' performance (in case of operating restrictions or emission ceilings).

Taking into account the above assumptions the administrative costs have been estimated in terms of:

- the total costs for added staff (measured as FTE, Full Time Equivalent) needed according to each policy option programme calculated as the sum over all 18 countries covered;
- specifically for the noise emission ceiling instrument (and the combined solution DEV), a noise monitoring system capable of identifying noisy wagons/trains: total cost for the purchase, installation and maintenance of several noise monitoring stations has been considered.
- Assuming a unit cost of €15,000 for each monitoring station and a total number of 160 stations (sum of stations necessary in each country, estimated on the basis of network complexity), it has been calculated for all 18 countries:
  - a start up cost of 2,76 M€ (purchasing, installation and SW development);
  - a yearly cost for maintenance of 0,24 M€

To set up and implement the policy options including the installation of a monitoring system for the option DEV leads – according to the study – to initial administrative costs of 6.1 M€ for SOV and 11.2 M€ for DEV (mainly investment).

For the estimation of the ongoing administrative costs additional tasks regarding the financial transfers required, control and verification activities, additional tasks for the fleet management as well as maintenance of the monitoring system have been considered. The following table shows different figures for added ongoing administrative costs of each policy option:

Table 7: Added ongoing administrative costs for different policy options

Actor	**SOV - subsidy**	**SOV – operating restrictions**	**DEV – diff. access charges**	**DEV – emission ceiling**
MS	1.6 M€	0.8 M€	-	1.6 M€
IM	-	3.6 M€	1.7 M€	1.6 M€
RU	Incl. in WO	1.6 M€	0.6 M€	-
WO	1.3 M€	-	-	-
total	2.9 M€	6.0 M€	2.3 M€	3.2 M€

For the policy option SOV, the ongoing administrative costs would be about 3 million Euros during the first phase when subsidies are granted and subsequently after the introduction of operating restrictions about 6 million Euros. The costs for DEV are in the same order of magnitude, 2.3 million Euros in the first phase and 5.5 M€ after the introduction of the emission ceiling (total for ceiling and charges in case the differentiation of access charges will be continued). This can be confirmed by information provided by ProRail, the Dutch IM, that the current track access charge scheme is run by only two members of staff; a differentiation would not add much complexity as detection, monitoring and invoicing are fully automated.

Overall, with the exception of costs of testing and accepting wagons after having been retrofitted with K-blocks, the additional administrative costs are negligible compared to the investment and maintenance costs of retrofitting.

5.4.4. Funding for the retrofitting programme

The possible modal shift from rail to road due to retrofitting costs (see section 5.5.2), could be avoided by public funding. Therefore, both combinations of policy options contain measures to (party or fully) cover costs of retrofitting.

For the policy option SOV it can be assumed that the funding needed is equivalent to 100% of total investment for retrofitting as the reimbursement of costs would be done based on evidence provided by the RU or WO. Transaction costs are estimated as administrative costs in section 5.4.3.

For the policy option DEV the calculation of the funding to be provided by public authorities is more complex as the incentivising mechanism is based on the fact that RUs will benefit from a discount on the track access charges. These charges are currently imposed by each IM on a train-km basis, with corrections according to the specific situation (e.g. hour of day, passenger or freight train, etc.). According to the political address in the various EU countries regarding financing of track maintenance, the average values of charge per train-km vary from country to country (from under 1 €/tr-km to about 10 €/tr-km). Each single company will decide whether to retrofit and how many wagons to retrofit on the basis of its own cost-benefit analysis. It will use a relatively high discount rate for this calculation (no less than 6%, probably 8% or 10%).

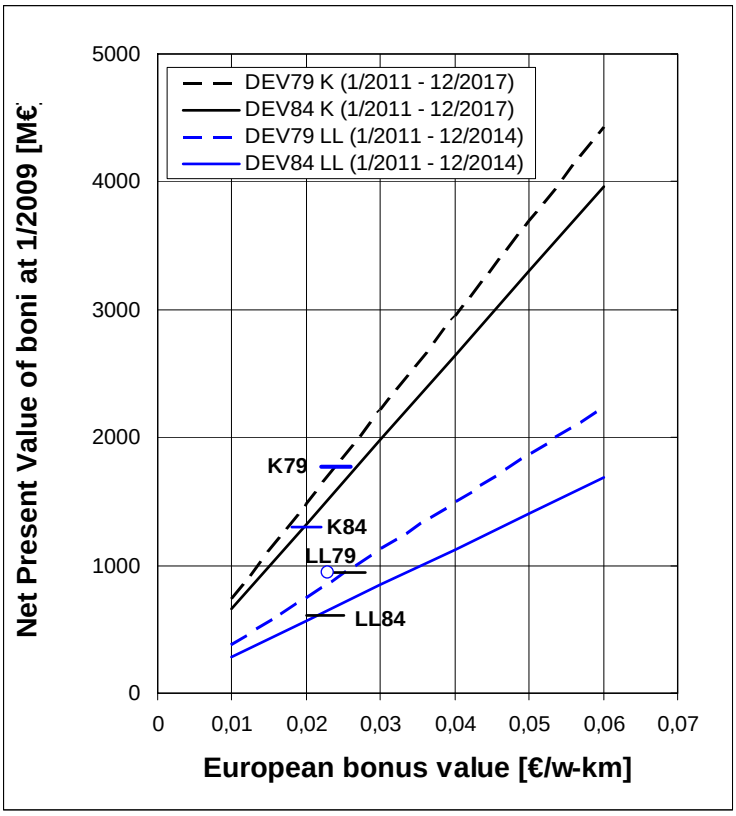

Figure 7: Net Present Values of costs and bonuses for the DEV scenarios

Under the assumption of a single European bonus value for all 18 countries considered, a decision of the value to be taken should be based on the consideration that this value affects the following: The total amount of funding required by IMs from MS (total funding €) = (w-km of low-noise wagons) × (bonus € / w-km). Figure 7 shows the Net Present Value (NPV, basis: January 2009) of total bonuses transferred to RUs as a function of the European bonus value for different scenarios (retrofitting with K- or LL-blocks, limit birthdate 1979 / 1984), compared with the respective NPV of added costs for retrofitting. The intersections between the horizontal lines representing costs and the other lines, representing bonuses transferred, indicate the values of European bonus value required to cover 100% of total costs. It can be seen that for all scenarios these values range roughly from 2 to 2.5 cents / w-km.

However, these calculations only apply to a theoretical, fully homogenous fleet. In reality, the annual mileage of wagons and the individual retrofitting costs are individual characteristics for companies. The bonuses calculated for the fully homogenous fleet are no sufficient incentives for many wagon owners to retrofit their fleet. To ensure a high retrofitting rate, the bonus needs to be higher to incentivise even owners not capable of running high mileages with their low-noise wagons and/ or with relatively high costs to retrofit their wagons.

In Figure 8 the values of bonuses necessary to incentivise such owners have been calculated assuming average mileages of 10,000-20,000-30,000 km /year for their low-noise wagons and increments of unit costs for retrofitting of 50%-100% respect to average. The time required for complete return of investment has been taken as 8 years for retrofitting with K-blocks and 4 years for retrofitting with LL-blocks. A sensitivity analysis to this parameter is shown in Figure 9.

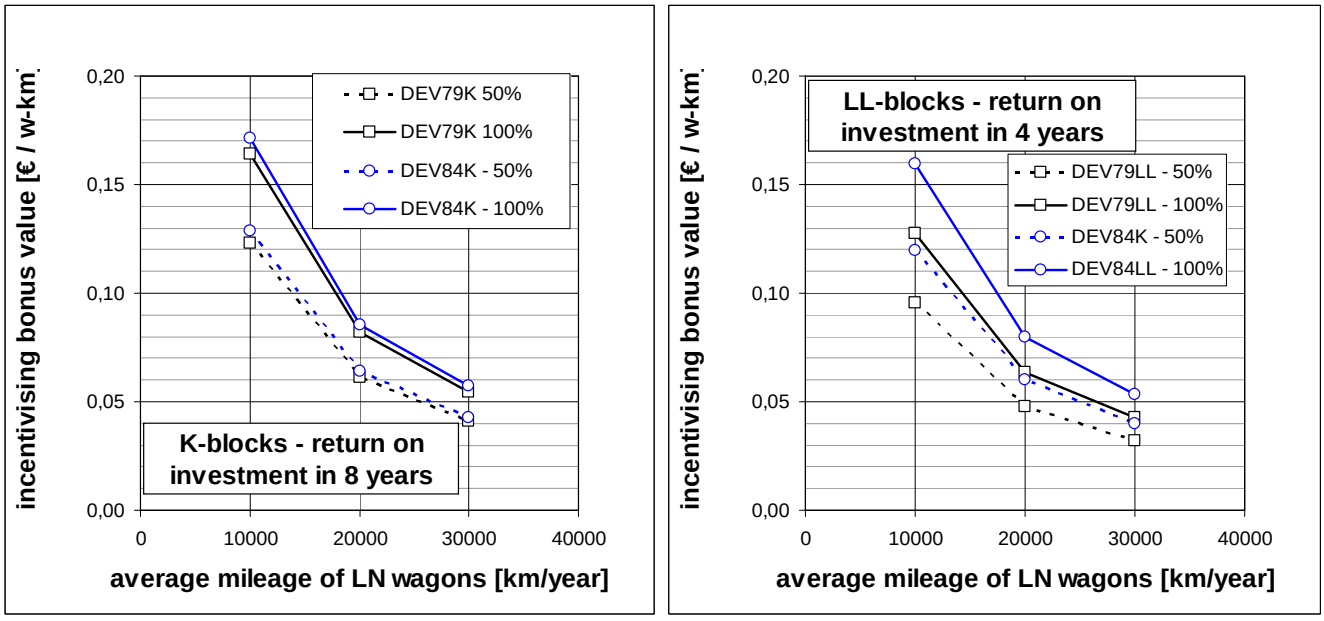

Figure 8: Bonus needed to incentivise retrofitting for owners under different conditions

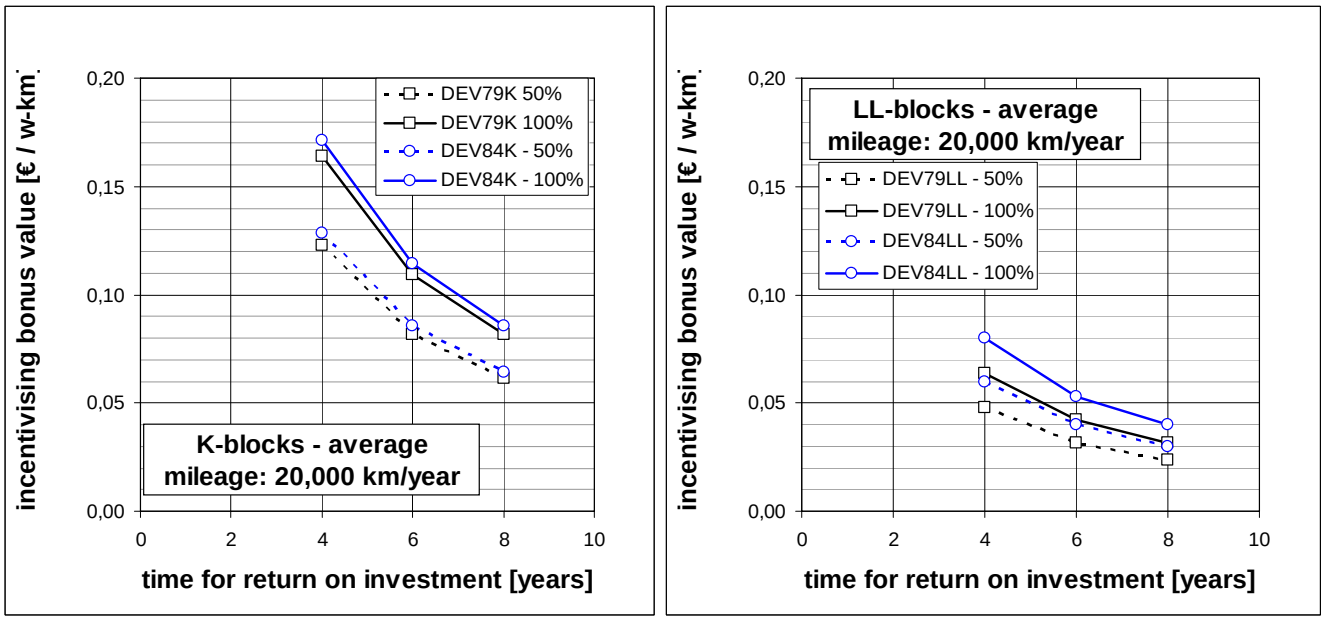

Figure 9: Sensitivity of the incentivising bonus value to the time for return on investment

These calculations lead to values for the bonus in the range of 3 – 9 cents/ w-km according to the scenario, provided that all companies are capable of reaching 20,000 km / year on average for their low-noise wagons. However, for K-blocks there are serious doubts if the necessary incentives can be granted for wagons with an annual mileage of 10,000 km that – according to the objectives of this initiative – be covered by the retrofitting programmes.

If bonuses were granted in this order of magnitude the total funding required to incentivise all or almost all wagon owners to retrofit would be about 25 to 85% higher than the total costs of retrofitting. To avoid such "overincentives" or subsidies to RUs and WOs, the aggregated bonus for a silent wagon needs to be limited to the retrofitting costs. However, the exact determination of these values is difficult. Therefore, the funds to be provided by the Member States are estimated to be about 20% higher than the costs. This leads to following figures for the funding required for the different scenarios:

Table 8: Required funding for different policy options

	Scenario	Wagons to be retrofitted	Total investment	Required funding
K	SOV (1979)	320,000	2,240 M€	2,240 M€
	SOV (1984)	191,000	1,337 M€	1,337 M€
	DEV (1979)	270,000	1,890 M€	2,268 M€
	DEV (1984)	190,000	1,330 M€	1,596 M€
K+LL	SOV (1979)	397,400	822 M€	822 M€
	SOV (1984)	191,000	542 M€	542 M€
	DEV (1979)	372,000	506 M€	607 M€
	DEV (1984)	191,000	260 M€	312 M€

5.4.5. Reduced investment for infrastructure-related noise abatement programme

The retrofitting programme connected with the SOV and DEV options could allow the reduction of infrastructure investment for noise reduction (for instance for noise barriers by a percentage of programme and/or of total costs). In fact many areas in which population is subjected to noise exceeding national limits would benefit from a decrease in rolling noise due to freight wagons which could in principle lead to noise returning within legal limits, thus avoiding infrastructure-related measures. This of course depends on the relative importance of the other sources of rail noise (squeal-, traction-, aerodynamic-, pantograph- noise etc.).

However, it is important to consider that:

- to have a higher benefit of noise abatement, a high fraction of the fleet needs to be silent; considering this assumption, a transient period before retrofitting reduces rail noise has to be managed (for instance until 2014 or 2015);
- decisions on infrastructure-related measures are often taken at a different political level (national, regional or even local) leading to difficulties of co-ordinating these programmes with retrofitting activities;
- investment structures are “rigid” and there are difficulties in changing scheduled investments (or eventually in shifting budget from IM to RU or WO); there are many long-period programmes that cannot be rescheduled or reorganised in the mid-term; a reduction in investments has been assumed possible only after 5-10 years;
- infrastructure investments solve problems that are not only related to rolling noise of freight wagons running at night (such as noise emissions of passenger trains).

Moreover it is very difficult to estimate the total reduction for infrastructure-related noise abatement costs and so far, no robust data is available.

Nevertheless, an order of magnitude can be estimated on the basis of the results of the EU-funded research project STAIRRS[22] which demonstrated that the same order of benefits in terms of affected population can be achieved with infrastructure-related noise abatement measures at costs of 2 to 4 times higher than those for retrofitting with K-blocks.

This impact assessment has estimated costs for retrofitting with K-blocks of approximately 2,000 M€ (assuming 1979 as the limit birthdate). The same results would be obtained with

[22] http://www.stairrs.org/

investments in infrastructure-related measures of 4,000 – 8,000 M€, leading to savings for Member States in the order of 2,000 – 6,000 M€ over the time-frame considered here. It is interesting to compare these figures with the estimates from the UIC status report[23] which considers a value of up to 10,000 M€ in infrastructure-related measures investments. Of these, according to the above calculation 4,000 – 8,000 M€ would be saved, leading to total expenses of 2,000 – 6,000 M€ for infrastructure-related measures plus 2,000 M€ for retrofitting.

To summarise, based on the findings of the STAIRRS project and on the estimates of the UIC status report savings due to a retrofitting programme would amount to approx. 2,000-6,000 M€ (for the K-block scenarios) and 3,000-7,500 M€ in case of LL-block retrofitting. But again, these figures are purely theoretical of the above reasons. Regarding the two policy options, the differences in impact on reduced investment for infrastructure-related noise abatement programme are not significant.

5.4.6. Reduced investment cost for renewal of fleet

Over the past decades, the number of freight wagons in Europe has decreased while the transport performance in tkm remained about stable. Even in very recent years when rail freight started to grow the trend towards smaller fleets continued. This phenomenon could easily explained by the average mileage of wagons in Europe of about 20,000 km/a, much less than e.g. in the road sector. Therefore, it has been assumed for this impact assessment that this trend will continue and in average 25,000 wagons will be put out of service per year while 20,000 new ones will be purchased. This leads to avoided annual investment costs of 450 M€ (assuming 90,000 € per wagon).

Since differentiated track access charges offer the possibility of higher bonuses if higher mileages are run, the DEV option may stimulate an improvement of fleet management in terms of know-how on how to obtain high average mileages for a part of the fleet or even the whole fleet. This would boost the impacts described above. However, this impact is extremely difficult to quantify. If a 10% contribution of differentiated track access charges to the overall efficiency gain was assumed, the economic benefit would be 45 M€ per year.

For SOV, there are no strong economic incentives to support the development towards higher efficiency of wagon use.

5.4.7. Reduced maintenance costs for infrastructure

Due to the higher wheel wear caused by composite brake blocks (the wheel surface is polished), it has been observed that the number of wheel defects is reduced for low-noise wagons (in particular wheel flats, cracks and wear of profile according to experiences of the Dutch noise innovation programme)[24]. This high quality of wheel surfaces has a positive impact on the rail and, due to less rail wear, infrastructure maintenance costs are reduced. However, the quantification of this impact is not yet possible.

A similar effect has been observed in The Netherlands after the introduction of the wheel monitoring system Quo vadis/ Gotcha leading the a decrease of infrastructure maintenance costs by 5 to 10%[25].

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23 UIC: Noise Reduction in European Railway Infrastructure. Status Report 2007. http://www.uic.asso.fr/download.php/environnement/reductionbruitinfra_en.pdf

24 J. Peen: Whispering Trains - Noise reduction on Freight Wagons. Presentation at the UIC Noise Workshop November 2007. http://www.innovatieprogrammageluid.nl/GBpage.asp?id=1054

25 Lloyd's Register Rail Europe: Project summaries; http://www.gotchamonitoringsystems.com/pdf/References.pdf

Therefore, it can be assumed that the implementation of retrofitting programmes would result in savings for IMs. These savings could be used to reduce the track access charges for silent wagons accordingly.

5.4.8. Competition within the rail sector

The costs for retrofitting are most probably not equally distributed among the RUs and WOs. At least for K-block retrofitting, large WOs and RUs (in particular incumbent operators) could benefits from economies of scale, when purchasing supplies and in particular by lower tests costs as tests are required per wagon type. This could be a competitive disadvantage for newcomers on the rail freight markets.

Policy option DEV incentivises a high mileage of wagons (see section 5.4.6). This gives a clear competitive advantage to private WO and new RUs as these companies use approaches for fleet management different from the ones applied by incumbents resulting in annual mileage of in some cases more than 100,000 km.

Certainly, these effects are very difficult to quantify. Overall, the impact on competition within the rail freight sector is rather limited even if policy option DEV provides some advantages for small RUs and private WOs.

5.4.9. Influence of restrictions for noisy wagons on non-EU countries

The non-EU States whose wagons can run on the networks of the 18 countries considered (Balkan countries, Switzerland and Norway) account for just over 4% of the total fleet. In Switzerland a retrofitting programme is ongoing will be completed by 2015. The other States may be incentivised to retrofit their wagons with the DEV option, due to the access charge bonus. However, an agreement on their voluntary commitment would be appropriate.

A voluntary commitment by these countries to provide financial support for retrofitting of wagons registered in these countries is essential for the SOV option in order to provide the necessary incentives.

5.5. Environmental impacts

5.5.1. Reduction of sound pressure levels

As the noise reduction for K- and LL-blocks is at the same level (8 dB are assumed for this impact assessment, the total average noise reduction achieved by retrofitting only depends on two factors, the number of vehicles retrofitted and the time when retrofitting takes places. Figure 10 and Figure 11 show the noise reduction over the time of the different policy options and scenarios compared to the status quo option. Certainly, the particular situation at specific railway lines could deviate from the average development according to the traffic development and the rolling stock used.

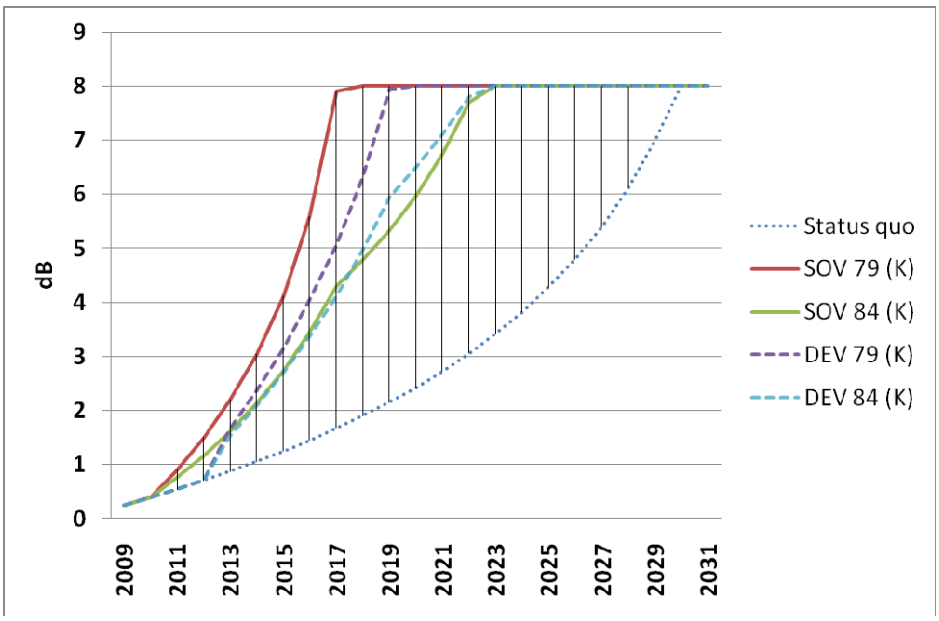

Figure 10**:** Noise reduction under scenarios K

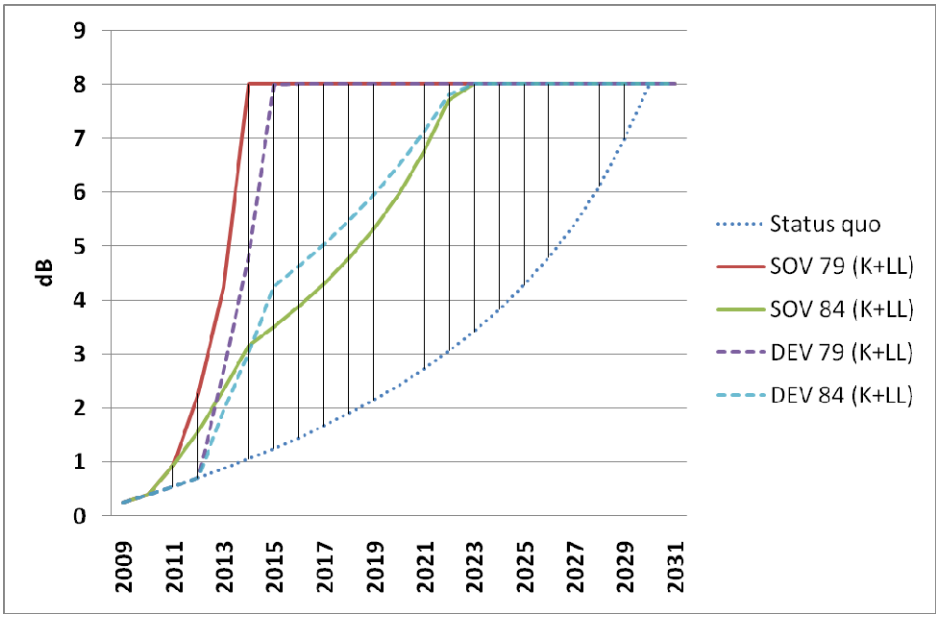

Figure 11**:** Noise reduction under scenarios K+LL

Obviously, the level of noise reduction achieved is the same for all options including the status quo. The only differences are the time when is reductions can be realised and the noise reduction level in the course of the retrofitting programme.

According to the calculations, the maximum noise reduction is earlier achieved by the LL-block scenarios of option SOV 79 and DEV 79 (silent fleet by 2013 resp. 2014) followed by the K-block based scenarios of the same policy options (full reduction by 2016 resp. 2018). Regarding the noise reduction, retrofitting the wagons with a birthdate between 1979 and 1984 shortens the time until a full reduction is obtained.

5.5.2. Influence on the modal split between rail and road (environmental effects)

In accordance with the assumptions of this impact assessment, RUs or WOs will have an added cost because of the retrofitting programme and incremental maintenance costs. To

cover this maintenance cost increase, unless adequately funded, RUs will apply a proportional increase to the final customer for the rail transportation services. These considerations fully apply for the policy option SOV, as only the initial investment can be covered by subsidies. For DEV, these costs could be considered for the calculation of the bonus for silent wagons.

According to the main literature, price changes often affect consumer decisions and transport activities tend to follow this pattern. This has been considered through the elasticity of the demand related to the price change. Even if the elasticity could vary over a wide range depending on the type of freight and the commodity group, it is calculated that this value could range between -0.25 and -0.35[26]. Within the analysis -0.35 level has been considered (as the worst case): this means that a 10% cost/price increase of the rail transport service reduces rail traffic by 3.5%.

The following table shows different rail traffic decreases according to different levels of incentives for policy option SOV (K brake block scenario, 1984 as wagon limit birthdate).

Table 9: Estimated transport price increase and modal (K, SOV, limit birthdate: 1984)

Level of incentive [27]	Total Price Increase (€/tr-km)	Average increase in pricing (%)	Expected rail traffic decrease (%)	Expected rail traffic decrease (mio tkm)
No Subsidies	0.20	1.09%	0.40%	4,035
50% of costs	0.10	0.57%	0.21%	2,115
75% of costs	0.06	0.31%	0.11%	1,155
100% of costs	0.01	0.05%	0.02%	196

Rail demand reduction has to be satisfied by alternative modes of transport. So it is probable that the variation in rail demand could be followed by an increase in road transport demand. According with the last assumption, a cross-elasticity has been considered to figure the variation of road traffic demand corresponding to variations in rail transport demand.

Accordingly, total modal shift towards road traffic will be between 0.02% and 0.4% of the total rail demand, equivalent to 200 million tkm (in case of incentives covering 100% of the costs of the retrofitting programme) resp. 4 billion tkm (in case of no incentives) according to the different scenarios within policy option SOV. For DEV, these values are lower or even 0 if a bonus covering additional maintenance costs is sustained after the end of the retrofitting period.

Based on these calculations emission factors for the most significant pollutants (CO_2, NOx, PM) have been applied to the estimated increase of road traffic in order to estimate environmental costs. The emission factors are derived from the TREMOVE database[28].

The following table shows different net effects of increased emission (due to the increase of road traffic) and reduction of emission (due to reduction of rail traffic) in case of the lack of financial support for retrofitting. Similar calculations could be carried out for road traffic noise and fatal accidents.

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26 Victoria Transport Policy Institute (http://www.vtpi.org/tdm/); RMH Breugem, DP van Vuuren, B van Wee, "Comparison of global passenger transport models and available literature"

27 The incentive considers only the cost of the retrofitting programme.

28 TREMOVE is a policy assessment tool developed by KU Leuven for the European Commission, DG Environment (http://www.tremove.org/)

Table 10: Estimated environmental impacts of a price increase of rail transport (K-blocks, limit birthdate: 1984)

	Increase of emission due to the increase of road traffic	**Emission reduction due to the reduction of rail traffic**	**Net effect (no funding)**	**Net effect (SOV)**
NO_x	+2,998 t/y	-483 t/y	+2,515 t/y	+126 t/y
PM 10	+75 t/y	-29 t/y	+45 t/y	+2 t/y
CO_2	+282 Mt/y	-27 Mt/y	+254 Mt/y	+13 Mt/y

The total increase in road transport emissions is much higher than the reduction of air pollutants and greenhouse gases expected as result of rail traffic decrease. In case of full financial support for the investment costs related to retrofitting (according to the option SOV), the figures for the net increase of emissions are significantly lower.

Concerning the savings of investment costs for the rail sector (see section 5.4.6), a decrease of transport prices and subsequently an increased demand for rail transport could e expected (modal shift from road to rail). Based on the rough estimation of 45 M€ annual saving for DEV, the average price decrease would be 0.15% and the rail traffic increase 0.06% equivalent to about 600 mio tkm. This effect would result in environmental net benefits of about 400 t NOx, 8 t PM-10 and 38 Mt CO_2 less emitted per year.

Overall, the environmental impact of a possible modal shift is difficult to quantify and very likely to be insignificant provided that retrofitting will be at least partly supported (directly or indirectly) by public funds. For DEV, the overall impact could be positive or negative, for SOV a negative impact is more likely. As K-block retrofitting is more expensive, the risk of modal shift towards road is higher for the K-block based scenarios.

5.5.3. Traction energy saving due to reduced weight of brake blocks

The replacement of cast iron brake blocks by K- or LL-blocks leads to a weight reduction of wagons as K-blocks and organic LL-block are significantly lighter (less than 50% of the mass of cast iron blocks). For sinter LL blocks, this reduction is less significant.

Assuming an average reduction of 125 kg per wagon and a specific energy consumption of 20 Wh per tkm for relatively fast, long-distance freight with electric traction, the total savings are about 50 kWh per year and wagon resp. in the range of 10 to 20 to GWh, equivalent to the electricity consumption of 3,000 to 6,000 average households.

The relative reduction of traction energy consumption of rail freight is less than 0.1%; however, savings of 5 to 10 Mt CO_2 emission and 1.1 – 2.4 M€ can be expected (depending on the number of wagons retrofitted according to the policy options and scenarios). The environmental impact of this effect is in the same order of magnitude as the one of a possible modal shift under option SOV.

5.5.4. Reduced risk of forest fires

This issue has proved to be relevant in Portugal. In this country the use of composite brake blocks (LL blocks for freight wagons) has been stimulated among other reasons in order to reduce the occurrence of bush fires. Although not a decisive impact, it may have certain relevance in terms of savings for Member States in the countries of Southern Europe which add to the other benefits of retrofitting wagons with composite blocks.

The reduction of the risk of forest fires is directly linked to the number of vehicles to be retrofitting and the timing of retrofitting. Therefore, the difference between the policy options

DEV and SOV are limited. More important are the technology used (K- or LL-blocks) and the decision whether the wagons built between 1979 and 1984 are retrofitted or not.

5.6. Social impacts

5.6.1. Reduction of affected population

Reduction of number of people affected

The reduction of the population affected by rail noise is calculated based on the noise emission reduction and data/ assumption on the distribution of citizens along main rail lines. Unfortunately, the results of the noise mapping exercise according Directive 2002/49/EC have not been available for this impact assessment.

Therefore, older existing information has been used. Due to the importance of affected population data and to the lack of specific information, two different data bases for affected population have been identified for the purpose of the impact assessment, in particular:

- population calculated on the basis of data from Entec report for DG-ENV (2006): these figures estimating the number of people exposed to levels above 65 dB L_{den} derived from calculations on the density of rail-noise-affected population reported in a document for DG-ENV by Entec UK Ltd and represent rail noise hot spots in Europe;
- population according to the INFRAS-IWW report (2004)[29]: the reduction of affected population is calculated assuming that noise exposure levels are reduced by the same amount as noise emitted (approximation), that 80% of the population affected by rail noise are affected by rail freight noise only (and 20% by passenger rail noise only) and that population is distributed according to levels of noise discretised into 1 dB intervals (the discretisation leads to the particular shape of the benefit curves). This study uses 55 dB L_{den} as threshold for the estimation of the number of people exposed.

As Directive 2002/49/EC retains 55 dB L_{den} as criterion, only estimates based on the INFRAS-IWW report are used for this impact assessment.

The following charts illustrate the effects of the different policy options on the achievable reduction of the affected population figures.

[29] Infras, IWW: External costs of transport – update study 2004. http://www.uic.asso.fr/html/environnement/cd_external/docs/externalcosts_en.pdf

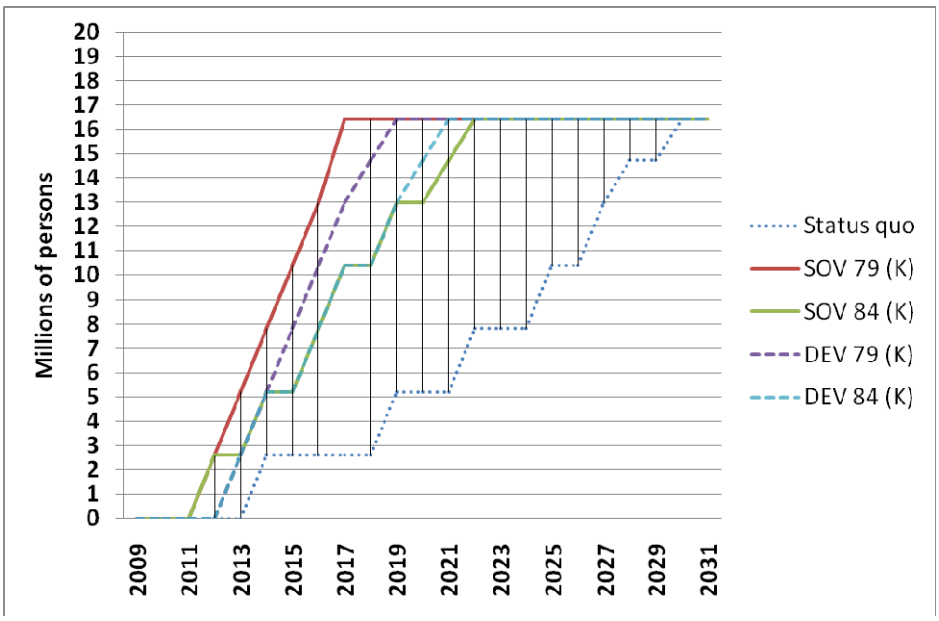

Figure 12**:** Reduction of affected population, K-scenario

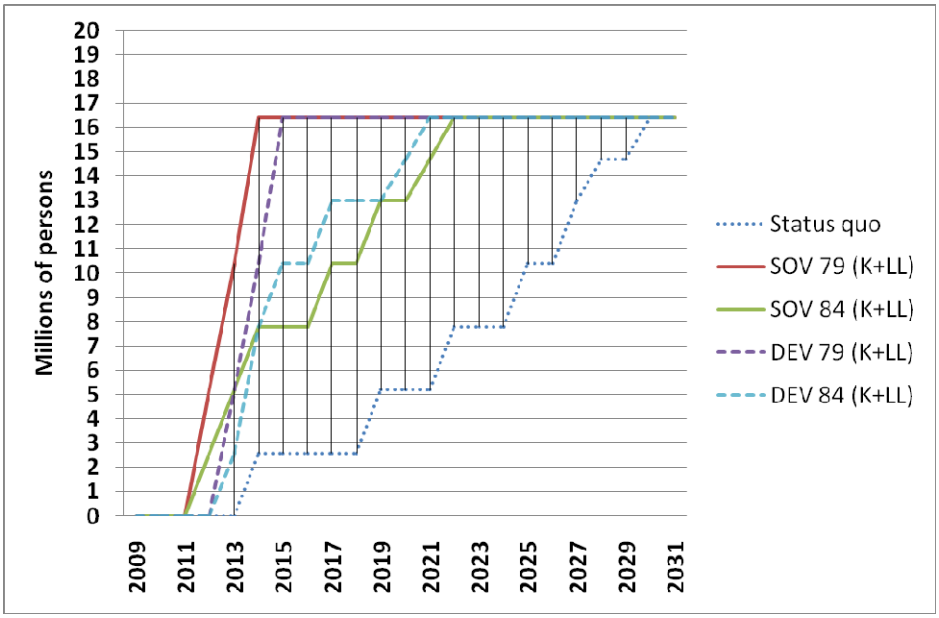

Figure 13**:** Reduction of affected population, K+LL-scenario

The reduction of number of persons affected by railway noise is the same for all options including the status quo. According to the INFRA-IWW method used, about 16.5 million citizens would benefits from retrofitting as the noise level they are exposed to will fall under 55 dB.

Regarding the comparison of policy options and scenarios, the considerations made in section 5.5.1 also apply to the reduction of the number of persons affected.

Reduction of health effects

The reduction of the levels of exposure of the population to rail noise leads to a reduction of health effects. Recent projects show that these can be quite significant. For example the World Health Organisation (WHO) is coordinating the EBD (Environmental Burden of

Disease) noise project on guidelines for the estimation of the disease burden generated by environmental noise[30]. The health effects investigated in the project are:

– Cardiovascular disease;

– Sleep disturbance;

– Annoyance;

– Tinnitus;

– Cognitive impairment;

– Hearing loss.

The policies presented in this impact assessment certainly lead to the beneficial effects listed above. However, such benefits are currently difficult to quantify and the results have a high level of uncertainty. The estimates are based on the amount of population no longer exposed to rail freight noise as well as on dose-effect relationships (for details see PWC study). As a result, the reduction of number of persons subject to annoyance and sleep disturbance due to rail freight noise is estimated at the beginning and end of the retrofitting programmes. This year varies according to the policy option (see section 5.2).

Table 11: Estimates of the persons subjected to different levels of annoyance and sleep disturbance

	millions of persons affected		
Impact	**2009**	**End of retrofitting**	**Δ [%]**
High annoyance	5.3	1.7	-69%
Annoyance	6.9	2.6	-67%
High sleep disturbance	1.6	0.5	-67%
Sleep disturbance	3.7	1.3	-66%
Low sleep disturbance	7.3	2.6	-65%

According to these estimates a reduction of 65 – 70 % of annoyed and highly annoyed persons is expected respect to the initial situation once the whole fleet is composed of low-noise wagons. Similarly, a reduction of 65 – 70% of persons subject to sleep disturbance is expected.

Monetisation

The monetary quantification carried out in this impact assessment of the benefits deriving from the reductions in persons affected and sound pressure levels is thus purely indicative. However, interesting conclusions can be drawn from the comparison of costs and the benefits thus calculated.

The monetary value attributed to the noise reduction benefits has been determined intentionally a simple way, taking into account the values available in literature concerning annoyance and sleep disturbance. Recent studies showed that significant health effects may arise from exposure to noise. In order to keep the analysis simple, a value of 10 € per dB and person and year has been applied verified by a sensitivity analysis (see PWC study for details).

[30] http://www.who.int/quantifying_ehimpacts/national/en/

Table 12: Monetised benefits for the affected population for different policy options

	Scenario	Benefit
K	SOV (1979)	7,100 M€
	SOV (1984)	4,100 M€
	DEV (1979)	5,800 M€
	DEV (1984)	4,400 M€
K+LL	SOV (1979)	9,500 M€
	SOV (1984)	4,400 M€
	DEV (1979)	8,400 M€
	DEV (1984)	5,200 M€

Obviously, the monetised benefits are related to the reduction of the number of people affected. The highest benefits are expected for the options SOV 1979 and DEV 1979 when LL blocks are used. The related scenario with 1984 as limit birthdate shows significantly lower benefits. The monetised benefits of SOV scenarios are in general slightly higher than those of the DEV scenarios.

5.6.2. Reduction of weight handled

Low-noise brake blocks are made of composite materials resulting in substantially lighter blocks compared with cast iron blocks (typical cast iron block mass: 13 kg, typical composite block mass: 4-8 kg).So K- and LL-blocks are easier and safer to handle.

This leads to a positive impact on health of maintenance workers as the number of back problems will decrease. This impact is not decisive in terms of the choice between the SOV and DEV options. However, policy options leading to fast retrofitting of a high number of vehicles, in particular SOV 1979 and DEV 1979 using LL-blocks provide the highest positive impact.

5.6.3. Increased transparency

The implementation of some instruments connected with the different policy options for retrofitting can lead to the availability of data on noise reduction that would not otherwise be gathered just on the basis of the European Noise Directive. This is true in particular for Noise Emission Ceilings if these are enforced on the basis of measurements.

5.6.4. Social impacts in non-EU countries

Non-EU countries with 1435 mm rail systems would benefit from the retrofitting programmes implemented in EU Member States. The extent of the reduction of number of people affected by rail noise strongly depends of national retrofitting programmes in additional to the ones of EU Member States and is therefore not quantified in this impact assessment.

Nevertheless, assuming that the share of silent wagons going to these countries is the same as on the territory of the EU Member States, up to 1 million citizens would benefit from noise emission reductions under the threshold of 55 dB (according to the results of the INFRAS-IWW report, see section 5.6.1).

5.7. Sensitivity analyses

For some main parameters or assumptions, sensitivity analyses have been carried out and the results are briefly presented in the following. More details are described in the PWC study.

Date of full availability of LL-blocks

For the calculation of costs and benefits of retrofitting, it has been assumed for the scenario "K+LL" that LL-blocks will be fully homologated in January 2011.

Assuming an earlier availability for policy option SOV (as for DEV, the implementation of the differentiated track access charges has been identified as the time-critical step) costs and benefits would change as follows:

- The implementation of the retrofitting programme with LL- instead of K-blocks for the first years permits a cost decrease of roughly 17% (1979 birthdate) and 29% (1984 birthdate) respect to the "K+LL" scenario (see Figure 14);
- Due to a higher retrofitting rate, the number of silent wagons in the first years would be higher and therefore, the benefit regarding the reduction of number of people affected by noise would increase by at least 10%.

Therefore, it can be concluded that the availability of LL-blocks is a crucial issue for both, costs and benefits of retrofitting.

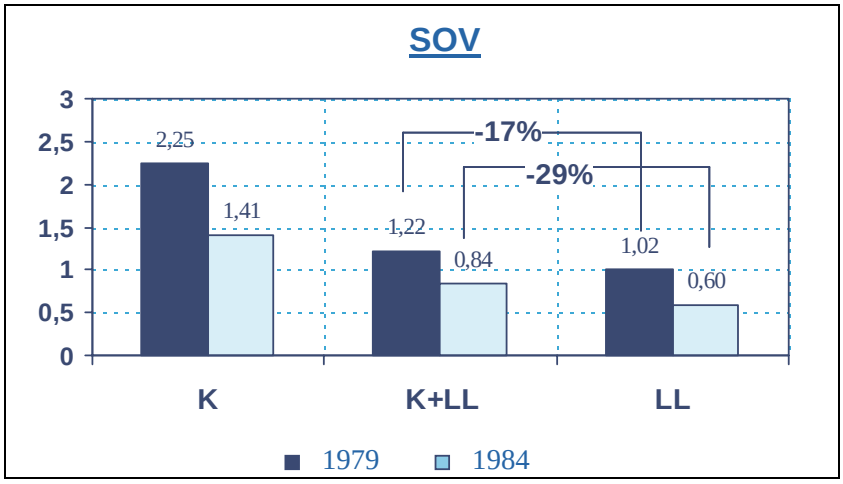

Figure 14: Total costs of retrofitting for policy option SOV and different technologies used

Maintenance costs

A variation of parameters determining maintenance costs leads to a range of –200 € to +3000 € additional annual costs. Obviously, the impact on maintenance costs is wagon- and company specific. Unfortunately, there are no exact figures available today. However, it can be concluded that there is at least a risk of additional costs. Therefore, financial support seems to be needed to provide the necessary incentives.

However, there is a potential for savings as two examples of retrofitting programmes for freight wagons in Europe show that at least cost-neutral solutions are technical feasible:

- In the United Kingdom, 80% of the freight wagons are equipped with disc brakes or K-blocks. Some vehicles have been retrofitted with K-blocks, for economic reasons as the life-cycle costs are lower. K-blocks produced in the USA are used, for which purchasing costs are about 25% lower than of the UIC homologated European K-blocks[31].
- In Portugal, the freight fleet of about 4,000 wagons has been retrofitted with LL-blocks (ICER T903 and JURID 833) in 1997 and in addition, passenger carriages have been

[31] Oral information received from Mr C. Carr, Department of Transport, UK

equipped with L-blocks. The costs were borne by CP, the incumbent operator. Since then, no technical problems occurred and life-cycle costs decreased[32].

To make best use of this potential, policy options providing incentives for such cost reductions are needed, DEV does provide such incentives.

Main risks of the two policy options regarding the implementation

The option SOV is based on the assumption of subsidies covering 100% of the initial investment. There are no experiences with state aids for rail noise abatement measures for rolling stock. However, according to the draft state aid guidelines for railways[33], a funding rate of 50% is regarded as proportionate for such cases. Above these thresholds Member States must demonstrate the need and proportionality of the measures in question.

It can be concluded that the subsidy component of policy option SOV might be a weak point regarding its legal compliance. Funding rates significantly below 100% risk to be ineffective (RUs and WOs do not make use of the subsidy scheme and do not retrofit) or to lead to high financial burdens for railways if retrofitting is implemented (e.g. to avoid operating restrictions as part of SOV).

For policy option DEV, individual approaches at national level would risk not being effective as the incentive for railway undertakings might not be sufficient if only some Member States introduced a bonus (as a critical mass is needed to provide sufficiently incentives to European RUs/WOs), the timeframes were contradictory and different types of silent wagons were treated differently. Furthermore, administrative costs for non-harmonised schemes would be unnecessarily high. Therefore, the common and simultaneous implementation of this instrument leading to the necessary incentives for retrofitting needs to be ensured and the harmonisation at European level is crucial for the success of differentiated track access charges.

Beside the harmonisation of the main elements of charging schemes, the development of a common classification system for wagons and their noise emission, of appropriate identification systems and registers are needed.

As far as the identification of wagons is concerned, appropriate systems are under development or in some case already implemented. They will allow identifying and tracing wagons running on the network. The costs of such systems have been assessed in section 5.4.3 concluding that total costs for installation and maintenance are in the order of magnitude of some millions of euros, significantly less than the direct costs of retrofitting.

Classification systems need to be developed but this does not seem to be to complicated as even simple schemes would be appropriate if harmonised at European level.

National vehicle registers already exist and allow the integration of information on noise emissions of wagons. At European level the European Railway Agency currently develops a central register connecting the national registers.

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[32] Written information received from Mr. P. Ferrão, CP (Portuguese Railways)

[33] Currently under development, see: http://ec.europa.eu/dgs/energy_transport/state_aid/consultation_ms_en.htm

6. COMPARING THE OPTIONS

Both, policy options DEV and SOV could be effective in achieving the objective of noise reduction as defined in section 3. 97% of the axle-km performed by silent wagons resp. all wagons with an annual mileage of at least 10,000 km would be archived at the earliest by 2013 for policy option SOV and by 2014 for DEV (both in the case of LL-block retrofitting).

Table 13 summarises the costs of retrofitting programmes, added maintenance and administrative costs as well as total noise reduction benefits in the different scenarios. All values are expressed in monetary terms and are referred to the period 2010-2024. The net benefits, i.e. total benefits – total added costs, are calculated. It is important to note that this net benefit does not take into account the incentivation margin and some additional economic, environmental and social benefits, which could not be determined quantitatively (such as savings in investment costs for rolling stock and in maintenance costs for the infrastructure). The qualitatively assessed impacts are summarised in Table 14.

Table 13: Overview of monetised impacts of the policy options and scenarios

Impact	**Limit birthdate**	**K (2009 – 2024)**		**K+LL (2009 – 2024)**	
		SOV	**DEV**	**SOV**	**DEV**
Investment cost for retrofitting programme	1979	1,847 M€	1,441 M€	728 M€	416 M€
	1984	1,102 M€	1,018 M€	488 M€	214 M€
Added maintenance costs	1979	317 M€	238 M€	406 M€	347 M€
	1984	226 M€	193 M€	268 M€	248 M€
Added administrative costs for new tasks	1979	85 M€	93 M€	85 M€	93 M€
	1984				
TOTAL ADDED COST	1979	2,249 M€	1,772 M€	1,219 M€	856 M€
	1984	1,413 M€	1,304 M€	841 M€	555 M€
Added BENEFIT on affected population	1979	7,071 M€	5,762 M€	9,460 M€	8,428 M€
	1984	4,133 M€	4,385 M€	4,450 M€	5,208 M€
TOTAL NET VALUE	1979	4,822 M€	3,990 M€	8,241 M€	7,572 M€
	1984	2,720 M€	3,081 M€	3,609 M€	4,653 M€

Finally, the following figure shows the total benefit/cost ratio for each scenario (K and K+LL) and for different wagon limit birthdates (1979 and 1984). Again, the incentivation margin and the additional benefits are not included.

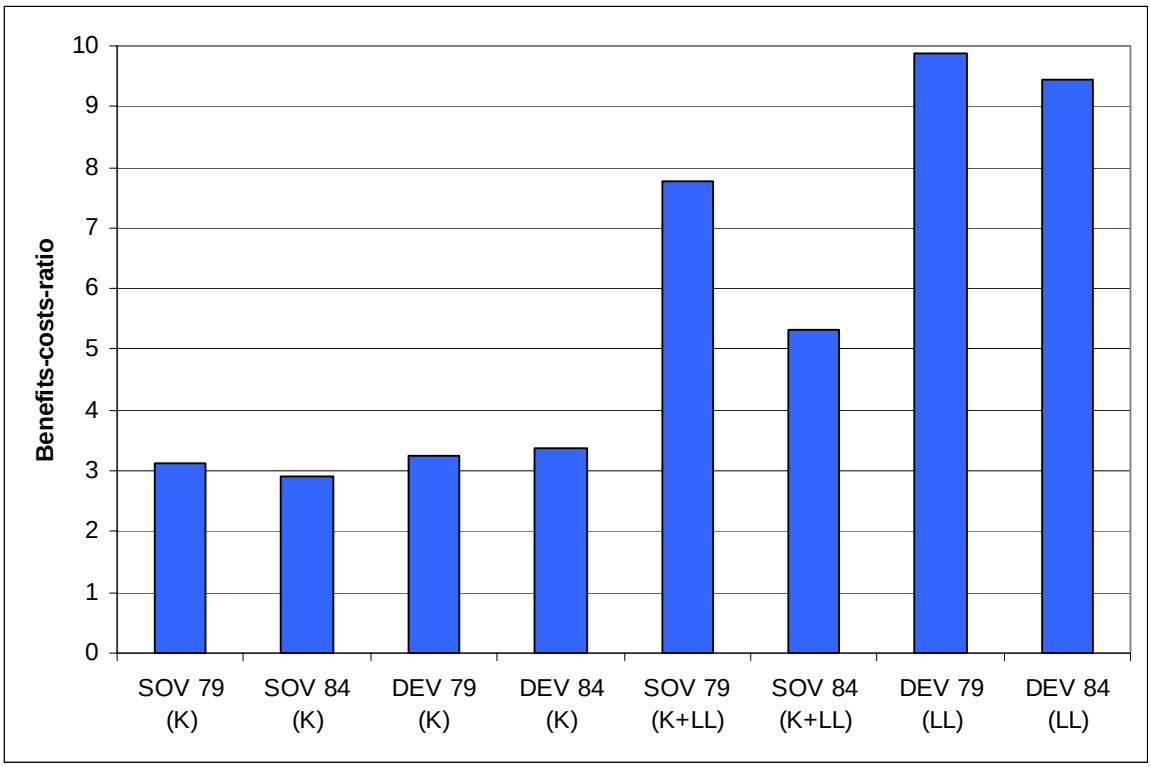

Figure 15: Benefits-costs-ratios for the policy options and scenarios

Table 14: Overview of impacts assessed qualitatively

Impact	**K**		**K+LL**	
	SOV	**DEV**	**SOV**	**DEV**
Reduced infrastructure-related noise abatement programmes	++	++	++	++
Reduced investment in new wagons	0	+	0	+
Reduced maintenance costs for infrastructure	+	+	+	+
Impact on competition within the rail sector	-	0	0	0
Restrictions for 3rd country wagons	-	0	-	0
Environm. impacts of modal shift	-	-	-	0
Energy savings (weight reduction)	+	+	+	+
Reduced risk of forest fires	+	+	+	+
Reduced noise in 3rd countries	+	+	+	+
Reduction of weight handled	+	+	+	+
Increased transparency	0	+	0	+

Explanation: ++: very positive impact; +: positive impact; 0: no significant positive or negative impact; -: negative impact; --: very negative impact

The results of the cost-benefit calculation show for all scenarios considerable net benefits. Furthermore, it needs to be underlined that major benefits of retrofitting could not be

quantified and monetised such as the savings due to reduced infrastructure-related noise abatement programmes, reduced maintenance costs for the rail infrastructure and efficiency gains in fleet management. These benefits have the potential to be of the same order of magnitude as the costs of retrofitting. It can be concluded that retrofitting freight wagon with low-noise brake blocks can be an important measure to reduce the negative environmental impacts of railways and that the need for EU action in this field is confirmed.

For all policy options and scenarios assessed, significant additional costs for retrofitting can be expected in the range of 550 million € to 2.25 billion €. The analysis of the cost structure results in following conclusions:

- For all scenarios the investment for retrofitting is the most important cost; added maintenance costs amount to 13-16% of the total (K-blocks) and 32-45% of the total (LL-blocks); administrative costs amount to 4-7% of the total (K-blocks) and 7-16% of the total (LL-blocks);
- Added maintenance costs constitute a significant portion of the total when retrofitting is considered to be done with K and LL-blocks;
- Added administrative costs do not appear to be decisive although they refer to essential components of the retrofitting programme;

Further to the assessment of costs and savings related to retrofitting it has been analysed which actor would bear the costs and who would benefit from revenues or savings (see Table 15). For both policy options railway undertakings/ wagon owners have to bear the costs directly related to retrofitting (investment and additional maintenance). However, SOV and DEV (only in case of a bonus system) foresee a reimbursement of at least parts of the costs. In case of a cost-neutral bonus-malus-system for DEV, this would not be the case. The study demonstrated that this would lead to a significant increase of transport costs resulting in a modal shift from rail to road in the order of magnitude of 0.4% of the total rail freight demand (see section 5.5.2). As far as the allocation of noise abatement costs in competing modes of transport is concerned, no similar measures have been taken for road transport while in aviation noise-differentiated airport charges are in place at some European airports in accordance with national legislation. Therefore, a deviation from the polluters-pays-principle can be recommended as long as competing modes of transport do not bear similar cost for noise abatement measures.

The impact on IMs is rather small as the bonus granted to RUs would be compensated either by the MS or by revenues from a malus.

MS would provide funding for retrofitting to RUs/ WOs either directly as subsidies or indirectly via the compensation paid to IMs for the noise bonus. However, it is very likely that savings in infrastructure related noise abatement costs will at least outweigh these costs (see section 5.4.5). Overall, retrofitting and providing financial support could be cost neutral for all parties involved as significant savings are possible (even if it has not been feasible within this impact assessment to quantify these savings).

Table 15: Overview of costs and revenues and which party bears them

Cost	RU/ WO		IM		MS	
	SOV	DEV	SOV	DEV	SOV	DEV
Investment for retrofitting	costs	costs	-	-	-	-
Additional maintenance	costs	costs	-	-	-	-
Administrative costs	costs	costs	costs	costs	costs	costs
Funding for retrofitting programmes	revenues compensating investment	revenues compensating investment & maintenance (only bonus system)	-	costs (only bonus system), but reimbursed by MS	costs: subsidy to RU/WO	costs (only bonus system): compensation to IM
Investment for infrastructure-related noise abatement	-	-	savings	savings	savings	savings
Investment cost for renewal of fleet	savings	savings	-	-	-	-
Maintenance costs for infrastructure	-	-	savings	savings	-	-

The comparison of the K-blocks and K+LL-blocks scenarios leads to clear results:

- The retrofitting costs with K-blocks are significantly higher than with LL-blocks (by 750 million to 1 billion € according to the scenario);
- The gross benefits of LL-block retrofitting are higher than those of the related K-block scenario. Even if K-block retrofitting can start earlier (due to the existing homologation of at least one product), in the LL-block scenarios retrofitting programmes are completed earlier as the retrofitting rates with LL-blocks are much higher (brake systems do not need to be modified for retrofitting with LL-blocks, no problems with restricted workshop capacities);
- Therefore, the K+LL scenarios always lead to significantly higher net benefits than the related K-block scenario;
- The elimination of the first year of retrofitting with K-blocks would lead to a further increase in net benefits (see section 5.7); a rapid homologation of LL-blocks is thus an important objective for the effectiveness of the retrofitting programme;
- It can be concluded that the use of K-blocks for retrofitting cannot be recommended provided that LL-blocks will be fully available as from 2011. Certainly, this is not guaranteed but this looks to be a likely scenario as by end of 2007, three products have received a provisional homologation and one of them successfully passed successfully all tests. An earlier homologation than in 2010 would create significant additional benefit. Therefore, the development and homologation of this technology shall become highest priority.

Based on both, the quantitative and qualitative impacts, the comparison of the policy options leads to following conclusions:

- The "business as usual" option cannot compete with the two other ones as these have positive benefits-costs-ratios and several additional positive impacts.
- The DEV option has better benefits-costs ratios than SOV (for the K+LL-scenarios 9.9 compared to 7.8 (1979 birthdate) resp. 9.4 to 5.3 (1984 birthdate). This is confirmed by the qualitative assessment where DEV shows better or equal results for all impacts considered.
- However, it has been shown that the incentivation margin for the DEV option will probably have to be higher than for the SOV option (see section 5.4.4); dividing the SOV/DEV total added cost values in Table 13, it can be seen that an incentivation margin for DEV of at the most 130% (K) or 150% (K+LL) that for SOV would lead to equal total funding for the two options SOV / DEV. Therefore, it is of high importance to limit the aggregated bonus for a silent wagon to the retrofitting costs.

Concerning the intended exclusion of older wagons from retrofitting, two scenarios have been introduced with the limit birthdates 1979 and 1984. Following conclusions can be drawn:

- Before going to the quantitative considerations it is important to note that the values for the number of wagons built after 1979 / 1984 are calculated from the available age distributions with a procedure that does not lead to a great accuracy; furthermore it is unknown whether in the future these wagons will last longer than expected (with the consequence of noisy wagons running for a long time) or disappear quickly;
- Assuming the figures calculated, the choice of a limit birthdate of 1984 would obviously lead to less costs than the choice of 1979 due to the lower number of wagons to retrofit; however in all scenarios and for all values assumed for affected population it can be seen that a reduction in net benefit ensues; it thus can be concluded that to retrofit the wagons built between 1979 and 1984 (limit birthdate 1979) leads to higher benefits than costs.

In addition to the results aggregated and discounted over the time, the annual costs and benefits have been analysed (see Figure 16 and Figure 17).

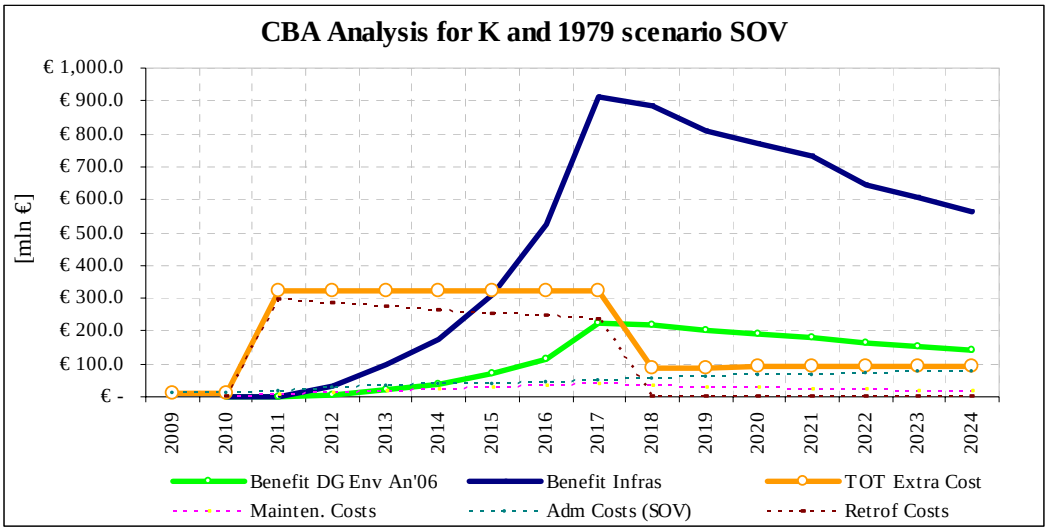

Figure 16: Time-dependent costs and benefits (K, 1979, SOV)

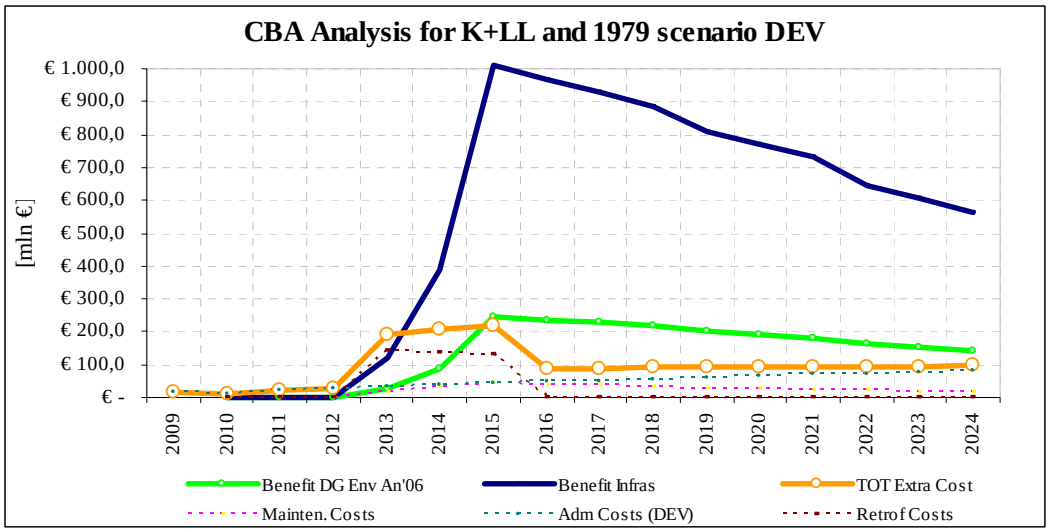

Figure 17: Time-dependent costs and benefits (K+LL, 1979, DEV)

This analysis underlines the advantages of LL-blocks for retrofitting as for K-blocks the costs occur at an early stage but benefits are delayed. For LL-blocks, the two curves are more aligned. Furthermore, these graphs demonstrate a need for ongoing financial incentives to use low-noise wagons as long as their maintenance costs are higher than those of cast-iron braked wagons. Only a mid-term bonus or a bonus-malus scheme on track access charges could provide these incentives.

Furthermore, for K-block retrofitting the initial investment is obviously of higher relative importance; therefore, the policy option SOV fits better to K-block retrofitting than DEV not providing the funding at the time the costs occur. And vice-versa: The more relevant additional maintenance costs of LL-block retrofitting can be better provided by DEV with its continuous financial support.

As overall result of this impact assessment, policy option DEV consisting of differentiated track access charges with a noise bonus for silent wagons, noise emission ceiling and voluntary commitments has been identified as the most appropriate solution to achieve the objectives of rail noise reduction while maintaining the competitiveness of rail freight. The main advantages of this option are the highest benefits in terms of noise reduction/ reduction of number of citizens affected by rail noise (with a benefits-costs ratio of up to 10), lower costs than related to the competing SOV option, the direct link to the objectives of this initiative (to reduce noise by using silent wagons) and its easy application to wagons registered in different Member States or even outside the EU.

As this policy option also has two main disadvantages, solutions need to be elaborated for passing the noise bonuses to the wagon owners/ keepers bearing the costs of retrofitting (if not these same entity as the railway undertaking getting the bonus) and concerning intermediate measures as the implementation of differentiated track access charges requires some time. In this context voluntary commitments could play an important role by addressing the issue of bonuses to be passed to wagons owners as well as a by rapid, but co-ordinated implementation of differentiated track access charges by some infrastructure managers.

The harmonisation of differentiated track access charges at European level is a crucial factor for the effectiveness of this instrument as solely national solutions would not provide the necessary financial incentives for retrofitting and could lead to unacceptably high administrative costs.

High priority needs to be given to the further development and homologation of LL-blocks as the most economic viable technology for retrofitting. By implementing policy option DEV providing incentives to further reduce costs of retrofitting and following the positive examples of the United Kingdom and Portugal of cost-neural retrofitting, it should be possible to reduce the additional costs of retrofitting to a minimum.

7. MONITORING AND EVALUATION

With regard to the objectives of the Communication on rail noise abatement measures addressing the existing fleet, the following indicators seem suitable to measure its progress and the related costs:

(1) Total number and share of vehicles retrofitted per country

(2) Total silent fleet per country

(3) Number and share of axle-km run by low-noise wagons

(4) Costs of retrofitting per country

(5) Annual noise bonuses granted per infrastructure manager

(6) Average annual maintenance cost per wagon (per country and per wagon-km)

(7) Total average noise reduction (dB)

(8) Noise reduction on affected population

(9) Noise reduction at particular “hot spots”

The noise mapping exercise in the framework of Directive 2002/49/EC should be used to assess the success of the retrofitting programmes: Against the 2007 maps as baseline, the effectiveness of retrofitting programmes will be monitored, the need for emission ceilings can be elaborated and the fine-tuning of ceiling values can be carried out. In this context, suitable data related to the indicators 7, 8 and 9 is reported by Member States to the Commission under the above mentioned Directive.

Other data has to be reported by the rail sector (IM: bonus; RU/WO: wagons, costs). Therefore, reporting and monitoring issues should be one element of the voluntary commitment of the sector to promote retrofitting.

Improved awareness on rail noise issues and exchange of information between stakeholders, as encouraged by the Communication, will also contribute to constantly improving the actions undertaken.

ANNEX I: DESCRIPTION OF POLICY OPTIONS

Possible policy options and instruments to support/ promote retrofitting of the European rail freight fleet are listed below (see Table 16) and briefly described. Beside, a 'doing nothing/ no policy change' option will be used as baseline scenario.

A combination of different instruments may be examined, as the problem is rather complex and rail freight and rail noise conditions vary greatly across the EU.

Table 16: List of policy options and instruments

Policy option	**Instrument**
A: Status quo (as baseline scenario)	
B: Voluntary commitment by the rail sector	
C: Financial incentives for retrofitting	
	C1: Differentiated track access charges
	C2: Subsidies for the use of low-noise wagons
	C3: Subsidies for retrofitting
	C4: Loans at preferential terms
	C5: Tax incentives
D: Legal measures to impose retrofitting	
	D1: Noise limit values for the existing fleet
	D2: Operating restrictions for noisy freight wagons
	D3: Noise emission ceiling
	D4: Tradable permit system

1. Voluntary commitment by the rail sector

This option consists of actions paving the way towards a voluntary commitment by the various stakeholders – railway undertakings, wagon owners and infrastructure managers. It is based on the assumption that it would be up to railway associations to take over the central role in organising retrofitting programmes. Commitment is needed from all stakeholders as retrofitting involves action at different levels.

A voluntary commitment could include such components as commitments to individual objectives (e.g. individual retrofitting targets), to set up and implement appropriate retrofitting programmes to define priorities in order to get the best results and/ or to financial contributions from the sector.

2. Financial incentives for retrofitting

To overcome the financing problem, which is the main obstacle to retrofitting, wagon owners could be given financial incentives. As a rule, subsidies granted by Member States to economic actors should be regarded as state aids according to Article 87 of the EC Treaty. The EC Treaty generally prohibits state aid which affects competition between markets actors, unless it is justified by reasons of general economic development. The European Commission is in charge of watching over compliance of state aid with EU competition rules to ensure that this prohibition is respected and that exemptions are applied equally across the European

Union. For this purpose, the Commission services are preparing state aid guidelines for the rail sector. A draft of the guidelines has been made available in December 2007 for consultation with the Member States and stakeholder.

Differentiated track access charges

This instrument addresses the existing financial flow between railway undertakings and infrastructure managers: the track access charge. The railway undertakings would receive a discount on this charge if using low-noise rolling stock.

At European level, Directive 2001/14/EC[34] harmonises charging principles. One of these principles is that infrastructure charges may be set to take account of the cost of the environmental impact of train operations, including noise. Any charge differentiation should in principle reflect the magnitude of the impact on the environment. As Directive 2001/14/EC does not allow an increase in overall revenue (unless there are similar charges for competing modes of transport), two basic models of differentiated track access charges could be used as an incentive:

– A cost-neutral, bonus-malus system;

– A bonus system where the infrastructure manager receives financial compensation from the Member State.

This instrument is applied in Switzerland since 2002 and will be introduced in The Netherlands in 2008/2009.

Subsidies for the use of low-noise wagons

Another instrument for granting financial incentives to railway undertakings to use low-noise freight wagons is subsidies from Member States directly to the railway undertakings. The subsidy scheme could contain components similar to a discount on track access charges.

Article 10 of Directive 2001/14/EC lays down requirements for compensation schemes for unpaid environmental and other costs. It needs to be investigated in detail whether a subsidy scheme for the use of low-noise wagons would fully comply with these requirements.

Subsidies for retrofitting

This instrument consists of introducing noise abatement programmes with direct public financial support. The cost of retrofitting would be partly or fully reimbursed. Subsidies for retrofitting could be granted by Member States or at European level.

Several Member States already have rail noise abatement programmes in place[35]. However, they all cover infrastructure-related measures such noise barriers or insulated windows. In Switzerland, the federal government finances the retrofitting of about 7 500 wagons owned by SBB and 4 000 privately owned wagons with K-blocks. Costs are estimated at EUR 125 million.

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[34] Directive 2001/14/EC of the European Parliament and of the Council of 26 February 2001 on the allocation of railway infrastructure capacity and the levying of charges for the use of railway infrastructure and safety certification, OJ L 75, 15.03.2001, p. 29.

[35] UIC Status Report: Noise abatement on European railway infrastructure, Paris, 2007.

Loans at preferential terms

Loans could be granted to wagon owners at preferential conditions to promote retrofitting, in particular to support the initial outlay. The level of the incentive strongly depends on whether the initial outlay is recouped. For retrofitting with K-blocks, savings on maintenance costs might be possible in some cases. However, full pay-back cannot be expected.

Tax incentives

In general, this instrument provides mechanisms of fiscal incentives by granting tax allowances for operators applying more environmentally friendly solutions. This instrument has been used to encourage the use for car emission abatement measures in several countries. To support retrofitting, composite brake blocks could be excluded from VAT.

3. Legal measures to impose retrofitting

Beside economic incentives, legal instruments could be used to impose retrofitting of freight wagons. These instruments normally entail restrictions on the use of "noisy" wagons. They can be implemented at European, national or regional level.

Noise limit values for the existing fleet

One approach would be to impose noise limit values for existing freight wagons, e.g. by extending the scope of the Noise TSI to the existing fleet while at the same time fixing a calendar for phasing out "noisy" wagons.

Such an instrument has been used in the aviation sector. Regulation (EC) No 925/1999[36] aims at reducing noise originating from aircraft. It prohibits Member States from registering aircraft with poor noise performance.

Operating restrictions for noisy freight wagons

On certain sensitive lines and/ or at certain times (at night), access for noisy vehicle types or train formations could be restricted. Like other instruments such as access charges or emission ceilings, access restrictions require individual vehicles to be identified and classified according to their noise emissions.

This approach has not yet been used to reduce rail noise, but it has been used for noise from aviation. Directive 2002/30/EC[37] allows the operation of aircraft at airports to be restricted following an environmental impact assessment. As a consequence, night flights are not allowed or strictly limited at certain airports.

Noise emission ceiling

The noise emission ceiling limits daily average emissions at a certain location along the line. For example, current noise emission could be taken as a limit to prevent noise from increasing if rail freight transport grows. Under Directive 2002/49/EC, Member States are legally competent to set such limits to environmental noise.

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36 Council Regulation (EC) No 925/1999 of 29 April 1999 on the registration and operation within the Community of certain types of civil subsonic jet aeroplanes, OJ L 115, 4.5.1999, p. 1.

37 Directive 2002/30/EC of the European Parliament and of the Council of 26 March 2002 on the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at Community airports, OJ L 85, 28.3.2002, p. 40.

The noise emission ceiling leaves it to the rail sector to find optimal solutions: the railway undertaking may use vehicles with lower emissions to increase the number and/or speed of trains without exceeding the noise limits. Therefore, the noise emission ceiling gives an incentive to use low-noise vehicles. Noise emission ceilings could directly address noise 'hot spots' in the European network. Furthermore, infrastructure-related measures are also covered by this instrument leading to a holistic approach of rail noise reduction.

Tradable permit system

Under a tradable permit scheme, a specific permit issued by public authorities must be obtained to produce emissions. A polluter who does not have enough permits can either reduce emissions or buy additional permits on the market. In theory, this minimises the cost of emission reductions.

To apply this system to rail noise, a permit could be required for the use of noisy wagons. The number of permits would be reduced every year until the retrofitting target has been achieved.

In Europe, a tradable permit system has been applied to greenhouse gas emissions from power plants and industrial installations since 2005[38]. Extension to aeroplane emissions is currently under discussion.

[38] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC, OJ L 275, 25.10.2003, p 32.

ANNEX II: PRE-SELECTION AND COMBINATION OF POLICY OPTIONS

1. Assessment criteria

With the aim to focus the detailed impact assessment on the most appropriate options, various criteria are used to assess whether the policy options and instruments are suited to achieving the established objectives:

- Effectiveness: Is the instrument suited to achieving the objective of the retrofitting exercise (equipping wagons with low-noise brake blocks, giving priority to vehicles with a high annual mileage)? To what extent?
- Suitability for wagons from other Member States: If measures are to be taken at national level, do they address foreign vehicles as well?
- Implementation time: How long will it take before the instrument will deliver tangible benefits?
- Impact on competitiveness of rail transport: Does the instrument create obstacles to the use of rail freight transport, particularly on the main European corridors?
- Efficiency: How high is the ratio of noise reduction to the cost of the exercise?
- Administrative feasibility and cost: Does the instrument create an additional administrative burden for the rail sector and what are the related costs?
- Consistency with the existing legal framework: Does the instrument fit into the existing European and national legal framework?
- Traceability of the results: Does the instrument easily allow its effects and costs to be monitored? As far as public funds are concerned, transparency is crucial to the scheme's credibility.
- Complementary nature: Is it possible to combine two or more instruments without any negative impact on their individual effectiveness and efficiency?
- Effectiveness for hot spots: Is the option effective regarding the noise reduction for the population effected? Retrofitting wagons do not automatically lead to a noise reduction as they have to be used where many people are exposed to high noise levels (“hot spots”). Does the policy option allow a differentiation regarding location and time?

2. Screening and its results

A screening of the policy options against the criteria is leading to the identification of those policy options that are likely to meet the objectives the best. They are further assessed regarding their environmental, economic and social impacts.

As a result of the public consultation, the policy option D4 (tradable permits) has been excluded as results of the consultation. As the only instrument the majority of the contributors refused tradable noise emission permits. About 40% even strongly disagree. As this instrument is likely to have serious disadvantages like a long implementation time as there is today no legal basis in place, high administrative costs and the missing capability to address rail noise 'hot spots', it has not been further assessed within the impact assessment.

The remaining policy options have been assessed against the criteria leading to a semi-quantitative mark "very good", "good", "medium", "poor" or "very poor". The results are documented in the following tables.

Table 17: Screening of policy options – Effectiveness

	Evaluation	**Comments**
Voluntary commitment (B)	poor	Not legally binding and no economic incentives, however, priority to vehicles with high mileage possible
Differentiated track access charges (C1)	medium	Only indirect impact, but incentive to give priority to vehicles with high mileage; problem of economic advantage to be transferred to wagon keeper
Subsidies for the use of low-noise wagons (C2)	medium	Only indirect impact, but incentive to give priority to vehicles with high mileage; problem of economic advantage to be transferred to wagon keeper
Subsidies for retrofitting (C3)	very good	High effectiveness due to direct impact; financial aid directly to keeper
Loans at preferential terms (C4)	very poor	Low economic incentive
Tax incentives (C5)	very poor	Low economic incentive (tax reduction only provides limited cost reduction)
Noise limit values for the existing fleet (D1)	very good	Legal measures are in general relatively effective
Operating restrictions for noisy freight wagons (D2)	good	Legal measures are in general relatively effective; potential problems with enforcement
Noise emission ceiling (D3)	good	Legal measures are in general relatively effective; potential problems with enforcement

Table 18: Screening of policy options – Suitability for wagons from other Member States

	Evaluation	**Comments**
Voluntary commitment (B)	good	High in case of commitment at European level
Differentiated track access charges (C1)	very good	High (equal treatment of all wagons)
Subsidies for the use of low-noise wagons (C2)	medium	In theory high, but doubts if subsidies given for foreign wagons
Subsidies for retrofitting (C3)	poor	strong doubts if subsidies given for foreign wagons
Loans at preferential terms (C4)	very good	High (no restrictions to certain MS)
Tax incentives (C5)	very poor	Low: only for RUs/ keepers paying taxes in the respective MS
Noise limit values for the existing fleet (D1)	very good	If imposed at EU level
Operating restrictions for noisy freight wagons (D2)	very good	Equal treatment of all wagons
Noise emission ceiling (D3)	very good	Equal treatment of all wagons

Table 19: Screening of policy options – Implementation time

	Evaluation	**Comments**
Voluntary commitment (B)	medium	Potentially fast, but missing legal obligations could lead to delays
Differentiated track access charges (C1)	medium	Depends on bonus and strategy of keepers, could accelerate retrofitting if limited in time, depends on monitoring and identification systems
Subsidies for the use of low-noise wagons (C2)	medium	Depends on amount of subsidy and strategy of keepers and on monitoring and identification systems, could accelerate retrofitting if limited in time
Subsidies for retrofitting (C3)	medium	Depends on design of subsidy scheme and use of existing funds, need for legal basis, notification to the Commission required
Loans at preferential terms (C4)	medium	Slow implementation could be expected, requires time to prepare projects, introduction of scheme needed
Tax incentives (C5)	medium	Slow implementation could be expected (low incentive)
Noise limit values for the existing fleet (D1)	medium	Time for adoption of legislation + transition period
Operating restrictions for noisy freight wagons (D2)	good	Faster to implement than limit values or noise emission ceiling
Noise emission ceiling (D3)	medium	Development of scheme is rather complex and therefore time-consuming

Table 20: Screening of policy options – Impact on competitiveness of rail transport

	Evaluation	Comments
Voluntary commitment (B)	medium	Ensures competitiveness, but financial contributions of sector would increase costs
Differentiated track access charges (C1)	good	Depends on system: bonus or bonus/malus scheme (with compensation for IM); mileage of wagons
Subsidies for the use of low-noise wagons (C2)	very good	Depends on amount of subsidy and mileage of wagons
Subsidies for retrofitting (C3)	very good	Could be cost-neutral for sector
Loans at preferential terms (C4)	very poor	Incentive is rather limited
Tax incentives (C5)	poor	significant contribution of sector required
Noise limit values for the existing fleet (D1)	very poor	High additional costs for sector
Operating restrictions for noisy freight wagons (D2)	poor	High additional costs for sector, but not as high as for limit values as this instrument is more focussed; limits network capacity
Noise emission ceiling (D3)	medium	High additional costs for sector, but flexibility for sector for cost-effective implementation; limits network capacity (but less than operating restrictions do)

Table 21: Screening of policy options – Efficiency

	Evaluation	**Comments**
Voluntary commitment (B)	very good	Provides incentives to sector to ensure efficiency (focussed retrofitting; sector's financial contribution avoids overrunning costs)
Differentiated track access charges (C1)	good	Strong incentive for focussed retrofitting, but risk of 'overcompensation' for high performing wagons
Subsidies for the use of low-noise wagons (C2)	good	Strong incentive for focussed retrofitting, but risk of 'overcompensation' for high performing wagons
Subsidies for retrofitting (C3)	medium	No incentive for focussed retrofitting in case of 100% funding; partly funding ensures efficiency to some extend, only reimbursement of costs occurred
Loans at preferential terms (C4)	very good	Strong incentive for focussed retrofitting as high contribution of sector required
Tax incentives (C5)	very good	Strong incentive for focussed retrofitting as high contribution of sector required
Noise limit values for the existing fleet (D1)	medium	Requires retrofitting of whole fleet (very in-efficient; only if no transition period foreseen), but scrapping/ replacement of old wagons can be expected; high incentive for sector to limit costs
Operating restrictions for noisy freight wagons (D2)	medium	Requires retrofitting of significant parts of the fleet (expected to be in-efficient), but scrapping/ replacement of old wagons can be expected; high incentive for sector to limit costs
Noise emission ceiling (D3)	very good	Leaves freedom to sector to optimise composition of fleet

Table 22: Screening of policy options – Administrative feasibility and cost

	Evaluation	**Comments**
Voluntary commitment (B)	very good	No bureaucracy to be expected; however, agreement and monitoring scheme required
Differentiated track access charges (C1)	medium	Additional burdens due to more complex track access charging scheme (likely to be calculated based on single wagons and not on full trains as today); however, existing financial flow can be addressed
Subsidies for the use of low-noise wagons (C2)	very poor	Funding schemes with interface to data on track access charges/ train composition required; new financial flow from state to keeper: more complex than C1
Subsidies for retrofitting (C3)	good	Funding schemes in-line with state aid provisions required; transparency of costs/ reporting system needed
Loans at preferential terms (C4)	medium	Design of appropriate projects required
Tax incentives (C5)	very good	VAT reduction for composite brake blocks without significant administrative burden possible
Noise limit values for the existing fleet (D1)	medium	Implementation of concept of 'in-use-compliance' required; medium administrative burden if no tests required to demonstrate compliance
Operating restrictions for noisy freight wagons (D2)	medium	Requires more complex train paths management; difficult enforcement
Noise emission ceiling (D3)	medium	Complex calculations for each line, complicated train paths management; measurements required? difficult enforcement; however, automated systems could reduce the burden significantly

Table 23: Screening of policy options – Consistency with the existing legal framework

	Evaluation	**Comments**
Voluntary commitment (B)	very good	No legal basis needed
Differentiated track access charges (C1)	very good	Explicitly foreseen in Article 7 (5) of Directive 2001/14/EC
Subsidies for the use of low-noise wagons (C2)	medium	Could be based on Article 10 of Directive 2001/14/EC; national legal basis to be put in place; compliance with state aid rules to be ensured
Subsidies for retrofitting (C3)	medium	National legal basis to be put in place; compliance with state aid rules to be ensured
Loans at preferential terms (C4)	very good	No legal basis needed
Tax incentives (C5)	medium	National legal basis to be put in place
Noise limit values for the existing fleet (D1)	poor	Implementation of concept of 'in-use-compliance' required which is today not foreseen in the legal interoperability framework
Operating restrictions for noisy freight wagons (D2)	medium	Could be based on Article 8 of Directive 2002/49/EC; national legal basis to be put in place
Noise emission ceiling (D3)	medium	Could be based on Article 8 of Directive 2002/49/EC; national legal basis to be put in place

Table 24: Screening of policy options – Traceability of the results

	Evaluation	**Comments**
Voluntary commitment (B)	good	Monitoring could be part of commitment
Differentiated track access charges (C1)	good	Track access charges revenues are in principle publicly available; noise reduction effect can be calculated on this basis
Subsidies for the use of low-noise wagons (C2)	very good	Subsidies need to be published; noise reduction effect can be calculated on this basis
Subsidies for retrofitting (C3)	very good	Subsidies need to be published; noise reduction effect can be calculated on this basis
Loans at preferential terms (C4)	good	EIB loans are in principle published; noise reduction effect can be calculated on this basis
Tax incentives (C5)	very good	Tax revenues are published; noise reduction effect can be calculated on this basis
Noise limit values for the existing fleet (D1)	medium	Noise reduction effect can be calculated; no information on financial impact available
Operating restrictions for noisy freight wagons (D2)	medium	Noise reduction effect can be calculated; no information on financial impact available
Noise emission ceiling (D3)	medium	Noise reduction effect can be calculated; no information on financial impact available

Table 25: Screening of policy options – Complementary nature

	Evaluation	**Comments**
Voluntary commitment (B)	very good	Fits well to other options (less to legal instruments)
Differentiated track access charges (C1)	good	Fits to voluntary and legal instruments, not to subsidies and tradable permits
Subsidies for the use of low-noise wagons (C2)	poor	Fits to voluntary and some legal instruments, not to other financial instruments
Subsidies for retrofitting (C3)	poor	Fits to voluntary and some legal instruments, not to other financial instruments
Loans at preferential terms (C4)	good	Fits to voluntary and legal instruments, not to subsidies
Tax incentives (C5)	good	Fits to voluntary and legal instruments, not to subsidies
Noise limit values for the existing fleet (D1)	medium	Fits to some financial instruments, less to other legal instruments and voluntary commitments (depends on transition period foreseen)
Operating restrictions for noisy freight wagons (D2)	medium	Fits to some financial instruments, less to other legal instruments and voluntary commitments
Noise emission ceiling (D3)	medium	Fits to some financial instruments, less to other legal instruments and voluntary commitments

Table 26: Screening of policy options – Effectiveness for hot spots

	Evaluation	**Comments**
Voluntary commitment (B)	very good	A commitment could focus on certain lines or corridors
Differentiated track access charges (C1)	good	Bonus for certain lines or corridors possible, but adds more complexity to the schemes
Subsidies for the use of low-noise wagons (C2)	good	Bonus for certain lines or corridors possible, but adds more complexity to the schemes
Subsidies for retrofitting (C3)	poor	No direct link to hot spots; however, wagons used on certain corridors could be given priority
Loans at preferential terms (C4)	poor	No direct link to hot spots; however, wagons used on certain corridors could be given priority
Tax incentives (C5)	very poor	No link to hot spots, low general effectiveness
Noise limit values for the existing fleet (D1)	poor	No direct link to hot spots
Operating restrictions for noisy freight wagons (D2)	very good	Restrictions could explicitly focus on hot spots
Noise emission ceiling (D3)	good	Ceilings could cover hot spots

The summary of results of the screening of the policy options are presented in Table 27 (policy options C1 – C5) and

Table 28 (policy options B, D1 – D3).

Table 27: Screening assessment of policy options providing financial incentives

	Differentiated track access charges (C1)	**Subsidies for use of low-noise wagons (C2)**	**Subsidies for retrofitting (C3)**	**Loans at preferential terms (C4)**	**Tax incentives (C5)**
Effectiveness	medium	medium	good	very poor	very poor
Suitability foreign wagons	very good	medium	poor	very good	very poor
Implementation time	medium	medium	very good	medium	medium
Competitiveness of rail	good	very good	very good	very poor	poor
Efficiency	good	good	medium	very good	very good
Administrative feasibility	medium	very poor	good	medium	very good
Legal consistency	very good	medium	medium	very good	medium
Traceability of the results	good	very good	very good	good	very good
Complementary nature	good	poor	poor	good	good
Effectiveness for hot spots	good	good	poor	poor	very poor
Overall	**good**	**medium**	**good**	**poor***	**poor***

*: very poor effectiveness leading to reduction by one rank in the aggregated result

Table 28: Screening assessment of legal measures and voluntary commitments

	Noise limits for existing fleet (D1)	**Operating restrictions (D2)**	**Noise emission ceiling (D3)**	**Voluntary commitments (B)**
Effectiveness	very good	good	good	poor
Suitability foreign wagons	very good	very good	very good	good
Implementation time	medium	good	medium	medium
Competitiveness of rail	very poor	poor	medium	medium
Efficiency	medium	medium	very good	very good
Administrative feasibility	medium	medium	poor	very good
Legal consistency	poor	medium	medium	very good
Traceability of the results	medium	medium	medium	good
Complementary nature	medium	medium	medium	very good
Effectiveness for hot spots	poor	very good	good	good
Overall	**medium**	**good**	**good**	**good**

As a first approach all "good" rated policy options are selected for further assessment. This is confirmed by the following more detailed evaluation:

- Policy option B, a voluntary commitment by the sector, receives a high mark as it offers various advantages regarding the efficiency, administrative burdens, legal consistency and complementary nature. However, following the experience with the UIC/CER/UIP action programme[39] and due to its poor effectiveness it cannot be regarded as appropriate stand-alone measure.
- The "Differentiated track access charges" and the "Subsidies for the use of low-noise wagons" (C1 resp. C2) follow the same principle idea to grant financial incentives for the use of silent wagons, but C2 requires the establishment of new financial flows between two actors (Member State authorities and RU resp. WO). This leads to significant disadvantages such as high additional administrative burdens and a limited suitability for foreign wagons. As the advantages are rather limited, differentiated track access charges will be dealt with in the detailed analyses whereas the subsidies for the use of low-noise wagons are excluded.
- Subsidies for retrofitting (C3) have on the one hand clear disadvantages like problems regarding foreign wagons and the low effectiveness to address noise "hot spots". However, as there are many strong points like the very high effectiveness and concerning the impacts

[39] In 1998 UIC, CER and UIP proposed the 'Action Programme Noise Reduction Freight Traffic' which aims to retrofit the European freight fleet in use during the next decade. The programme, however, has never started due to technical problems at the beginning and most importantly due to lack of funding.

on railways' competitiveness, this policy option has been selected for the detailed assessment. This selection is in line with the results of the public consultation and the stakeholder workshop where policy options C1 and C3 have been in the focus of the discussions.

- The policy options C4 (Loans at preferential terms) and C5 (Tax incentives) are expected to have a very poor effectiveness as they provide very limited financial incentives for RUs to retrofit. In case of implementation of retrofitting programmes at large scale, this instruments would require major financial interventions from industry and would therefore result in high financial burdens for the sector, leading to an increase of transport prices and potentially to a modal shift towards road transport (higher environmental burden including noise). As other options do provide necessary incentives, C4 and C5 are not further dealt with in the detailed impact assessment.
- Compared to the other legal instruments, noise limits for existing fleet (D1) have been assessed as the most effective policy options of this group. However, the use of this instrument would be a serious threat for rail freight as high costs for the sector would reduce its competitiveness. Furthermore, D1 does not comply with today's legal framework for interoperability that does not foresee the instrument of compliance for rolling stock already in use (unless it gets upgraded or renewed). Therefore, as there are no other significant advantages compared to the other two legal instruments, noise limits for the existing fleet are excluded from the detailed impact assessment.
- The policy options D2 and D3 (Operating restrictions and Noise emission ceiling) offer various advantages (such as high effectiveness, in particular for hot spots) with limited disadvantages at the downside. As the direct comparison does not lead to a clear ranking, both options are selected for the detailed analyses.

As result of this evaluation, the preliminary finding of the screening can be confirmed. Policy options B, C1, C3, D2 and D3 will be further dealt with in the impact assessment.

3. Combinations of policy options

The remaining policy options have been checked regarding possible combinations as according to the results of the public consultation, no single instrument is regarded as sufficient to achieve the objectives. Moreover, it has to be considered that it is quite unlikely that a single solution could be suitable, effective and successful, because:

- legal options not combined with financial incentives would result in excessive burden on the rail sector, for the same reasons which led to the exclusion of policy option D1 (see chapter 0);
- financial incentives not combined with legal measures could not guarantee alone a high retrofitting rate due to a lack of obligatory nature of these instrument. In particular at long term, accompanying legal measures could ensure the effectiveness of retrofitting programmes.

A voluntary commitment by the sector is strongly recommendable in any future scenario; it is considered as a part of all policy options assessed. As stand-alone measures it strongly lacks effectiveness (see Annex II, section 2).

The possible combinations of legal and economic instruments have been further analysed regarding complementarity aspects and possible synergies (see Table 29):

- The two selected financial instruments (differentiated track access charges and subsidies for retrofitting) are difficult to combine. A possible double funding and/or a distortion of competition are two main concerns. The competition issue becomes relevant in case of different funding schemes in Member States. A successive use of both instruments might be acceptable, in particular as subsidies necessarily have a transient character (until the end of the retrofitting programmes); however, further reflections are needed on this issue.
- The combination of the two selected legal measures (operating restrictions and emission ceiling) is possible and potentially advantageous. Simultaneous application of different instruments could distinguish among lines. The application at different times is also possible. However, the implementation of such a combination would be extremely complex to design and would be related to a high risk of non-optimal solutions. Furthermore, the high burden for the sector due to missing financial support clearly led to the exclusion of this combination.
- In case of a combination of differentiated track access charges and operating restrictions (C1 and D2), the added value would be rather limited as the track access charges do not have a significant weak point that needs to be compensated. However, operating restrictions could help to increase the effectiveness of track access charges as RUs/ WOs would have more incentives for retrofitting than in case of a stand-alone policy option. Overall the degree of complementarity of this combination can be regarded as medium.
- These considerations also apply for differentiated track access charges combined with noise emission ceilings (C1 and D3). In addition, synergy effects could be used as both instruments require the implementation of monitoring systems to identify silent/ noisy wagons. Therefore, the administrative costs per individual policy option could be reduced. As consequence, this combination has a higher degree of complementarity as "C1 + D2".
- In case of a combination of subsidies for retrofitting and operating restrictions (C3 and D2), the complementarity would be high as the effectiveness to address hot spots would be higher compared to subsidies as single instrument. In addition, negative economic impact on the rail sector caused by the introduction of operating restrictions would be compensated by the subsidies. Overall, the degree of complementarity of this combination can be regarded as high.
- For the combination of subsidies for retrofitting and noise emission ceilings (C3 and D3), some complementary effects can be expected, in particular regarding the suitability for foreign wagons which would be covered by the ceiling. Other positive effects deriving from the combination of both policy options are more limited than for the combination "C3 + D2" (e.g. emission ceilings have a less direct impact on hot spots and compensate the disadvantage of subsidies in this regard to a lower degree than operating restrictions do). Therefore, the overall level of complementarity of this combination is regarded as medium.

Table 29: Summary of the possible combinations of the selected policy options

		Differentiated track access charges	Subsidies for retrofitting	Operating restriction	Noise emission ceiling
Financial incentives	Differentiated track access charges (C1)		Low	Med.	**High**
	Subsidies for retrofitting (C3)			**High**	Med.
Legal measures	Operating restriction for noisy wagons (D2)				Low
	Noise emission ceiling (D3)				

As the combined measures are regarded as superior to the single policy options, the detailed impact assessment will focus on the two following combinations:

– "SOV": **S**ubsidies for retrofitting, **O**perating restrictions and **V**oluntary commitment (C3 + D2 + B);

– "DEV": **D**ifferentiated track access charges, **E**mission ceiling and **V**oluntary commitment (C1 + D3 + B).

ANNEX III: IDENTIFICATION OF IMPACTS

In accordance with the Commission guidelines for impact assessment the economic, environmental and social impacts are systematically compiled in the following tables.

Table 30: Identified economic impacts

Impact on	Description	Type of assessment
Competition in the internal market	**Investment cost for the retrofitting programme** depending mainly on the number of types and number of wagons of each type.	Quantitative
Operating costs and conduct of business	**Added wagon maintenance costs.** Different wheel and brake block wear-rates will generate different maintenance costs per wagon-km mainly depending on wagon characteristics, type of operation, type of brake blocks.	Quantitative
Administrative costs on businesses	**Added administrative costs for new tasks**. Administrative costs will increase or arise for some MS or IM for the implementation of the monitoring system to identify silent and/ or noisy wagons (differentiated track access charges, emission ceiling, enforcement of operating restrictions); Costs will be incurred to maintain and manage such a system.	Quantitative
Public authorities	**Funding for the retrofitting programme** by MS to provide the necessary financial incentives for RUs and WOs.	Quantitative
Public authorities	**Reduced investment for infrastructure-related noise abatement programme:** Retrofitting could lead to a reduction of future noise abatement programmes today financed by public authorities and usually implemented by IM. However, the reduction is difficult to quantify as the programmes are based on political decisions.	Qualitative
Competition in the internal market	**Reduced investment cost for renewal of fleet:** The current development towards higher performance of freight wagons (annual mileage resp. tkm) could be stimulated by differentiated track access charges by giving preference to using the available silent wagons. This could lead to savings due reduced annual investments in new wagons.	Qualitative
Competition in the internal market	**Competition within the rail sector**: Costs and subsidies for retrofitting might not be equally distributed among the RUs. Competitive advantages/ disadvantages for some market player could be a result.	Qualitative
Operating costs and conduct of business	**Reduced maintenance costs for infrastructure:** Retrofitting would lead to a reduction of damages of rail caused by wheel defect. Savings for IM can be expected.	Qualitative
Third countries and international relations	**Influence of restrictions for noisy wagons on non-EU countries**. The degree of restriction has the potential to affect cross-border trade with non-EU countries.	Qualitative

Table 31: Identified environmental impacts

Impact on	Description	Type of assessment
Noise emission	**Reduction of sound pressure levels.** These positive effects derive from the increase of the fraction of low-noise wagons respect to the total fleet and from the mileage run by these wagons.	Quantitative
Mobility (transport modes) and the use of energy	**Influence on the modal split between rail and road (environmental effects).** The possible modal shift from rail to road could cause a high increase in transport externalities.	Qualitative
Mobility and the use of energy	**Traction energy saving due to reduced weight of brake blocks:** Composite brake blocks are lighter than cast iron ones. This leads to a reduced net weight of freight wagons resulting in savings in energy consumption.	Quantitative
The likelihood or scale of environmental risks	**Reduced risk of forest fires:** Retrofitting reduces the likelihood of fire breaking out due to sparks from the block-tyre interface.	Qualitative

Table 32: Identified social impacts

Impact on	Description	Type of assessment
Public health and safety	**Benefits in terms of noise reduction, population affected by freight rail noise and consequent health effects**: reduction of sound pressure levels to which affected population is exposed (reduction of affected population by railway noise over 55 dB).	Quantitative
Standards and rights related to job quality	**Reduction of weight handled** by wagon maintenance workers due to lighter blocks could lead to improved working conditions and reduced risks of health problems.	Qualitative
Governance, participation, good administration, access to justice, media and ethics	**Increased transparency** due to publication of data on noise exposure.	Qualitative
Public health and safety	**Social impact in 3rd countries**: Reduction of number of people affected by rail noise to be expected in non-EU countries	Qualitative