REDUCING RAILWAY NOISE POLLUTION

STUDY

Executive summary

Abstract

12 million EU inhabitants are affected by railway noise during the day and 9 million during the night. This study lists measures, funding and regulations to reduce it. The introduction of modern rolling stock will lower noise most significantly. In the short run, the replacement of cast iron by composite brake blocks on rail freight cars is most important. Developing a regulation scheme for a staged process towards low-noise rolling stock is the heart of a rail noise abatement strategy.
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EXECUTIVE SUMMARY

According to Member State reports compiled by the European Environment Agency (EEA) in 2010, railway noise affects about 12 million EU inhabitants at day time, with a noise exposure above 55 dB(A), and about 9 million at night time, with a noise exposure above 50 dB(A). In fact, the real figures are undoubtedly higher since the EEA’s European noise mapping initiative concentrates on agglomerations with over 250,000 inhabitants and on main railway lines with over 60,000 trains per year. The railway noise problem is concentrated in central Europe, where the majority of the affected citizens live and the volume of rail freight transport is highest (primarily Germany, Italy and Switzerland, but traffic density is high also in Poland, Austria, the Netherlands and France, and noise mapping indicates that significant population is affected in Belgium and Luxembourg).

Noise is an annoying phenomenon, contaminating the environment and adversely affecting the health of people exposed to high ambient noise levels above 70 dB(A) – or even less. The discussion about railway noise has become very important in several European countries as railway transport increases and plays a more important role in greening transportation. For implementing the sustainability goals formulated in the EC 2011 Transport White Paper and the Greening of Transport package, the environmental impact (carbon, energy, noise, etc.) of railway operations needs to be minimised to maintain rail’s position as a green transport mode – and thereby promote a modal shift to rail, to reduce the environmental impact of transport overall.

In order to analyse the noise situation in Europe, following current EC legislation, the Member States have to provide noise maps and noise action plans. Noise action plans describe the measures taken to lower environmental noise for identified affected inhabitants. However, legal conditions differ widely across Europe as Member States have different limits or threshold limits for environmental noise emissions, and usually these limits are tested only when building new infrastructure or during major redevelopment.

In general, three different sources of railway noise are identified:

- Engine noise
- Rolling noise
- Aerodynamic noise.

Railway noise is largely a problem of freight trains and trains containing older wagons or engines, and is a particularly severe problem during the night. Rolling noise is generally higher from poorly maintained rail vehicles, and from trains running on poorly maintained infrastructure. Aerodynamic noise is particularly relevant for high speed lines where, in most cases, noise limiting measures like noise barriers are implemented; noise barriers reduce the impact of rolling noise, but are usually too low to have any effect on noise originating at the pantograph. Engine noise is most relevant at lower speeds up to about 30 km/h, rolling noise above 30 km/h and aerodynamic noise dominates above 200 km/h. The most important noise source is rolling noise, which affects all kinds of train.

To reduce railway noise pollution, passive measures at the place of disturbance can be distinguished from active measures at the noise source. The most important passive methods used to reduce the impact of railway noise on the environment are noise protection walls and insulating windows, and for the most part action plans and investments of the Member States concentrate on these methods. However, they are only locally effective, requiring huge investments to protect wider parts of railway networks.
In contrast, source-driven measures lower noise across the whole railway system if they are widely introduced. As an example, the problem of noisy rail freight cars can be reduced by the replacement of cast iron brake blocks by composite brake blocks. This is currently being investigated by the railway industry and would affect about 370,000 old freight wagons. Also, wheel absorbers, aerodynamic design of pantographs and noise insulation of traction equipment (e.g., locomotive engines) are measures to reduce noise at source. According to the current Technical Standard for Interoperability (TSI Noise), rolling stock which was introduced since the year 2000 (including engines and passenger coaches or passenger power cars) are required to lower noise emissions by about 10 dB(A) compared to the equipment of the 1960s and 1970s.

In the authors’ opinion, noise should ideally be reduced at the source because these measures have a network-wide effect. Where track infrastructure causes increased noise levels (e.g., structure-radiated noise from viaducts or curve squeal in narrow radius curves), or where the local environment is particularly sensitive to noise (e.g., areas of natural beauty or urban environments with residences very close to the railway line) then additional trackside noise mitigation measures may be necessary. Such measures include friction modifiers, rail dampers, floating (or isolated) slab tracks and of course noise bunds and barriers in various heights. Vehicles and track should all be maintained to eliminate unnecessary sources of noise, e.g., corrugation.

Retrofitting of existing rail freight cars with composite K- or (if approved) LL-brake blocks is the most cost-effective measure on the vehicle side. Additional measures on the vehicle side are wheel absorbers, vehicle-mounted friction modifiers (most effective in urban or sub-urban networks) and (for high-speed trains) aerodynamically optimised pantographs (e.g., shielding or coating). These measures are effective network-wide. Additional research could be made for modified wheel constructions as they are very effective but experiences with accidents lead to reluctance to use new wheel constructions replacing mono block types.

On the infrastructure side, friction modifiers, rail dampers and slab track are cost-effective measures for reducing noise. In densely populated environments and highly trafficked railway sections, the use of noise barriers or coverings cannot be avoided. However, if there is a wide introduction of vehicle-related measures, the number of noise barriers or covers can shrink significantly.

Additionally, wheels and rails need frequent monitoring and maintenance to reduce noise. The surface quality of wheels and rails is a key factor determining rolling noise and deteriorates naturally over time; severely damaged surfaces (out of round wheels or corrugated tracks) are a major noise source.

The European Parliament and European Commission try to encourage the Member States to take more action to reduce railway noise, e.g., by introducing noise-dependent track pricing schemes. Such economic incentives (rail track charging differentiated according to noise emissions) can help to:

- stimulate the use of low-noise technology for the rolling stock;
- foster the use of routes which avoid hot spots for noise;
- foster noise-reducing operational routines and speeds in sensitive areas.
On the regulative side, the Japanese top-runner scheme\(^1\) is an example to come to a long term reduction of noise. The TSI Noise is an appropriate basis for noise regulation in the medium and long term. Presently, the standards for noise emissions are valid for new or modified vehicles only. In the medium and long-term view the TSI can become compulsory for all vehicles. The noise levels in TSI Noise should also be lowered from time to time according to technical development similar to the Japanese example.

In principle, there are three approaches to a noise-dependent track pricing, and each can be configured as a mix of bonus and penalty components:

1. The train-related noise emissions can be measured at critical points in densely populated areas and/or low distances to residential zones and then allocated to the trains causing the noise. The noise mark-up for the track charge then would vary with the local noise level and eventually with the noise exposure of the residential population.

2. The wagons can be classified into noise categories and charged with a noise mark-up or granted with a bonus according to the noise category. The train operator would pay the charge to, or get the bonus from, the infrastructure manager, and pass the bill or grant the bonus to the car owner or operator.

3. Trains can be classified on the basis of the rail car types from which they are composed. In the case of freight trains, the emission category of a train could vary with every change of the train composition in marshalling yards.

The first approach would directly correspond to the polluter-pays principle, but causes high transaction costs for implementation and control. The second approach is the most simple and easy to implement, but neglects the nature of rail noise; a high percentage of noise-reduced cars is required in order to achieve a substantial reduction of train-related emissions. The third approach does not require a sophisticated payment system but needs a functioning (eventually international) information system for wagon control.

The charging schemes can be embedded into appropriate legislative regulations to set a clear framework for long-term activities to reduce railway noise. The following instruments for regulation are possible:

- Limits for stationary and pass-by noise for freight wagons and locomotives;
- Operation and maintenance rules;
- Noise-limiting technology for new rolling stock according to the Japanese top-runner scheme. This scheme aims at reducing energy consumption and climate impact by dynamic setting of emission targets on the basis of current best practice (“top runners’ performance”);
- Retrofitting programmes for vehicles currently in service (phased obligation schedule).

Noise depending track access charges (NDTAC) should be introduced to encourage the vehicle owners to invest in noise reduction measures. At the first stage they should focus

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\(^1\) This scheme aims at reducing energy consumption and climate impact by dynamic setting of emission targets on the basis of current best practice (“top runners’ performance”).
on rail freight wagons but the scheme can include other vehicles or measures later or focus on noise limits without regard to measure to reach the limit.

Importantly, NDTAC should be realised so that no burdens for competitiveness for the rail sector appear. Investment and higher operational costs should be covered. NDTAC should be harmonised in the Member States and each vehicle operating in a national network should be included (also foreign vehicles). To meet the fact that significant noise reductions are only to be achieved if trains are completely equipped with low noise equipment, the NDTAC should favour trains which are nearly fully equipped with these vehicles. To avoid losses in competitiveness lower TAC for low noise vehicles a substantial part should be financed by the Member States. To motivate an early switch to low noise vehicles or retrofitting of existing freight cars also direct funding of investments should be considered for a few years.

**Summary of recommendations**

As rail freight wagons commonly travel across wider international distances, it is essential to harmonise noise legislation policies across Europe. As a result the authors recommend focusing on the following actions:

- Retrofitting the existing freight wagon fleet with low noise braking systems especially by replacing the cast iron by composite brake blocks as the most important and effective first step of source related noise reduction measures.

- Establishing funding schemes to cover the retrofitting and additional operating costs of the new noise reduction technologies to avoid a reduction of the rail sector's competitiveness; a substantial part of costs should be covered by the Member States, since quieter trains will reduce the need for, and therefore the cost of, infrastructure noise mitigation measures.

- Introducing rail track charging systems which differentiate the train charges according to the noise category of a train. The noise classification of a train should be determined by the wagon with the highest noise emission level.

- Making activities concerning NDTAC or noise limit regulation depending on the same actions in road transport to avoid losses of competitiveness for the rail sector.

- Making noise limits by TSI Noise ([TSI Noise 2011] also compulsory for existing rolling stock 10 or 12 years after introduction of funding schemes and noise limits for new rolling stock.

- Adjusting limits of TSI Noise in a phased process for a medium and long-run future to foster the development of new noise reduction technologies.

- Monitoring and maintenance of noise development due to abrasion to assure low noise levels also during operation over long periods.