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Overview of environmental noise limits in the European Region

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ABSTRACT

In October 2018, the World Health Organization (WHO) published environmental noise guidelines based on dose-response curves for relevant noise-related health impacts. The guidelines provide recommended noise limits, but do not describe what consequences of exceedance should be. Also, it is helpful to know how the currently adopted limit values in European countries relate to the recommended limit values. Our research aims to address these questions. To do so, a survey has been sent out to national experts to collect data regarding current critical noise limits. From the output, an overview has been created which allows a comparison of limit values between countries. Also, a comparison is made with respect to the new WHO recommendations, revealing the current state of noise legislation in the European region. In addition, information has been gathered on the scope and basis of these values, as well as detailed information on their assessment, exceptions and legal consequences. From it, general trends in noise level policy and enforcement methods are extracted. The results provide insight in the broad spectrum of noise legislation within the European region and form a basis from which to build best practices for countries that aim to implement the WHO guidelines.

Keywords: Noise, Limits, Health

1. INTRODUCTION

The World Health Organization (WHO) has published its "Environmental noise guidelines for the European Region" in October 2018 (1). To understand how current European noise legislation relates to the recommendations of the WHO, an overview of noise limit values in European countries is wanted. In order to obtain such an overview, the current national situation has been analyzed based on input from national experts in nearly 30 European countries.

This study aims to address two main questions: (a) how do limit values relate to the WHO recommendations? and (b) in which way are limit values implemented: what is their scope, and what are the consequences of exceedance? In this paper we provide the State-of-the-Art of current noise limits in European countries, including a description of related regulations and consequences. From this information, recommendations are derived for countries that aim to implement the WHO guidelines.

2. RESEARCH METHODS

2.1 Scope

The scope of this study is co-determined by the scope of the WHO publication from 2018. Of primary interest are limit values regarding noise immission at the facade of dwellings, outdoors. Like the WHO guidelines, the study differentiates between different sources of sound: roads, railways, aircrafts, wind turbines and industry. Although the WHO does not provide recommendations for industry noise, it is regarded as an interesting supplementary source to take into account as it can have strong negative effects on human health, and as it is included in the END noise mapping obligations.

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The study focusses on national limit values, not on threshold values set in the context of the Environmental Noise Directive. Although countries may determine threshold values in the process of setting up action plans, these values do not protect citizens against noise the same way limit values do, as an actual follow-up of the action plans is not mandatory.

The term 'limit' value is not clearly defined. In this study, in order for a noise limit to be considered a limit value, there needs to be a legal obligation to assess noise levels against that value, even if there are no consequences attached to it. In that sense, a limit value may be used as a 'target value': a value below which there will be no action, and above which there is an obligation to consider taking actions (see Figure 1). Some countries report using both target values and limit values, the latter of which should not be exceeded. Even then, exceptions that allow exceedance of the limit value may apply.

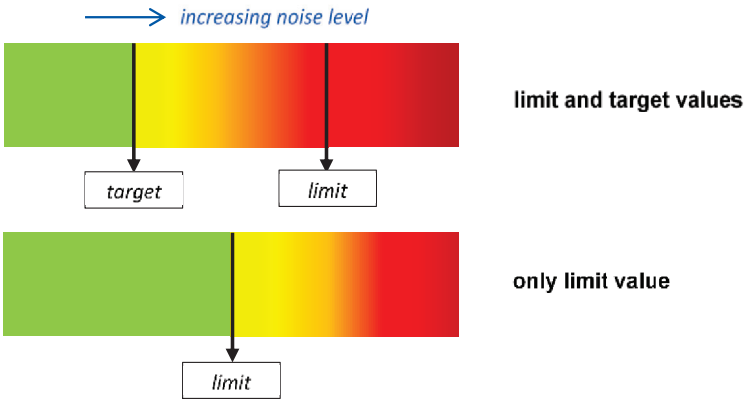

Figure 1 – Limit vs. target values

2.2 Method

Because information available on the internet, such as (2), was not sufficient to get an up-to-date and in-depth overview of noise limits in Europe, it was decided that the most appropriate source of information would be noise experts from the European countries themselves. Therefore, a questionnaire was prepared and sent out to 33 countries represented in the EIONET NRC noise community. The questionnaire was presented in the format of a fact sheet. This was done because the fact sheet in itself is suitable for presentation of the information provided, and secondly, because the fact sheet format provides a way of presenting questions in a structured fashion.

In short, among the following research questions were included:

- What types of limit values exist for the different sources?
- Which quantities are used? Are these all L_{den} and L_{night}, or are other indicators used as well?
- What is the scope of limits in force and what are legal consequences of exceedance?
- Based on which criteria have limit values been established?

The questions in the factsheet are grouped together into eight sections. The first section serves to make a distinction between END threshold values and other national noise-related legislation (see paragraph 2.1). In section two, a bar graph is presented that graphically summarizes limit values set in the particular country. The analysis of the data is based on the limit values that are shown in the bar graph. An example is shown in figure 2.

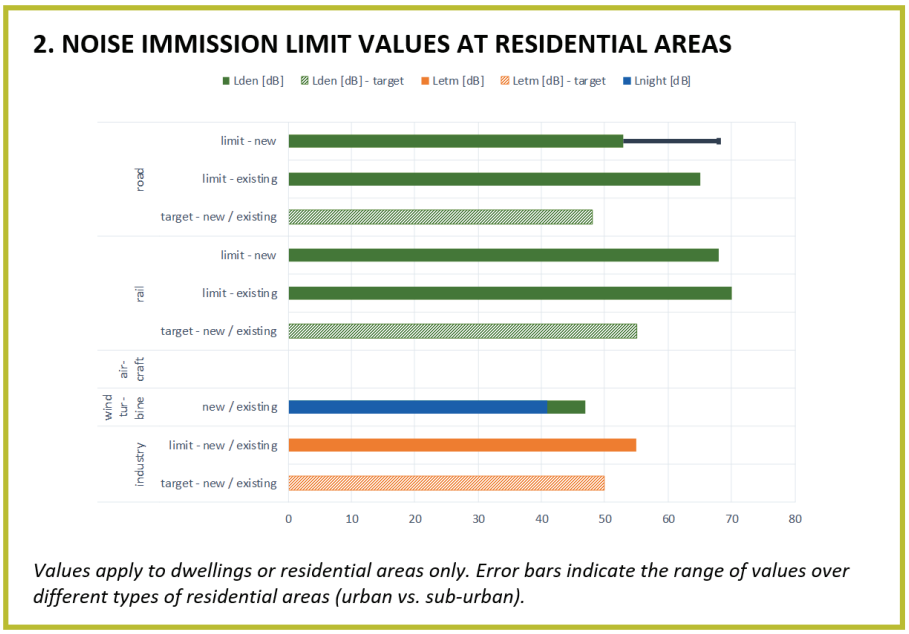

Figure 2 – Section 2 from the fact sheet of the Netherlands, with the bar graph representing the limit values

Under section 3 of the fact sheet, supplementary information is provided regarding the limit values. A definition is given of the indicators (metrics) used, and nuisance penalties and/or correction values are described. Then, under section 4, respondents are asked to choose from a set of possible consequences resulting from exceedance of the limit values. The question is presented in a tickbox format, such that the possibly widely varying forms of consequences and situations to which they apply are brought down to a result that allows for a meaningful analysis of the information provided. Below the tick boxes, additional information may be provided by the respondent.

In section 5, respondents are asked to indicate at which position of the dwelling limit values are assessed. The receiver position, which may be a microphone or a receiver point in an acoustic calculation model, is important for the comparison since it may affect the results. In section 6, respondents are asked how limit values were established. This could be, for example, based on the previous WHO recommended noise limits from 1995, or by a national study including cost/benefit considerations. Finally, under section 7, respondents are asked to provide the name of main legal documents, and any other relevant information may be supplemented under section 8.

3. RESULTS

3.1 Occurrence of limit values

The results show that there is a certain degree of noise legislation in virtually all countries, with 90% of the countries reporting the use of limit values for environmental noise with a legal obligation to assess these, not including countries that use these only as non-binding thresholds for the END action plans. Of all countries with limits, traffic noise limits (road, rail and/or aircraft) exist in 80% of the cases, industry noise limits in 75% of the cases, and slightly more than 50% of the countries have limits for wind turbine noise (see Figure 3). Limit values mostly apply to both new situations (i.e. new dwellings, installations or infrastructure) and existing situations. However, some countries have higher noise limits for existing situations, and 20% of countries have no noise limits for existing situations at all.

A few countries report limits that are not source specific, but defined more generally for a specific receiver area type, applying to the cumulated noise or dominant source. Only limits applying to the dominant source are included in the analysis and do not fall under category ‘none’ in Figure 3.

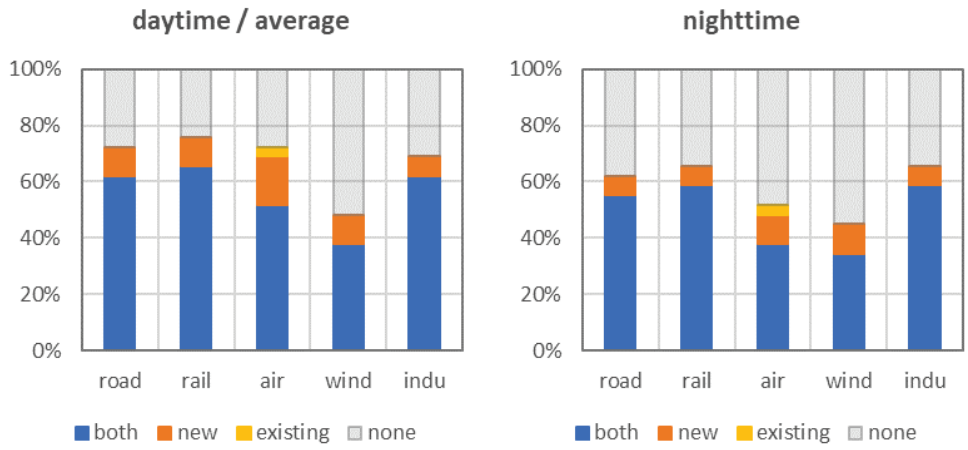

Figure 3 – Occurrence of limit values for different sources, for new situations, existing situations or both.

3.2 Noise indicators

The WHO defines their recommended intervention levels in terms of long-term noise indicators L_{den} and L_{night}. Current noise limits defined in European countries are, in all countries and for almost all sources, defined as long-term noise indicators as well. Several countries report additional limits for short-term noise events, such as Germany, where aircraft noise may not exceed a certain peak level more than 6 times during the night.

As shown in Figure 4, there is a minority of countries that uses L_{den} to define a limit for the average noise levels over the entire 24-hour period, or a combination of L_{den} and L_{night}. Most countries have separate noise limits for the day and night period (L_{day} and L_{night}). Separate $L_{evening}$ limits also exist, and a few countries specifically assess the morning hour between 06:00 and 07:00. Other indicators are rare but do exist, for example: L_{eq24h} (SE), L_{etm} (NL: maximum of L_{day}, $L_{evening}$ + 5 dB and L_{night} + 10 dB) and LVA (IT: specific indicator based on 3-week average day/night levels). In BE (Flanders), a generic dB-value is defined as an industry noise limit, but the corresponding statistical indicator used to assess it (e.g. L_{eq}, L_{50}, L_{95}) is determined per situation.

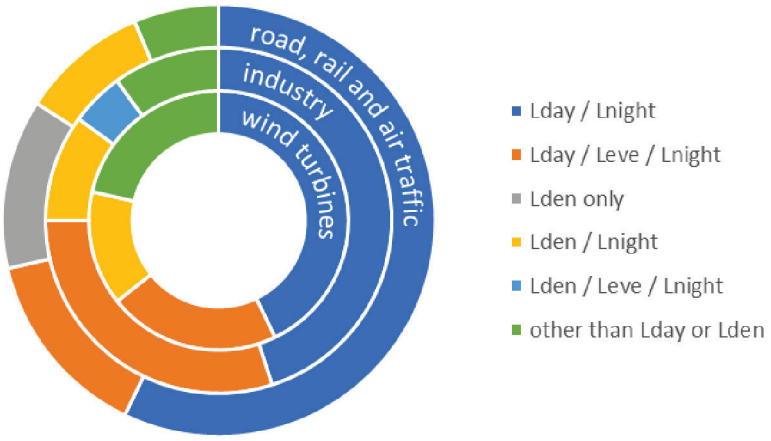

Figure 4 – Indicators used as limits for different noise sources

3.3 The dB-values

3.3.1 Limit values and WHO recommendations

From the country fact sheets, comparable limit values have been gathered that are within the scope and definitions described in section 2. Figure 5 shows the daytime/L_{den} limit values and the L_{night} limit values as a cumulative distribution: the vertical axis shows the countries that report a limit value higher than or equal to the dB-value on the horizontal axis, as a percentage of all countries that have a limit value for that noise source. The dashed vertical lines show the intervention as recommended

by the WHO. Countries that have no noise limits for that noise source and period are not included in the graph. Values selected for these graphs apply to new situations (new infrastructure/installations and/or new dwellings).

The range of limit values is wide. For road and rail traffic, there is range of 18 and 20 dB between the highest and lowest values used as daytime noise limits. For aircraft, the range is smaller (10 dB). For industry noise, there is a higher range (31 dB), but the upper half of that range is covered by only 20% of the countries. For wind turbines, the range is 20 dB. For nighttime noise, L_{night} limit values are typically lower, but the ranges are similar to those found for daytime/average limits, for nearly all sources.

Noise limits are relatively high compared to the WHO recommended noise levels for road, rail, aircraft and wind turbine (daytime) noise. For road and rail traffic, 10% of the countries have limits at or below the WHO values. For aircraft noise, there is not a single country with limits at or below the recommended value. For wind turbines, 6 out of 14 countries have daytime limit values below or at the WHO-level (45 dB). This indicates that there are currently many countries in which noise levels above the WHO-recommended values are allowed. There may very well be noise mitigating actions below the limits, but there definitely are many situations in which there is no obligation to bring down noise levels to a value below the WHO-recommended levels.

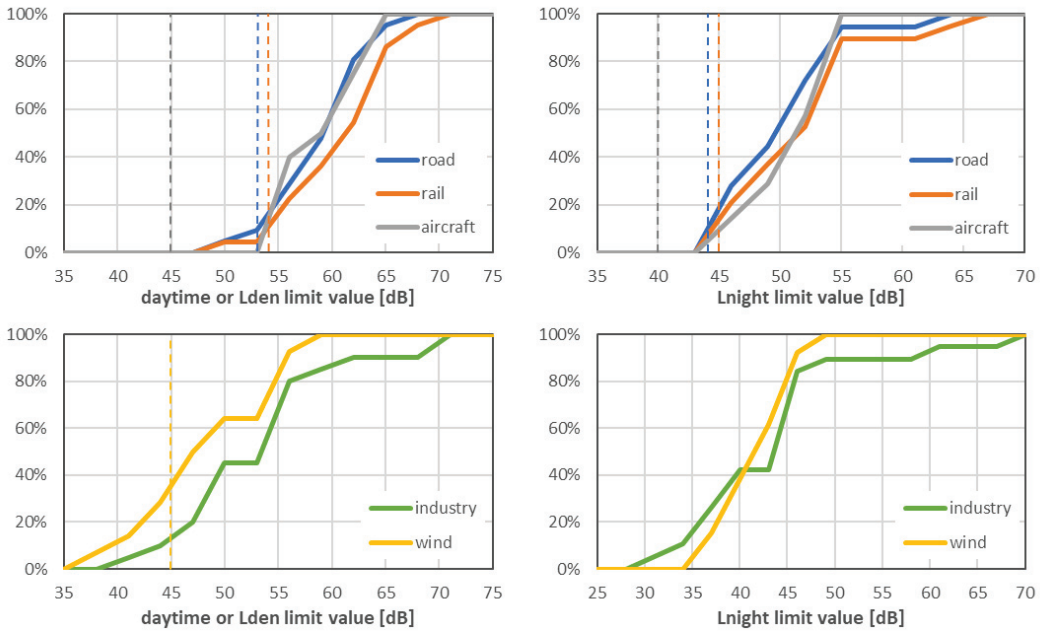

Figure 5 – Cumulative distribution of limits: % of countries with a limit value higher than or equal to the value on the x-axis. Countries without limits for that source have not been counted. Left: daytime/average noise (L_{day} or L_{den}), right: nighttime noise (L_{night}), for traffic sources (top) and industrial sources (bottom).

3.3.2 Differences between noise sources

As figure 5 shows, the cumulative distributions of limit values are quite close together for the three traffic noise sources (road, rail and aircraft). Figure 7 shows a histogram of the difference, within the same country, between rail and road noise limits (*top graph*) and between aircraft and road noise limits (*bottom graph*). Approximately 70% of the countries with limits for road and rail use equal limit values for both sources. Nearly 25% applies a 'rail bonus', i.e. a higher noise limit for rail noise than for road noise. This was in line with earlier dose-response relations (3), that showed a lower percentage of people highly annoyed or sleep disturbed by rail noise than by road noise, at the same L_{den}/L_{night} levels. However, the recently updated dose-response curves underpinning the WHO guidelines, as shown in figure 6, do not support such a rail bonus. In fact, the recent relations show a slightly higher occurrence of annoyance and sleep disturbance for rail than for road traffic noise.

Figure 6 also shows that people are much more annoyed and sleep disturbed by aircraft noise than for road and rail noise. Yet, only 25% of the countries apply lower noise limits for aircraft than for road noise, and 35% of countries actually have aircraft limits above the road limits.

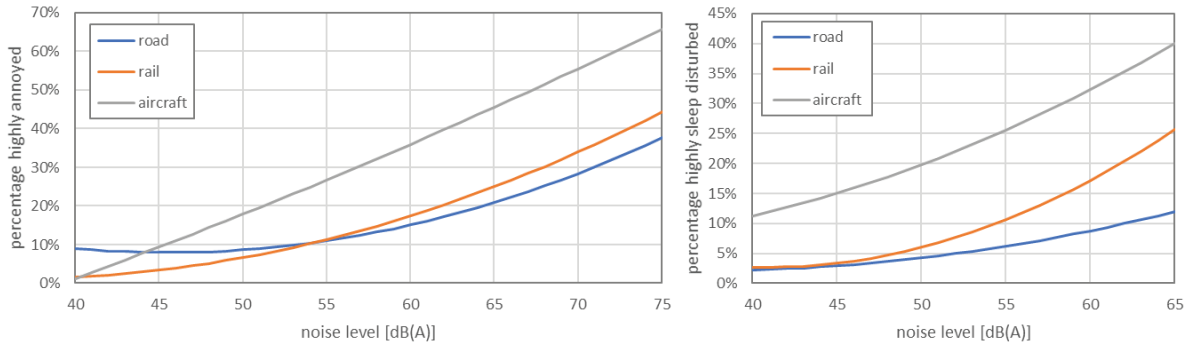

Figure 6 – WHO 2018 dose-effect relations for annoyance and sleep disturbance; left: %HA vs. noise level, for road, rail and aircraft, right: %HSD vs. noise level, for road, rail and aircraft

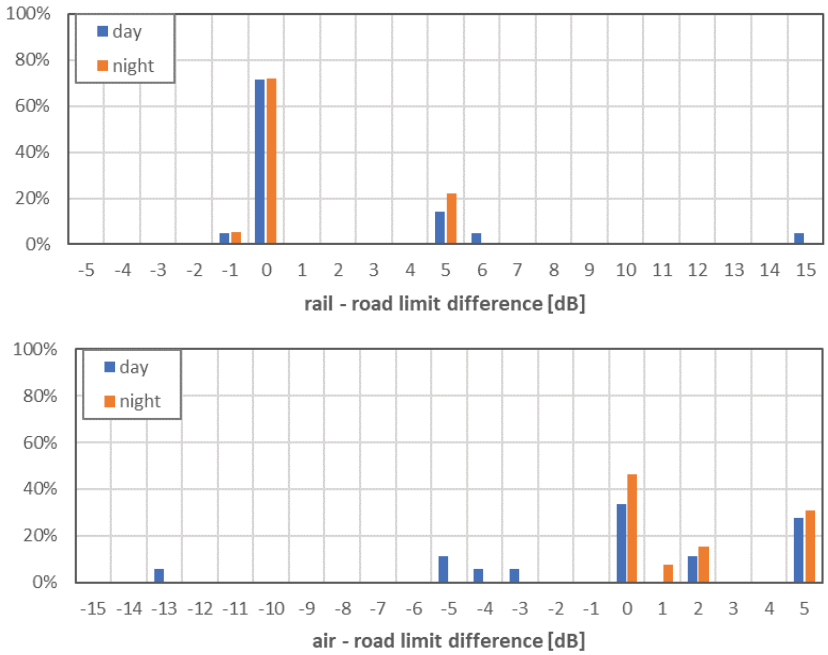

Figure 7 – Difference between limits for rail and road (top) and between aircraft and road (bottom)

3.4 Consequences

Countries were asked for consequences of exceeding the limit values, that range from:

- prohibition: a full stop of the (planned) noise producing activity;
- active noise measures, e.g. silent road or track measures, noise barriers or source reduction measures;
- passive noise measures, e.g. facade insulation or buying out house owners;
- financial sanctions: fines for the installation owner, or financial compensation of exposed people.

And then there may also be further, non-legally binding actions, such as drawing an action plan, monitoring the noise immissions and/or informing the public.

As figure 8 shows, exceeding the limit often leads to a prohibition of operations or construction of industrial installations or wind turbines, but is uncommon for traffic noise sources. The consideration of active noise measures is required in a majority of countries for all sources, often followed by the obligation to take passive noise measures when active measures are not possible or not cost-effective. Financial sanctions are more common for aircraft and industrial sources than for road and rail traffic.

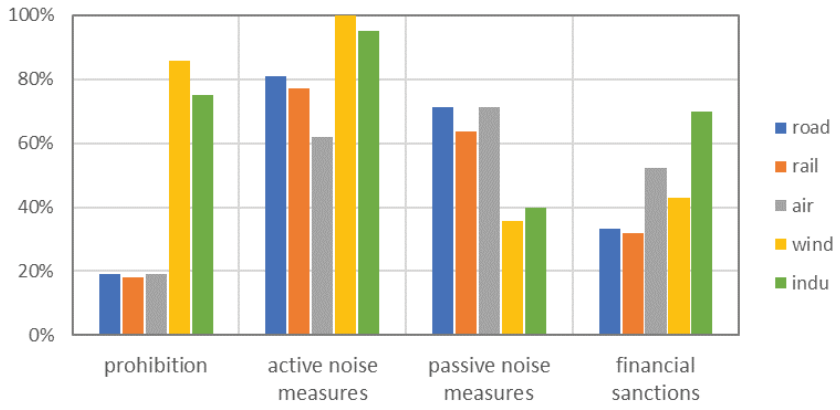

Figure 8 – Occurrence of various consequences as a result of exceeding the limit, for each noise source

3.5 Basis of limit values

About 1/3rd of the respondents indicate that the dB-values are based on the previous WHO-guidelines or the then-used Miedema dose-response curves, often aimed at some level of annoyance (9 to 15%). Another 1/3rd of countries reports a specific national policy-making process to establish their limit values, incorporating national impact studies based on health impacts, cost/benefit data and/or public/stakeholder consultation. About 25% of the respondents did not answer the question about the rationale behind the limit values. The basis for the limit values is not always known or well-documented.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Research questions

What types of limit values exist?

This study aims to provide an overview of the current status of noise legislation in Europe. From the fact sheets, received from nearly 30 European countries, we conclude that there is a high level of noise legislation in Europe that includes assessment of noise immission levels. 90% of the countries responding to our questionnaire report that limit values for environmental noise exist. Of all countries with noise limits, traffic noise limits (road, rail and/or aircraft) exist in 80% of the cases, 75% have limits for industry noise, and 50% have limits for wind turbines. Limit values are most often assessed using L_{day} and L_{night}, sometimes in combination with $L_{evening}$. Less common is the use of the L_{den}, sometimes combined with a separate L_{night} limit, as suggested by the WHO.

What values and quantities are used?

Limit values used in European countries are generally higher than the intervention levels recommended by the WHO. For road and rail, 80 to 90% of the noise limits are higher, and for aircraft noise all countries with limits use values higher than the WHO recommendation. For wind turbines, this is about 60%. The values of the noise limits vary widely, with ranges of approximately 20 dB for road, rail, aircraft and wind turbine noise, and over 30 dB for industry noise.

The dose-response relations presented by the WHO show that the health impact of aircraft noise is stronger than for road or rail noise. In general, this dissimilarity is not reflected in European noise limits, as 75% of countries allow equal or higher levels of aircraft noise than road noise. For rail noise, 25% of the countries have a 5 dB higher rail noise limit than for road noise. Such a 5 dB 'rail bonus' is not justified by the new 2018 WHO guidelines.

What is the scope of these values and what are the legal consequences?

Even if limit values exist, they may not apply everywhere and always. In 20% of the countries, noise limits exist only for new situations (new dwellings, new infrastructure or new installations), and not for existing situations. The value of the noise limit for existing situations may be higher than for

new situations: in 40% of the countries, road and rail noise limits are higher (usually +5 dB) for existing situations. For aircraft and industry noise, this is 20%. For wind turbines, such a difference was not reported.

The impact of a noise limit is determined not only by the dB-value, but to a large extent by the consequences attached to exceeding the limit, as well. A full prohibition of activities or planned constructions is common (75 to 80%) for industry and wind turbines, but uncommon (20%) for traffic noise sources (road, rail and aircraft). A legal obligation to consider the application of active noise measures (e.g. source measures, noise barriers) is common for all sources, often followed by the obligation to take passive noise measures (e.g. facade insulation) if active noise measures are not possible or not cost-effective. Financial sanctions are also a regular instrument (30 to 70%).

4.2 Recommendations

National and local authorities in European countries may be currently considering to update their noise legislation based on the new WHO guidelines. From the results in this report, the following recommendations are given for the implementation of these guidelines:

- When considering new or different values for noise limits, authorities should regard the legislative system as a whole, regarding also the enforcement and legal consequences. Specifically for existing situations, a trigger to assess the noise levels against the limit should exist.
- The legislation should be clear about the objective of any limit or target value: either as a minimum value above which actions should be considered, or as a maximum value that should not be exceeded.
- Following the WHO-recommendations, limit values for road and rail traffic should be similar and limit values for aircraft noise should be considerably lower than for road and rail traffic. This recommendation is purely from a health perspective, however, and other considerations may apply.

4.3 Discussion

The findings in this report are based on data provided by national experts from 29 European countries and, therefore, covers the majority of European noise legislation. The information provided by respondents varies from concise to quite extensive, but generally provides good and complete answers to the questions asked. Nevertheless, the details of national noise legislation are undoubtedly more complex and refined than the summarized descriptions given. Moreover, some level of detail might have been lost in the process of analyzing the data.

It should be noted that noise limits do not directly reflect the real noise levels generally present in a particular country, nor do they relate to the number of people exposed to harmful noise levels. Conclusions about the actual health situation in any country, or in Europe as a whole, should not be drawn from this paper.

ACKNOWLEDGEMENTS

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