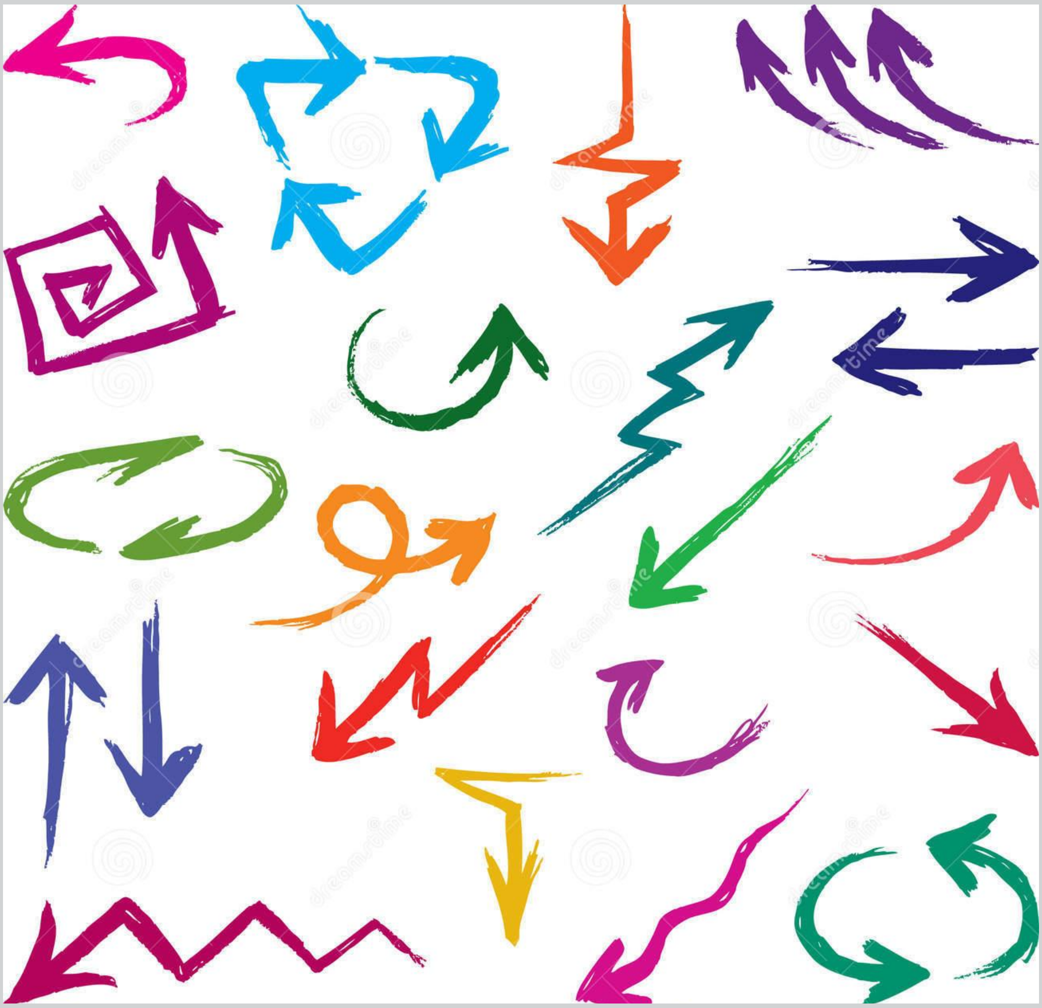
Eionet Report - ETC/ATNI 2019/4

Analysis of changes on noise exposure 2007 – 2012 - 2017

May 2019



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Executive summary

After 18 years of implementation of the Environmental Noise Directive (END) substantial progress has been made in terms of placing noise on the agenda of Member States and taking action to reduce the noise exposure –the final aim. Moreover, the END provides a common approach to avoid, prevent or reduce on a prioritized basis the harmful effects due to exposure to environmental noise.

Changes of number of people exposed during the period 2007-2017 are strongly dependent on the noise source, which reflects different patterns of emissions and different type of management.

Number of people exposed to noise inside agglomerations decreased over the period 2007-2017. However, the observed decrease was more pronounced in 2007-2012 (ranging from 30% decrease in size of population exposed to road noise, to 11% decrease in size of population exposed to airports). In the latest period (2012-2017), the reduction of population exposed was less marked (e.g. 15% decrease of population exposed to industrial noise), or even increasing for population exposed to airports and road noise (8%). Several factors could explain these patterns, although their relative contribution requires further research: a) impact of economic crisis on reduction of traffic in 2007-2012; b) implementation of noise abatement measures; c) differences on the methodology to assess the population exposed.

Number of people exposed to noise from major airports has slightly decreased between 2007 and 2017, with two contrasting periods. In 2007-2012 there was a significant reduction of the number of people exposed (about 32% decrease). The trend in the following period, 2012-2017, was a 18% increase.

The ubiquity of the road network in most European countries is reflected in the trends in numbers of people exposed to noise from major roads. While aggregated figures for Europe show that number of people exposed to noise decreased, some countries have an opposite trend clearly determined by the increase of the length of the road network. These results reflect the complexity of managing the (growing) road traffic and, at the same time, fulfilling the END objectives. However, the results also show good examples with countries that succeed to decrease the number of people exposed even while increasing the road network length.

In contrast with major roads, number of people exposed to railway noise increased about 2% in the period 2012-2017. Changes on the length of major rail have no impact on numbers of people exposed. The particularities of the rail system (controlled traffic with very specific regulations) has not resulted in a more efficient management of noise.

1 Introduction

After 18 years of implementation of the Environmental Noise Directive (END) substantial progress has been made in terms of placing noise on the agenda of Member States and taking action to reduce the noise exposure –the final aim. Moreover, the END provides a common approach to avoid, prevent or reduce on a prioritized basis the harmful effects due to exposure to environmental noise.

The objective of this report is to update on the state of environmental noise in Europe with the most recent information, which allows analysis of changes on noise exposure between the first phase (2007), second phase (2012), and third phase (2017). This analysis is an update of the EIONET report published in 2018 (Fons, 2018).

2 Data and methodology

The data used for this assessment is based on the data reported by countries under the END up to 1 January 2019. The current state of knowledge on noise in Europe is largely based upon the noise mapping data related to the END, which is derived from large-scale modelling exercises at national, regional and city scales, and noise action plans information related to the END.

Where data is available, the analysis covers up to 35 countries, the 33 EEA member countries plus the Former Yugoslav Republic of Macedonia and Montenegro. This includes assessments for up to 525 urban areas, referred to as agglomerations, in which road, rail, airport and industrial noise are considered. The assessment encompasses 92 major airports, 29 countries for the analysis of major rails, and 35 countries for the analysis of major roads. In the following sections, a detailed account of data completeness is provided.

To be taken into account that this report analyses population exposure changes in agglomerations, in major roads, major rails and major airports for which data is available and completed in 2012 and 2017. Therefore, the results of the analysis do not represent the complete territory and trends are likely to change when a higher completeness of reported data is achieved. So, trends shown in this report may not be strictly related to a real increase/ decrease in population exposed to noise: the use of different modelling methodologies across years by countries can lead to changes that are not related to changes in the number of people exposed to noise.

2.1. Data collection and reporting

The reporting obligations set out under the END are contained in a number of provisions, which have been consolidated into the Electronic Noise Data Reporting Mechanism (ENDMR) (EEA, 2012).

The ENDRM categorizes the obligations that Member States have in order to fulfil the END requirements in a series of data flows, compiling information from Member States' strategic noise maps, summaries of the action plan details and designated roads, railways airports and agglomerations in a five-year's cycle. Competent bodies, noise limit values and noise control programs should be communicated to the Commission if updates occurring. The ENDRM data flows have been summarized in the previous Noise in Europe 2014 report (EEA, 2014).

In this analysis, we have used all the available data as 1 January 2019, which includes figures of population exposed to environmental noise for three reference years: 2007, 2012, and 2017.

2.2. Completeness of the END dataset

In order to analyse changes, those entities with a complete set of information for the three reporting years (2007-2012-2017) were selected. Agglomerations and major airports are well-differentiated entities where one can identify the completeness of the data for each individual entity. Exposure to major roads and major railways is reported at country level, although some MS provide disaggregated data by regions. For both, major roads and major rails, only changes for the period 2012-2017 have been analysed due to a change on the traffic thresholds specified by the END between the first phase (2007) and the second phase (2012).

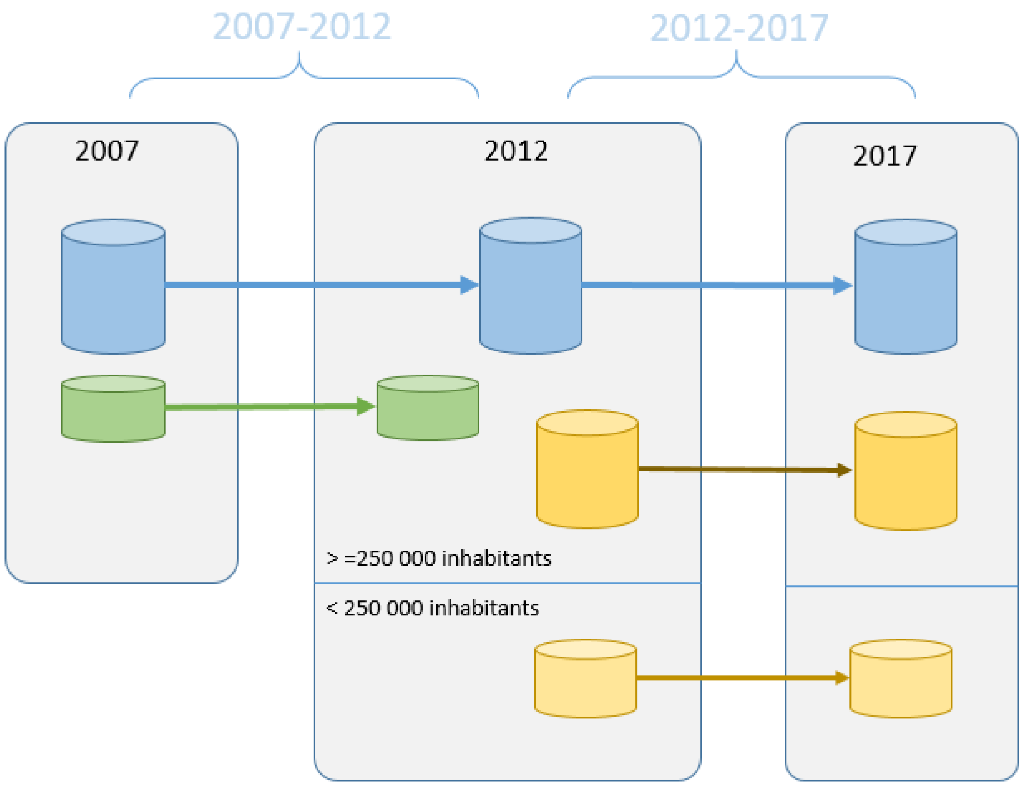
The following sections provide the specificities of each noise source.

Agglomerations

Since data provided by Member States was not complete, different combinations of data availability were found (Figure 1). Consequently, three periods were assessed, according to data availability:

- Entities with available data for 2007-2012-2017. The analysis of changes in agglomerations was conducted for entities that had information available for the three reporting years, i.e. 2007, 2012 and 2017. This is the most suitable situation since it provides a robust comparison over the complete period (data set in blue on Figure 1). It should be noted that in 2007, END reporting obligations were set for agglomerations with more than 250 000 inhabitants. However, starting in 2012, and consecutive deliveries, the scope was broadened to agglomerations with more than 100 000 inhabitants. Therefore, the analysis of changes over the complete period will exclude agglomerations below 250 000 inhabitants.
- Entities with available data for 2007-2012. An analysis of changes was conducted for agglomerations where data was available for 2007 and 2012. Two data sets are included here: data available for the complete period 2007-2017 (in blue on Figure 1) and data only available for the period 2007-2012 (data set in green on Figure 1).
- Entities with available data for 2012-2017. An analysis was carried out for all agglomerations where data was available for 2012 and 2017. Two data sets are included here: data available for the complete period 2007-2017 (in blue on Figure 1) and data only available for the period 2007-2012 (data set in yellow on Figure 1). Data only available for this period includes those agglomerations below 250 000 inhabitants that started to report in 2012 according to the regulations of END.

Figure 1: Overview of different scenarios of data availability for each reference year. In blue: agglomerations where information is available for the three reference years. In green, agglomerations where information is only available in 2007 and 2012. Dark yellow, agglomerations equal or above 250 000 inhabitants where data is only available in 2012 and 2017. Yellow, agglomerations below 250 000 inhabitants where information is only available in 2012 and 2017 -in that case data was not provided in 2007 since they became part of the reporting obligations only in 2012, and consecutive periods. Brackets on top indicate periods considered for analysis of changes.



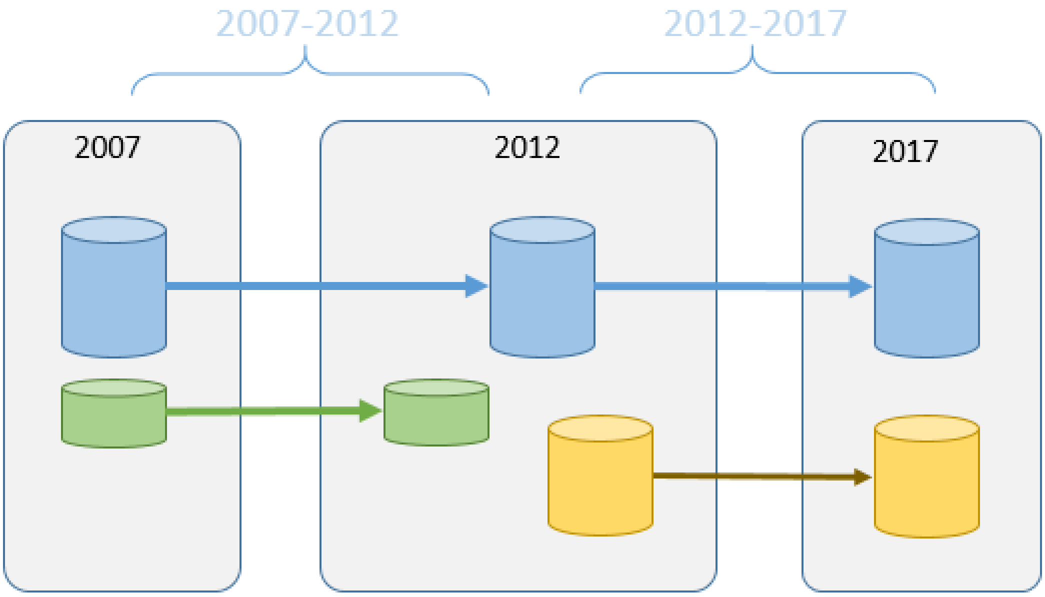
Major airports

In the case of major airports, the same periods of changes as for agglomerations have been considered for analysis (Figure 2). There is also a similar situation regarding data availability: some major airports provided data for the three reference years (in blue in the figure), while other major airports only reported for two reference years (green and yellow data sets). However, in the case of major airports the threshold set by the END to report was the same over all period.

In any case, the three possible analysis, according to data availability, have been conducted:

- 2007-2012-2017
- 2007-2012
- 2012-2017

Figure 2: Overview of data available for each reference year, and possible analysis of changes between different periods. In blue: major airports where information is available for the three reference years. In green, major airports where information is only available in 2007 and 2012. Yellow, major airports where data is only available in 2012 and 2017. Brackets on top indicate periods considered for analysis of changes.



Major roads and major rails

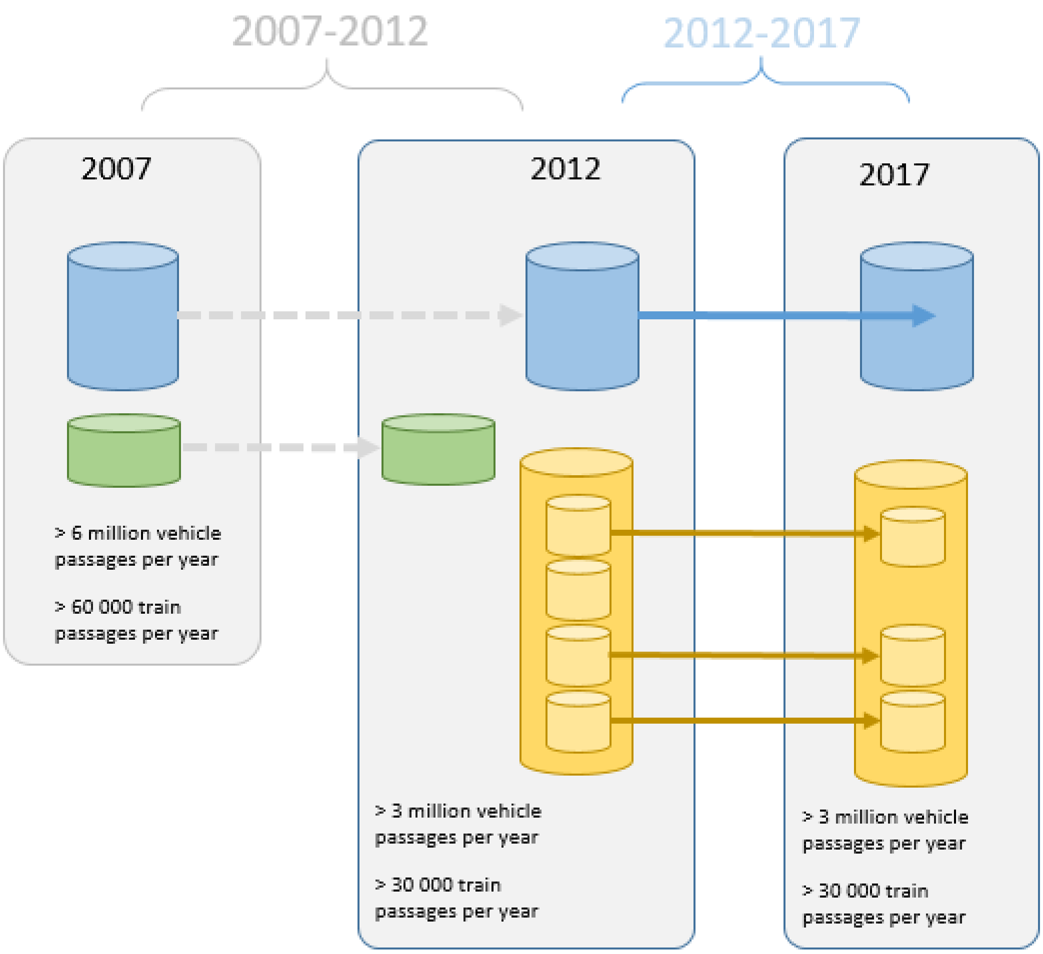
The assessment on completeness of the data reported by member states was based on the following assumptions:

- Data aggregated at country level without any link to the rail or road segments. In that case, it is not possible to check if data on people exposed has been provided for all segments. Therefore, we have assumed that these countries delivered all the data.
- There is an explicit link between the major road or major rail segments to be reported and the provided data on people exposed. In that case, we can check if data covers all the extent of major roads or major rails. This is the case of Bosnia and Hercegovina, Latvia, Lithuania, Poland and Portugal –for major rails; and England, Latvia and Lithuania for major roads.

Figure 3 illustrates the different combinations of data availability that determine the possible changes for analysis:

- 2007-2012-2017. Changes over the complete period could not be analysed since the scope of major roads and major rails broadened in 2012 (see the decrease on passages' thresholds in Figure 3). Given the complexity of the transport network, the code for individual segments has not been maintained between two reference years. Therefore, it is not possible to filter the number of people exposed by passages threshold.
- 2012-2017. This is the only period where changes have been analysed. These changes included those countries that provided data for both reference years (2012, and 2017), according to the criteria above described. Belgium, Germany and UK are particular cases since they provided the data at regional level. Therefore, analysis of completeness has also been done at regional level. This may lead to a situation where data is only complete for some regions, but not for the whole country (see data set in yellow on Figure 3).

Figure 3: Overview of data available for each reference year, and possible analysis of changes between different periods (major roads and major rails). Countries are represented as individual data sets with the same colour. Grey arrows, between 2007 and 2012, indicate that data on exposure is not comparable given the broadening of the scope in 2012 –lower passages threshold. Data set in yellow illustrates the case of a country that reports at regional level; therefore, comparison is also done at regional level.



Overview of data completeness for the analysis

There is a clear contrast between the data available for the first period in agglomerations (2007-2012), which ranges between 58 % (aircraft noise) and 81% (railway noise) of the total data to be reported, compared with the data reported for the period 2012-2017 (around or below 50%, Figure 4 and Figure 5). Consequently, the data available for the complete period, 2007-2017, is also below 50% in most noise sources. Data from major airports is the more complete one, followed by railways and road traffic noise inside agglomerations.

There are no major differences between data reported for noise L_{den} and noise L_{night}, although data completeness is slightly lower in L_{night}, in particular for exposure to noise from airports inside agglomerations.

Major airports have a higher completeness for all the periods considered.

Data completeness for major roads and major rails was only assessed for the period 2012-2017, according to the explanations provided before. About 58% of the countries provided complete data for this period concerning major rails. The percentage is much lower for major roads (40%).

Consequently, changes of people exposed to noise for the complete period should be taken with caution since they only represent 50%, or less, of the different noise sources inside agglomerations. For major airports, the percentage is 52%. To complement this assessment we have also analysed, separately, the two intermediate periods using all the data available for each one. The latter case also includes agglomerations with data available for the whole period 2007-2017.

Figure 4: Data completeness for analysis of changes on people exposed to L_{den} from different noise sources (2007-2017). Percentage indicates the share reporting entities where data is available for a given period, compared to the number of entities to be reported at the beginning of the corresponding period. Reporting entities: agglomerations, major airports, and countries for major roads/major rails.

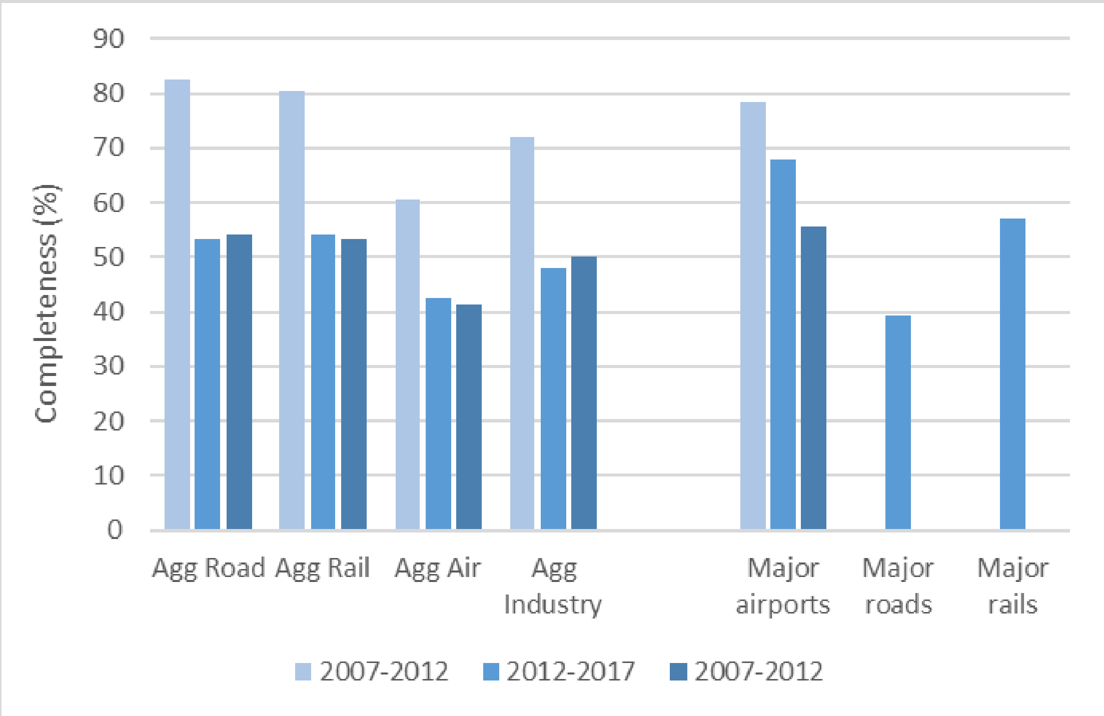
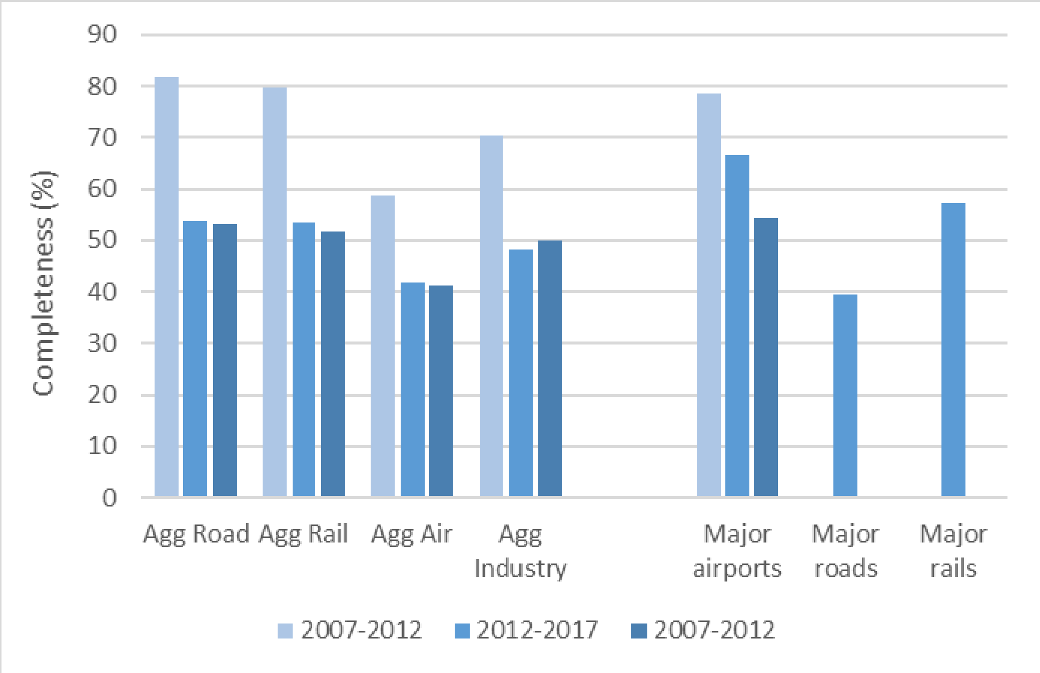


Figure 5: Data completeness for analysis of changes on people exposed to L_{night} from different noise sources (2007-2017). Percentage indicates the share of agglomerations or major airports where data is available for a given period, compared to the number of agglomerations or major airports to be reported at the beginning of the corresponding period.



2.3. Methodology

Since data of people exposed is rounded to hundreds, as required by the END, we have considered that there has not been a significant change of people exposed to noise in the following situations:

- People exposed at the initial year of the period equal or below 500 and change of people exposed equal to 100 inhabitants. It should be noted that 100 inhabitants is the minimum possible change to be reported since data is provided rounded to hundreds.
- No change at all.

These assumptions have been checked in all noise sources and it has been found that they do not introduce any significant change on overall results.

3 Results

This section provides an overview of changes for the complete period. This analysis used all available data. Therefore, comparison of changes between different periods (i.e. 2007-2012 and 2012-2017) should be taken with caution since they do not include the same number of agglomerations, or major airports. For major roads and major rails only the period 2012-2017 is analysed.

3.1. Changes in agglomerations

3.1.1. Overview

During the period, 2007-2017 population exposed to noise inside agglomerations has decreased (Figure 6 and Figure 8). However, a more detailed analysis reveals that:

- **Road** and **rail** remain the sources where more agglomerations have not been able to reduce the number of people exposed. In fact, the situation worsened in the latest period 2012-2017, which resulted in an 8 % increase of people exposed to road noise. By contrast, people exposed to railway noise remained stable in the same period (2012-2017), i.e. the increase of population exposed in half of the cities is counterbalanced by exposed population decrease in a smaller number of cities (39%).

- **Aircraft noise** is the source where more agglomerations succeed in reducing the number of people exposed or keeping it to zero, both L_{den} (Figure 7) and L_{night} (Figure 9). However, three cities alone -Paris, Berlin and Manchester, explain about 63% (L_{den}) and 86 % (L_{night}) of overall population increase in the latest period (2012-2017). These figures illustrate how overall change of people exposed at European level may be strongly influenced by few cities and, therefore, mask the larger number of cities that succeed in reducing people's exposure.
- Observed changes of people exposed could not be attributed to demographic changes. Correlation between changes in total population and changes on people exposed was not significant and very low (r^2 = 0,1). This may be explained because the spatial dimension is not captured with the aggregated figures at agglomeration level. Changes in total population are not equally distributed in all neighbourhoods and, consequently do not necessarily follow the same pattern as population exposed.
- Observed changes could be attributed to multiple factors:
    - The more accentuated decrease of people exposed to noise in the period 2007-2012 occurs at the time of the economic crisis. It has been widely reported the decrease of economic activity and traffic because the economic crisis, which in turn may have reduced the levels of noise. (INRIX, 2016). Therefore, the increase of people exposed to road and railway noise during the second period, 2012-2017, could be partly related to a recovery of the economic activity, and, consequently traffic.
    - Implementation of noise abatement measures. At current stage, it is not possible to establish a direct link or to assess the impact of noise action plans on the reduction of people exposed, although it is expected that with the implementation of some abatement measures from 2009, an improvement of the noise situation would be occurring gradually.
    - Differences on the methodology applied to estimate the people exposed. It has already been mentioned the case of UK. It is suggested to have country consultations on the extreme cases of change.

3.1.2. Detailed analysis of L_{den}

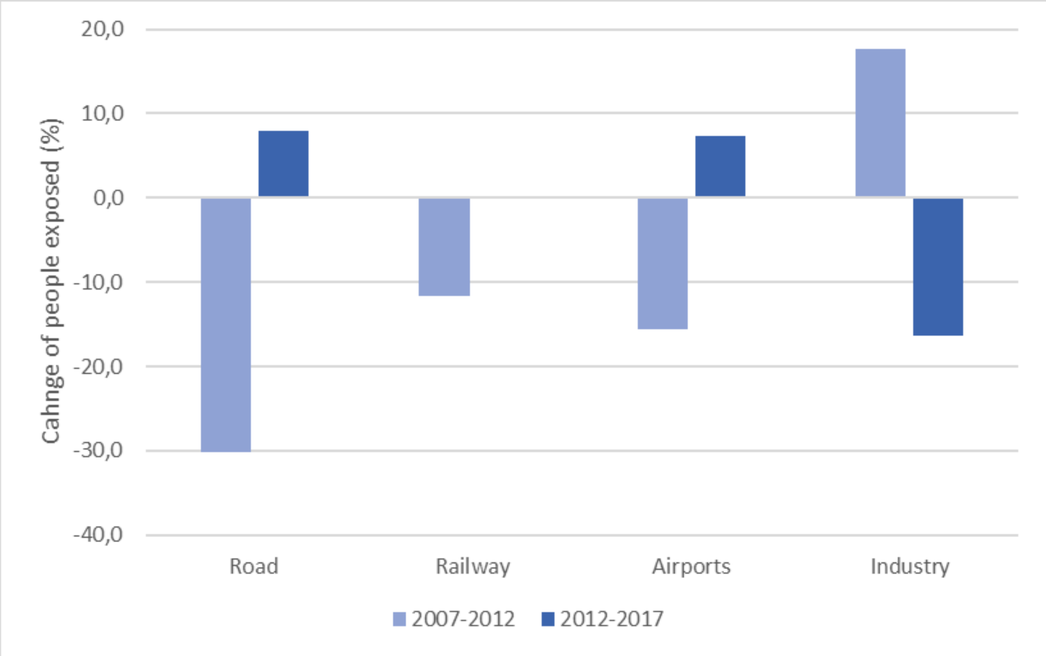
In the period 2007-2012, people exposed to L_{den} noise decreased in all sources (Figure 6), except industry. Since the number of agglomerations differ from one source to the other, percentage of changes have been provided to facilitate the comparison. The larger decrease, in relative terms, occurs on people exposed to road, followed by aircraft and railway sources.

Agglomerations from France and UK, together, explain about 82% of the reduction of people exposed to road noise. Both countries provide data for 37 agglomerations, i.e. 52% of total reported data for the analysis. However, in 2007, the initial year of the period, population exposed to road noise from the agglomerations reported in these two countries accounted for 66% of the total population exposed in Europe (only reported data). Therefore, changes in these two countries have a strong impact on the general pattern. The percentage of reduction is about 61% in both countries.

This is relevant since it is known that UK used a different approach in 2012. Therefore, the decrease of population exposed should also be attributed to these changes. If UK is removed from the analysis, the decrease of people exposed to road is less pronounced (18%). Further clarification from corresponding countries would help to confirm these findings.

In the period 2012-2017, the number of people exposed to L_{den} >= 55 dB decreased only for industrial noise source. For the rest of sources there were no changes (railway) or an increase of 8 % (road and aircraft noise sources -Figure 6).

Figure 6: Percentage of change of people exposed to different noise sources inside agglomerations, L_{den} (2007-2012, 2012-2017). See Figure 7 for the number of agglomerations included in the figure for each noise source and period. Note that there are no changes on people eposed to railway noise for the period 2012-2017.



To understand the processes behind these changes requires analysing the individual performance of each city. In fact, all possible trends have been found: cities where people exposed increases, cities where people exposed remain stable, and cities with a decrease (Figure 7).

These patterns can be analysed considering the objective set on the 7th Environmental Action Programme (EU, 2013): "ensure that by 2020 (...) noise pollution in the European Union has significantly decreased, moving closer to WHO recommended levels;".

During the period 2007-2012, 50% of agglomerations, at least, achieved this objective in all noise sources, except for railway noise (42%). This result can be due to:

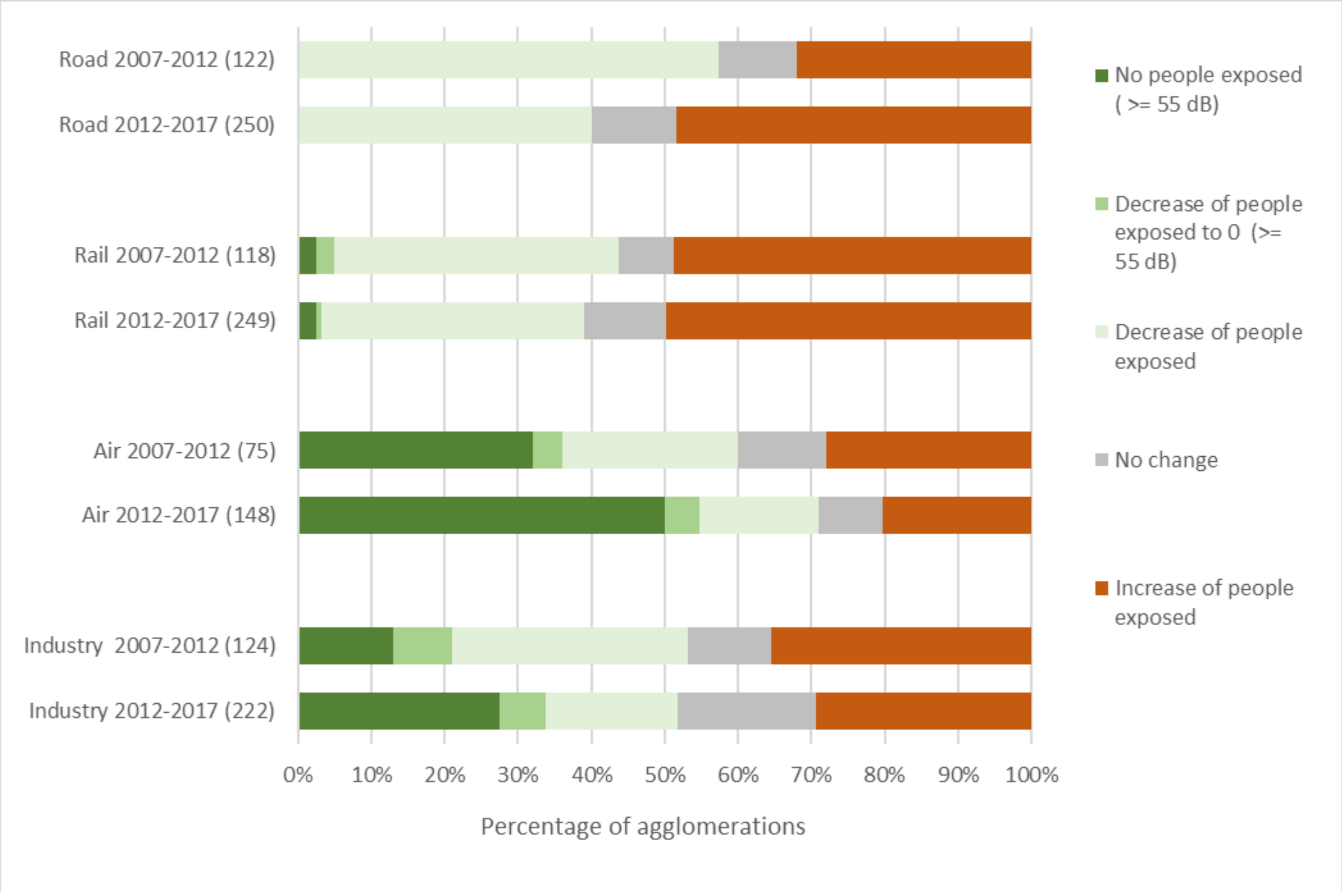
- Noise management and local conditions lead to a situation where no people were exposed to L_{den} noise equal or above 55 dB during the period (dark green in Figure 7). Aircraft noise is the source with more agglomerations in this group (32%).
- Agglomerations that reduced to zero the number of people exposed above the END threshold. This accounts for less than 10% of agglomerations on all noise sources, except for road noise.
- Agglomerations that reduced the number of people exposed, but this improvement was not enough to lead to zero people exposed above END thresholds. This is the predominant trend for road noise (58% of agglomerations) followed by railway noise (40%).

On the other hand, there is still a substantial number of agglomerations without a reduction of people exposed to different noise sources: 50% of agglomerations increased the people exposed to railway noise, and 35% increased the people exposed to industrial noise (in red in Figure 7). Finally, a small number of agglomerations maintained the number of people exposed (in grey in Figure 7).

In the following period, 2012-2017, only aircraft noise had substantial improvements by either reducing the number of people exposed or maintaining it to zero (in total 72% of agglomerations –sum of all green bars in Figure 7). Most of the agglomerations increased the people exposed to railway noise (49%) and road noise (48%).

It may seem contradictory that most agglomerations reduced the number of people exposed to aircraft noise (2012-2017, Figure 7), but when aggregated at European level the resulting balance is a net increase on population exposed (Figure 6). This is explained by three cities (Paris, Manchester and Berlin) which together account for an increase of 155 000 people exposed (2012-2017) and explain about 63% of net increase in Europe. If these three cities are not included, the balance is a decrease of 2 % of population exposed to aircraft noise in European agglomerations. Additionally, this is the only case where the size of the city is relevant, i.e. decrease of population exposed is the predominant process in agglomerations below 1 million of inhabitants, while the increase is predominant on cities above 1 M. These results reflect that aggregated figures may be misleading since the performance of few agglomerations may have a strong influence on aggregated figures and obscure important improvements observed in most cities.

Figure 7. Trends of change of population exposed to different noise sources inside agglomerations, L_{den} (2007-2012 and 2012-2017). In brackets number of agglomerations available for each source and period.

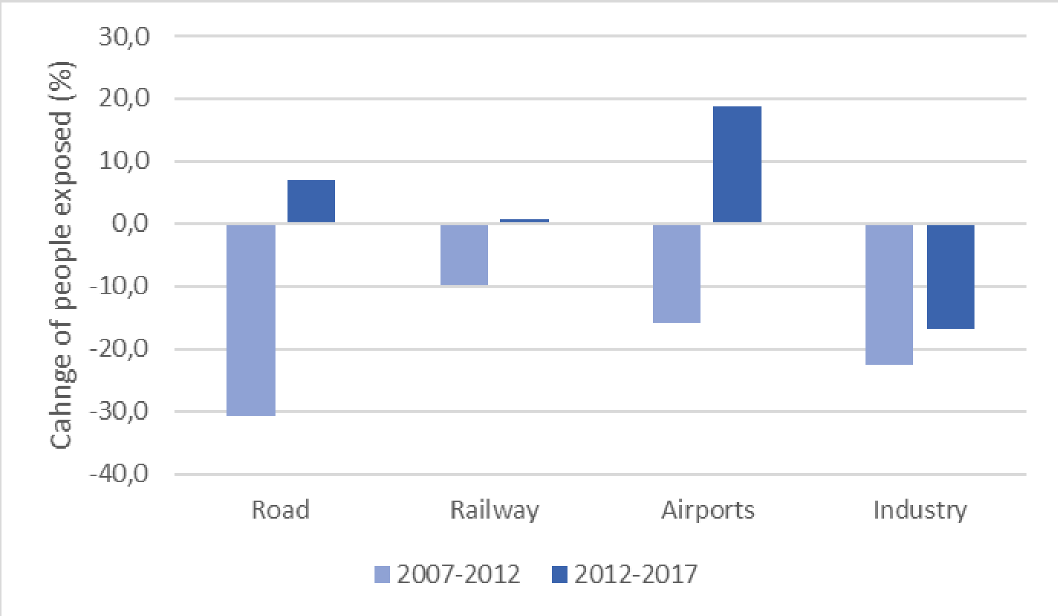


3.1.3. Detailed analysis of L_{night}

In the period 2007-2012, people exposed to L_{night} noise increased in all sources, except industry (Figure 8). The larger increase, in relative terms, occurs on people exposed to aircraft noise, followed by road and railway.

The same issue related to the impact of the exclusion of some streets on data reported from UK in 2012, explained on the previous section, obviously applies here. If UK is removed from the analysis, decrease of people exposed is limited to a 10%. Further clarification from corresponding countries would help to confirm these findings.

Figure 8: Percentage of change of people exposed to different noise sources inside agglomerations, L_{night} (2007-2012, 2012-2017). See Figure 9 for the number of agglomerations included in the figure for each noise source and period.



To understand the processes behind these changes requires analysing the individual performance of each city. In fact, all possible trends have been found: cities where people exposed increases, cities where people exposed remain stable, and cities with a decrease (Figure 9).

These patterns can be analysed considering the objective set on the 7th Environmental Action Programme: "ensure that by 2020 (…) noise pollution in the Union has significantly decreased, moving closer to WHO recommended levels;".

During the period 2007-2012, more than 55% of agglomerations achieved this objective in all noise sources, except for railway noise (45%). This achievement is consequence of three different trends:

- Agglomerations without people exposed to L_{night} noise equal or above 50 dB (dark green in Figure 9). Almost 50% of the agglomerations have no people exposed to aircraft noise above the END threshold.
- Agglomerations that reduced to zero the number of people exposed above to END threshold. This accounts for less 10% of agglomerations on all noise sources, except for road noise.
- Agglomerations that reduced the number of people exposed, but there remain people exposed. This is the predominant trend for road noise (59% of agglomerations) followed by railway noise (45%).

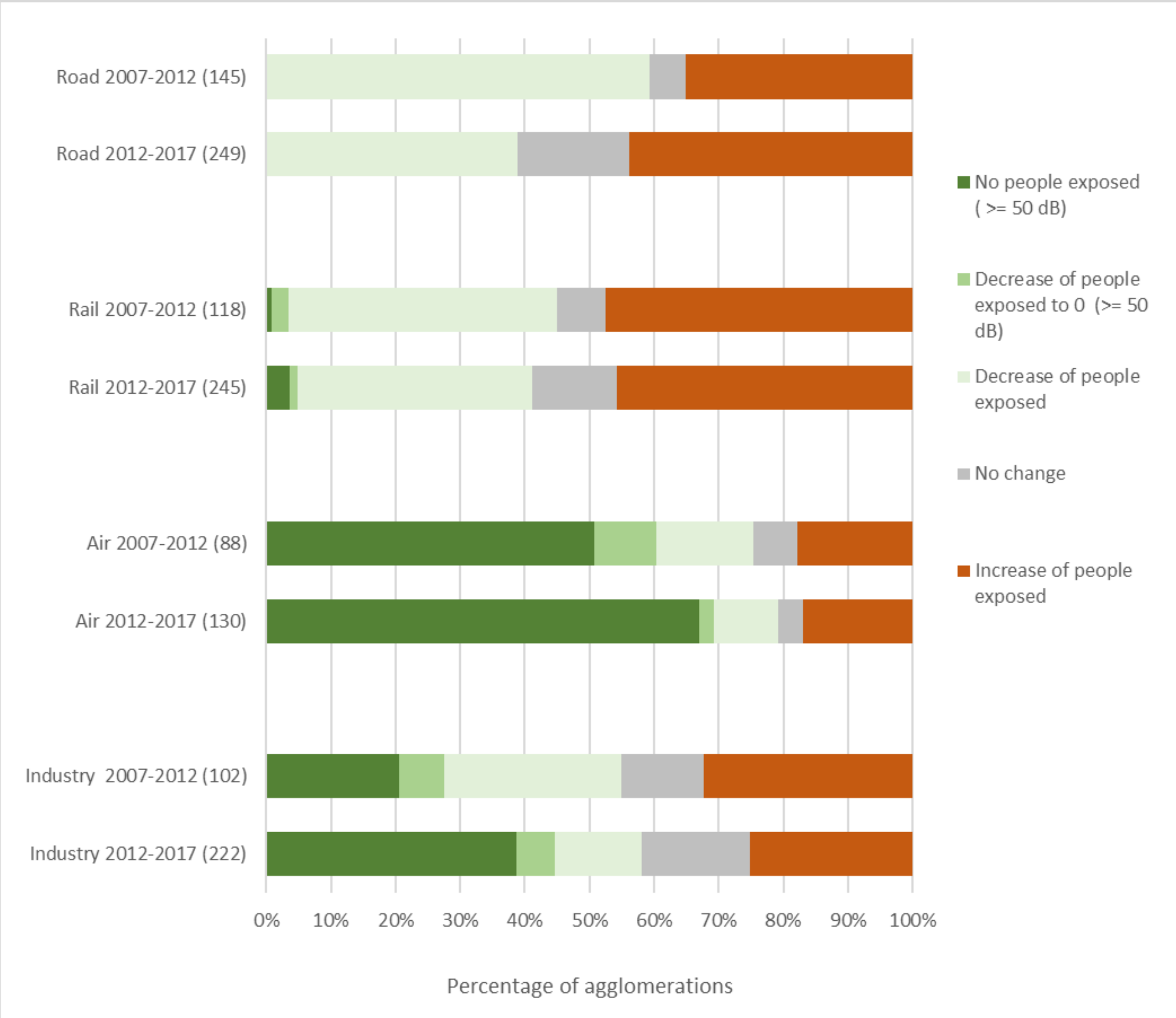
By contrast, there is still a substantial number of agglomerations without a reduction of people exposed to different noise sources. In fact, 48% agglomerations increased the people exposed to railway noise, and 35% increased the people exposed to road noise.

In the following period, 2012-2017, only aircraft and industrial noise had substantial improvements by either reducing the number of people exposed or keeping it to zero (in total 78% of agglomerations for aircraft noise and 58% for industrial noise –sum of all green bars in Figure 9). Most of the agglomerations increased the people exposed to road noise (54%) and railway noise (48%).

As was observed in the case of L_{den}, we found the same situation related to people exposed to aircraft noise: while the total number of people exposed, aggregated at European level, increases, most of the agglomerations succeed in reducing the number of people exposed. This is explained by the same three cities (Paris, Manchester and Berlin) which together account for an increase of 36 700 people exposed (2012-2017) and explain about 60% of net increase in Europe. If these three cities are not included, the balance is a marginal increase of 1 % of population exposed to aircraft noise in European agglomerations. Additionally, this is the only case where the size of the city is relevant, i.e. decrease of population exposed is the predominant process in agglomerations below 1 million of inhabitants, while the increase is predominant on cities above 1 M. These results reflect that aggregated figures may be misleading since the performance of few agglomerations may have a strong influence on aggregated figures and obscure important improvements observed in most cities.

Therefore, one can conclude that at European level, people exposed to noise inside agglomerations decreased (Figure 8). However, there are still a substantial number of agglomerations where the trend is the opposite: increase of people exposed. These figures are counterbalanced by agglomerations where people exposed decreased (Figure 9).

Figure 9. Trends of change of population exposed to different noise sources inside agglomerations, L_{night} (2007-2012 and 2012-2017). In brackets number of agglomerations available for each source and period.



3.2. Changes in major airports

3.2.1. Overview

People exposed to noise from major airports has decreased between 2007 and 2017. However, two contrasting periods could be identified. In 2007-2012 there were a significant improvement on the reduction of the number of people exposed. This trend was reversed in the following period, 2012-2017, since most airports experienced an increase of population exposed to both L_{den} and L_{night}. Therefore, people exposed to airport noise outside urban areas increased substantially.

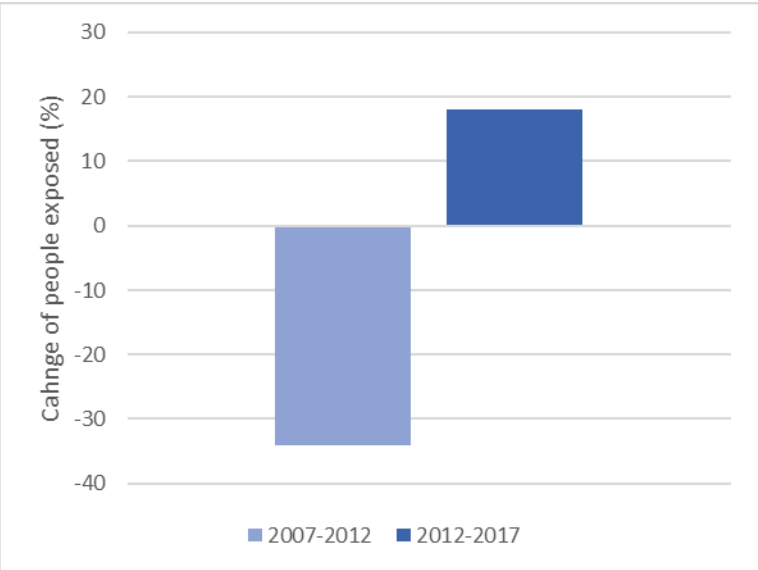
Airport traffic does not explain the observed patterns. For example, Schiphol, Frankfurt or Hamburg airports, with important increase on the number of flights, have been successful in reducing the number of people exposed. On the other side, airports that are highly linked to tourism as Malaga, Ibiza, or Gran Canarias, have significantly increased the number of people exposed.

3.2.2. Detailed analysis of L_{den}

In the period 2007-2012, the number of people exposed to noise from major airports decreased by 34%. It has been followed by an increase of 18% in the following period 2012-2017 (Figure 10). This pattern is similar to the one observed on people exposed to aircraft noise inside agglomerations.

Lisbon is the airport with a higher increase (127 000 people), accounting for 66% of the total increase of people exposed. On the other side Amsterdam Schiphol Airport is the airport with a higher decrease on people exposed (51 600 people), a trend already observed in the previous period.

Figure 10: Percentage of change of people exposed to major airports, L_{den} (2007-2012, 2012-2017). Number of major airports where data is available: 62 (2007-2012), 53 (2012-2017).



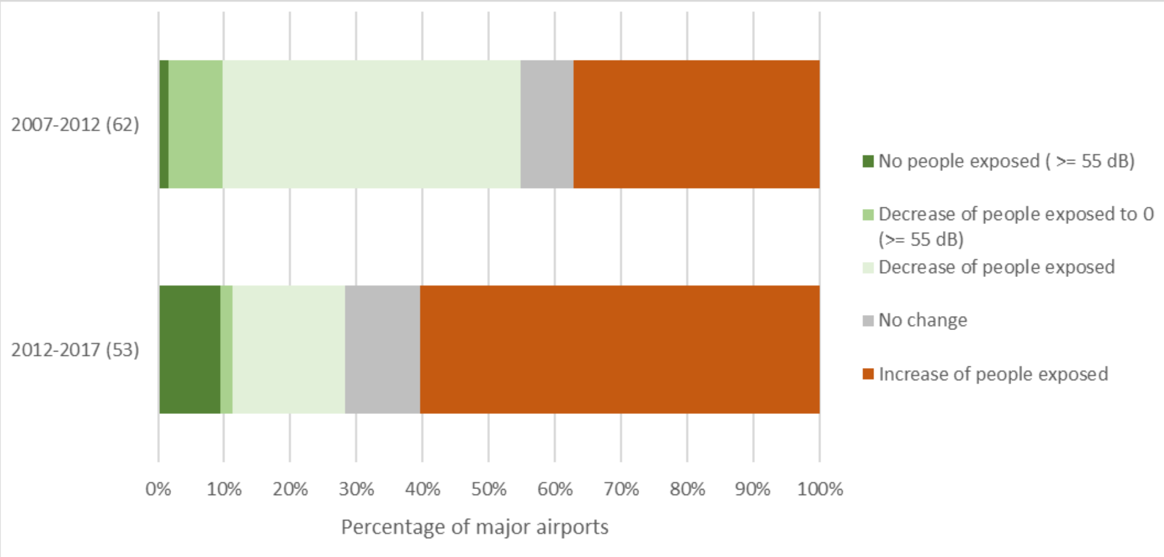
When looking at trends individually, in each major airport, all possible patterns have been found, from exposure decrease (by different degree), no change, to increase of people exposed (Figure 11).

People exposed to noise above the END threshold remained zero or has been reduced by different degree in 55% of the major airports (2007-2012). This positive trend was counterbalanced by 33% of major airports where the number of people exposed increased in the same period.

In the subsequent period, 2012-2017, about 60% of major airports increased the number of people exposed. A substantial change compared with the previous period, which is in line with the overall increase of people exposed (Figure 10).

Portugal, Spain and UK are the countries with a greater number of airports where population exposure has increased.

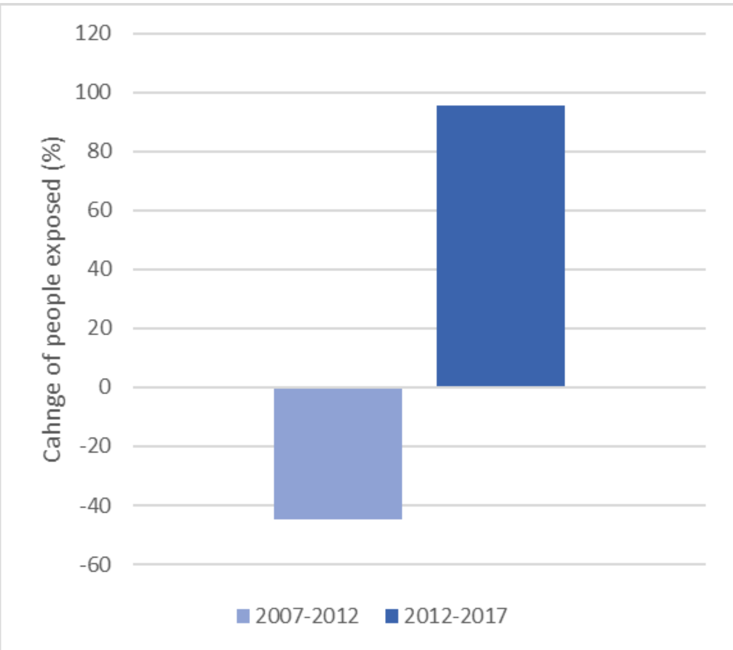
Figure 11: Trends of change of population exposed to major airports, L_{den} (2007-2012 and 2012-2017). In brackets number of major airports available for each period.



3.2.3. Detailed analysis of L_{night}

In the period 2007-2012, the number of people exposed to noise from major airports decreased by 47% (Figure 12). However, there is a dramatic increase in the following period 2012-2017, mainly explained by two airports London Heathrow Airport and Lisbon Portela Airport. Both airports explain 60% of the total increase of people exposed to major airports in Europe (only reported data).

Figure 12. Percentage of change of people exposed to major airports, L_{night} (2007-2012 and 2012-2017). Number of major airports where data is available: 62 (2007-2012), 52 (2012-2017).



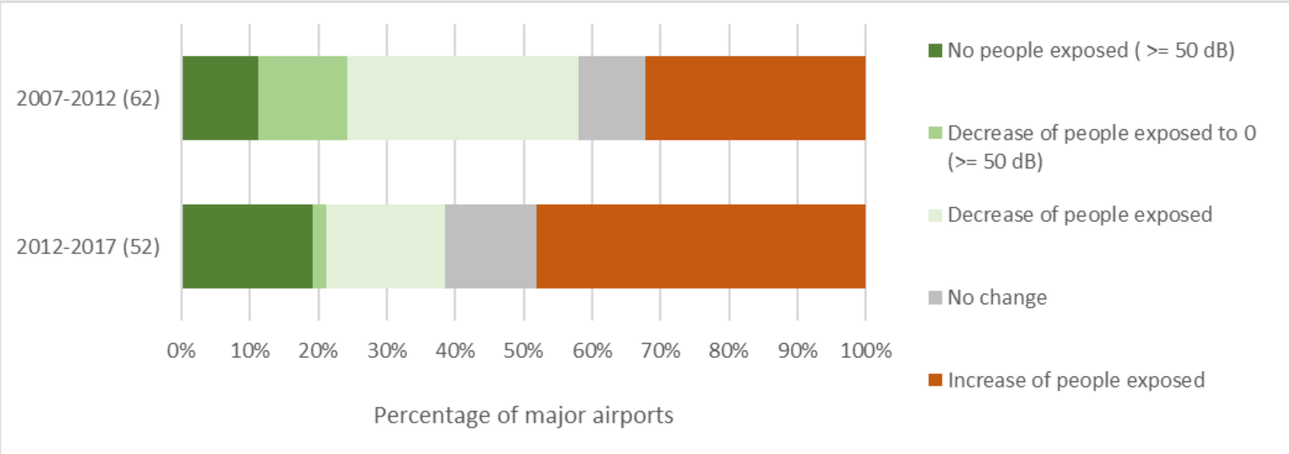
Changes observed on population exposed in the two periods are also reflected on the individual trends of major airports (Figure 13).

People exposed to noise above the END threshold remained zero or has been reduced by a different degree in 59% of the major airports (2007-2012). There were still 32% of major airports where the number of people exposed increased in this period.

In the subsequent period, 2012-2017, about 58% of major airports increased the number of people exposed. A substantial change compared with the previous period, which is in line with the overall increase of people exposed (Figure 12).

Portugal, UK and Germany are the countries with a greater number of airports where population exposure has increased.

Figure 13. Trends of change of population exposed to major airports, L_{night} (2007-2012 and 2012-2017). In brackets number of major airports available for each period.



3.3. Changes in major roads

3.3.1. Overview

The ubiquity of the road network in most European countries is reflected in the trends of people exposed to noise from major roads. While aggregated figures for Europe show that people exposed to L_{den} decrease by 129 000 people (Figure 14), some countries have an opposite trend clearly determined by the increase of the length of the road network (Figure 15).

The situation is worst for people exposed to L_{night} since the overall figures indicate a slight increase in people exposed.

These results reflect the complexity of managing (growing) road traffic and, at the same time, fulfil the END objectives. However, the results also show good examples with countries that succeed to decrease people exposed even increasing the road length.

3.3.2. Detailed analysis of L_{den}

During the period, 2012-2017 people exposed to major roads has decreased in most of the countries and regions analysed (Figure 15). Consequently, the total number of people exposed in Europe has also decreased by 129 000 people, 0,6 % (Figure 14).

Countries that faced an increase of people exposed had a significant correlation with the increase of the length of roads to be reported during this period (R^2 = 0.69). The increase of length could be attributed to two complementary factors: a) new road infrastructure developed over the period; b) increase of the traffic on the existing road network. However, an increase on the length of the road network does not always implies and increase on people exposed. For example, the road network in Czech Republic increased by 2240 km between 2012 and 2017, but people exposed decreased by 1,6 %.

Figure 14: Change of people exposed to noise from major roads, L_{den} (2012-2017). Decrease of population exposed includes only countries where people exposed has decreased; increase of population exposed includes only countries where people exposed has increased. Total change is the net balance for the given period. Countries included: AT, BE, BG, CH, CZ, DE, DK, ES, FI, FR, GB, HR, HU, IE, LT, LU, LV, MT, NL, NO, PL, SE, and SI. In case of Belgium, Germany, and UK information is provided at regional level and each region is accounted as a reporting entity.

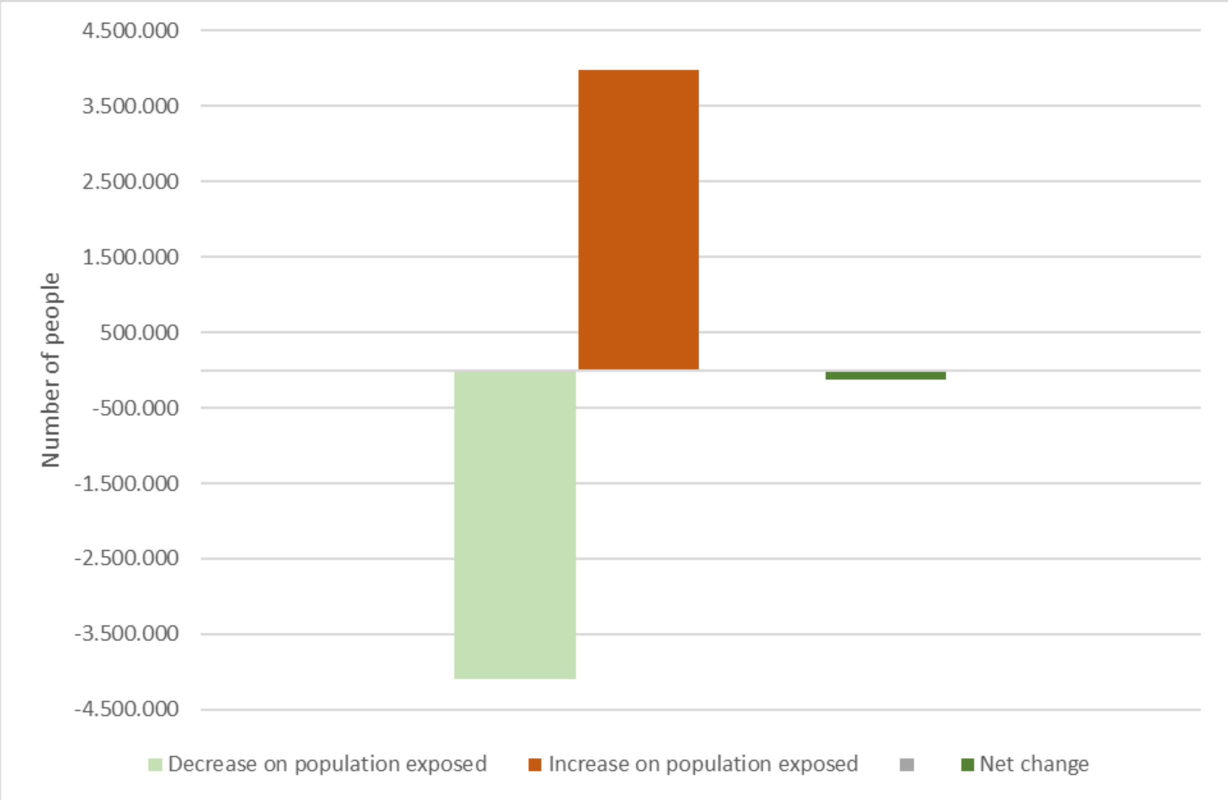
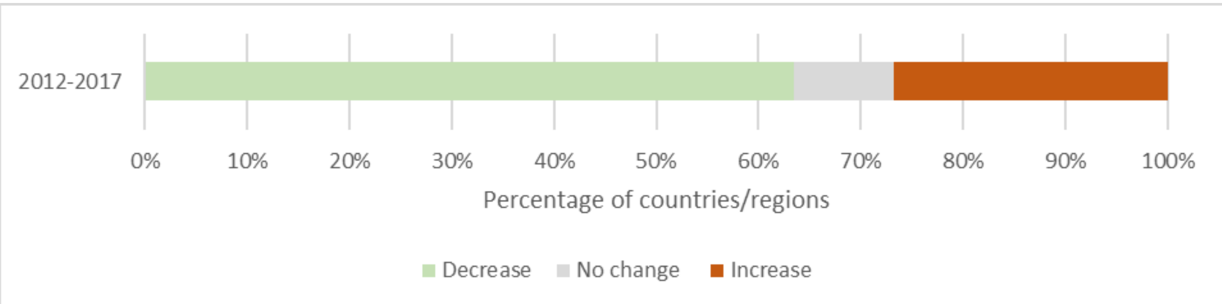


Figure 15: Trends of change of population exposed to noise from major roads, L_{den} (2012-2017). Percentage of countries. Countries included: AT, BE, BG, CH, CZ, DE, DK, ES, FI, FR, GB, HR, HU, IE, LT, LU, LV, MT, NL, NO, PL, SE, and SI. In case of Belgium, Germany, and UK information is provided at regional level and each region is accounted as a reporting entity.



3.3.3. Detailed analysis of L_{night}

In contrast with the decrease of people exposed to L_{den}, people exposed to L_{nigh} has increased during the period 2012-2017 by 5,7% (728.400 people, Figure 16). This trend has been identified in 35% of the countries and regions analysed (Figure 17).

The increase of the length of major roads to be reported has also an important influence on the countries where the population exposed increased (R^2 = 067).

The higher decrease of population exposed occurred in Spain, Hungary and Bulgaria. The higher increase has been observed in France, Lithuania and Malta.

Figure 16: Change of people exposed to noise from major roads, L_{night} (2012-2017). Decrease of population exposed includes only countries where people exposed has decreased; increase of population exposed includes only countries where people exposed has increased. Total change is the net balance for the given period. Countries included: AT, BE, BG, CH, CZ, DE, DK, ES, FI, FR, GB, HR, HU, IE, LT, LU, LV, MT, NL, NO, PL, SE, and SI. In case of Belgium, Germany, and UK information is provided at regional level and each region is accounted as a reporting entity.

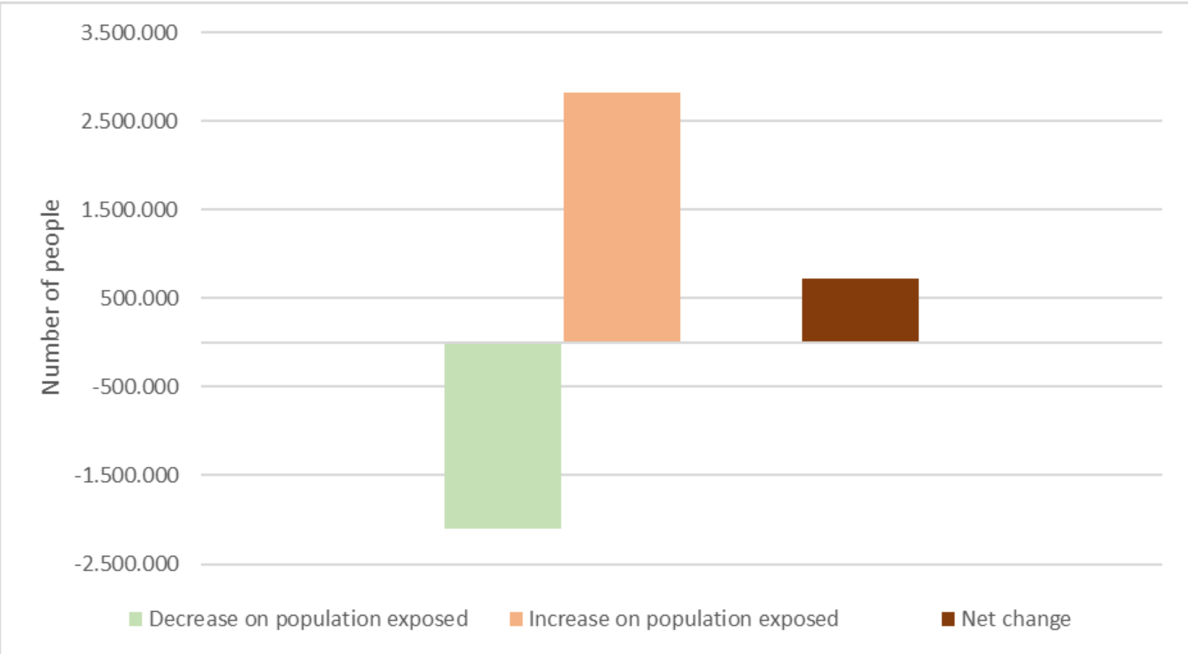
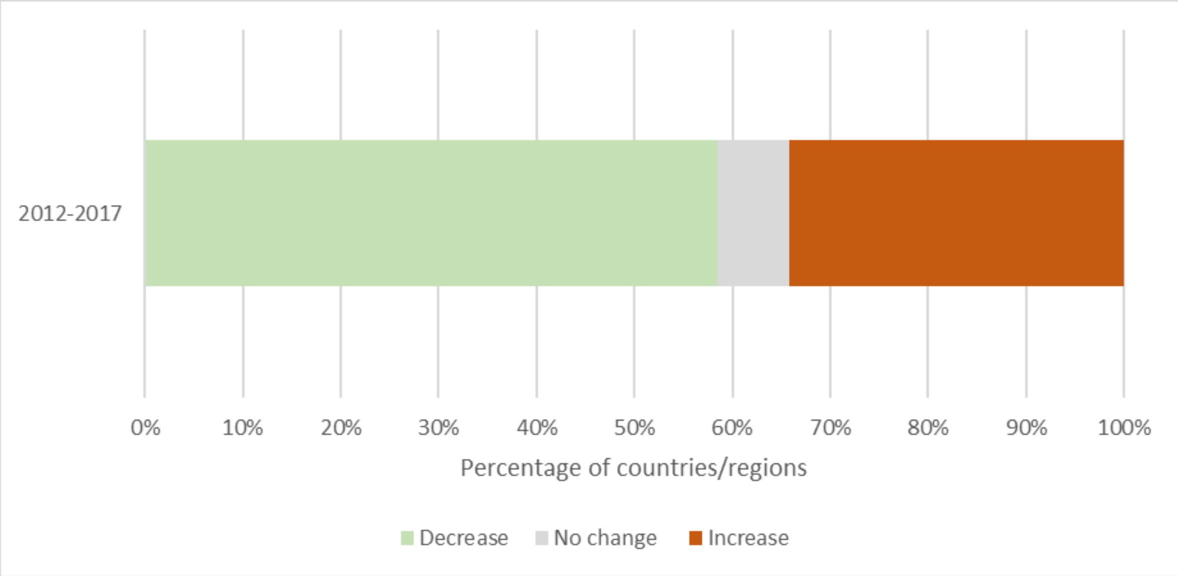


Figure 17: Trends of change of population exposed to noise from major roads, L_{night} (2012-2017). Percentage of countries. Countries included: AT, BE, BG, CH, CZ, DE, DK, ES, FI, FR, GB, HR, HU, IE, LT, LU, LV, MT, NL, NO, PL, SE, and SI. In case of Belgium, Germany, and UK information is provided at regional level and each region is accounted as a reporting entity.



3.4. Changes in major rails

3.4.1. Overview

In contrast with major roads, people exposed to railway noise, both L_{den} and L_{night}, slighlty increase in the period 2012-2017. Changes on the length of major rail have no impact on people exposed.

3.4.2. Detailed analysis of L_{den}

During the period, 2012-2017 people exposed to major rails has decreased in most of the countries and regions analysed (Figure 18). However, the aggregated figures reflect a net increase of the total number of people exposed in Europe by 2 % (Figure 19).

There is not any connection between change in rail length and people exposed.

Germany (some landers), Finland, Bosnia and Hercegovina, Latvia and Lithuania are the countries with a higher decrease of people exposed, above 50%.

France, Ireland and Poland are the countries with a highest increase of people exposed over the period above 100%.

Figure 18: Change of people exposed to noise from major rails, L_{den} (2012-2017). Decrease of population exposed includes only countries where people exposed has decreased; increase of population exposed includes only countries where people exposed has increased. Total change is the net balance for the given period. Countries included: AT, BE, CH, CZ, DE, DK, ES, FI, FR, GB, HR, HU, IE, IT, LT, LU, LV, NL, NO, PL, PT, SE, and SI. In case of Belgium, and UK information is provided at regional level and each region is accounted as a reporting entity.

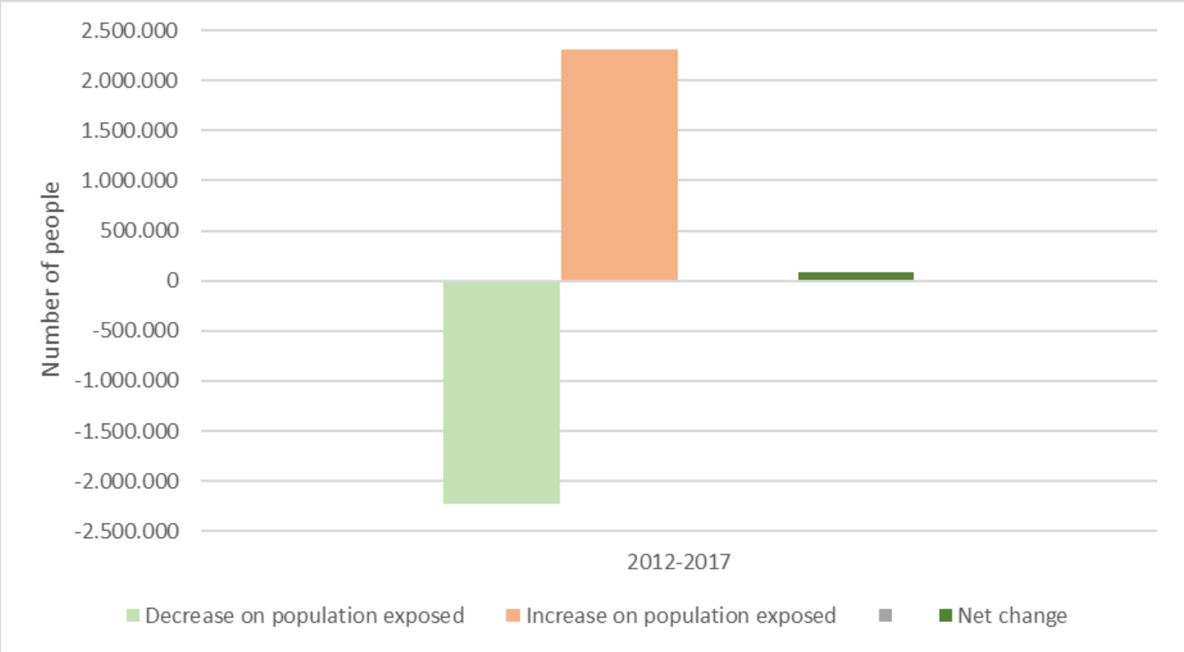
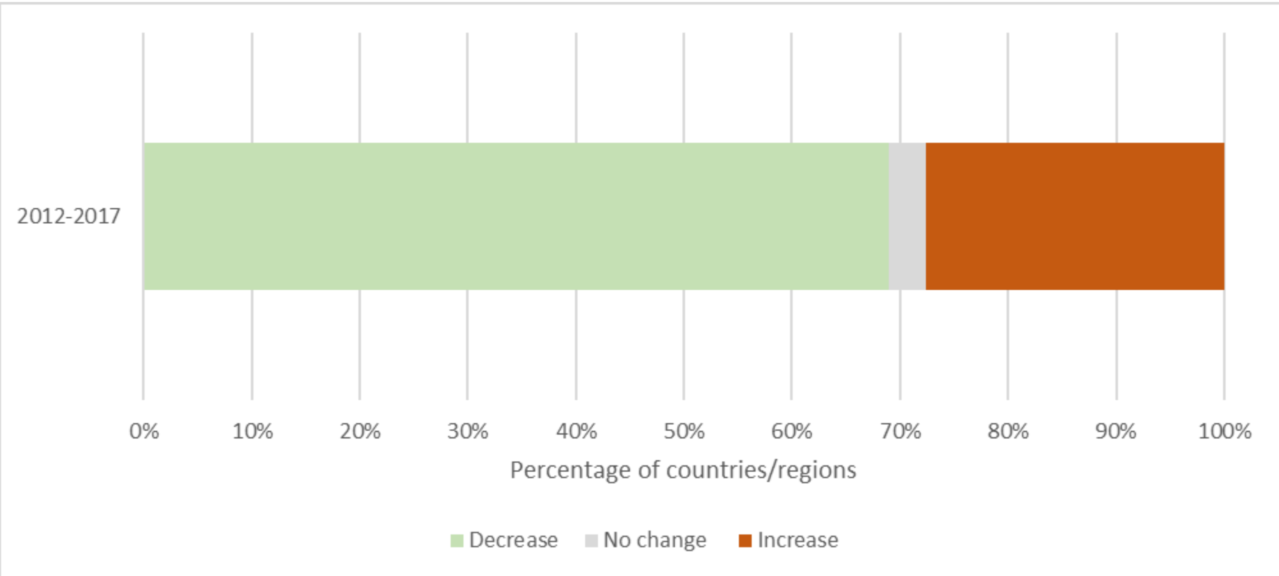


Figure 19: Trends of change of population exposed to noise from major rails, L_{den} (2012-2017). Percentage of countries. Countries included: AT, BE, CH, CZ, DE, DK, ES, FI, FR, GB, HR, HU, IE, IT, LT, LU, LV, NL, NO, PL, PT, SE, and SI. In case of Belgium, and UK information is provided at regional level and each region is accounted as a reporting entity.



3.4.3. Detailed analysis of L_{night}

Change of people exposed to noise L_{night} slightly increased over the period 2012-2017 (Figure 20). However, the dominant trend is a decrease in 60% of countries (Figure 21). Bosnia and Hercegovina, Finland, Latvia, Lithuania and Switzerland are the countries with a higher decrease of people exposed, equal or above 50%.

Denmark and Ireland are the countries with a higher increase.

Figure 20: Change of people exposed to noise from major rails, L_{night} (2012-2017). Decrease of population exposed includes only countries where people exposed has decreased; increase of population exposed includes only countries where people exposed has increased. Total change is the net balance for the given period. Countries included: AT, BE, CH, CZ, DK, FI, GB, IE, LT, LV, NL, SE, HR, NO, PL, PT. In case of Belgium, and UK information is provided at regional level and each region is accounted as a reporting entity.

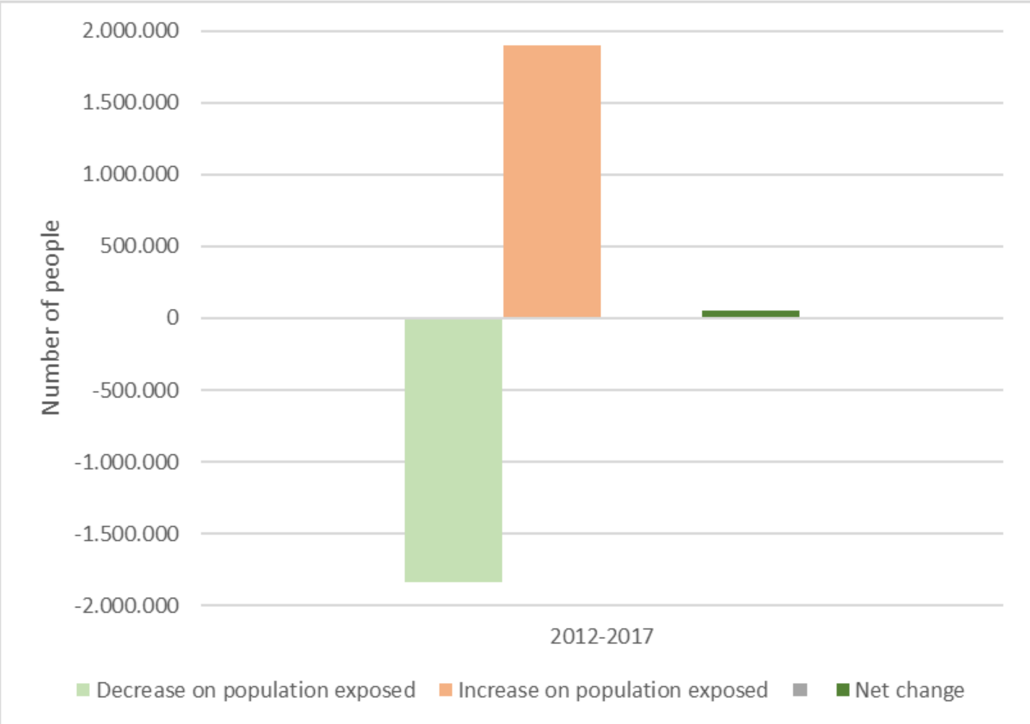
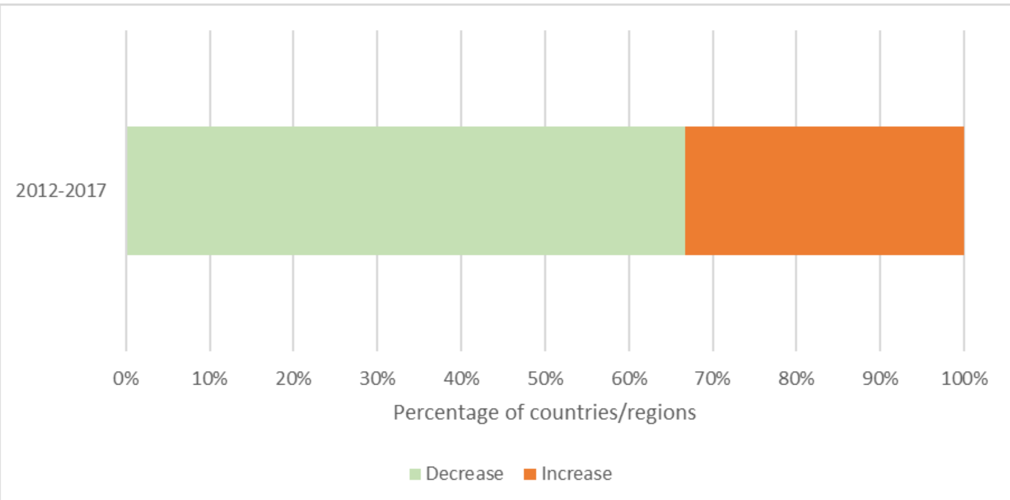


Figure 21: Trends of change of population exposed to noise from major rails, L_{night} (2012-2017). Percentage of countries. Countries included: AT, BE, CH, CZ, DK, FI, GB, IE, LT, LV, NL, SE, HR, NO, PL, PT. In case of Belgium, and UK information is provided at regional level and each region is accounted as a reporting entity.



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