Eionet Report - ETC/ATNI 2019/8

Noise Action Plans

Managing exposure to noise in Europe

December 2019

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ETC/ATNI c/o NILU
ISBN 978-82-93752-05-9

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Summary

The Environmental Noise Directive (END) sets legally binding obligations for reduction and management of environmental noise. Based upon noise mapping results, action plans have to be drawn up for major transport sources and the largest urban areas. Furthermore, where areas are found to be of a high acoustic quality, in other words, free from noise pollution, they should also be protected by appropriate action plans. However, the specific types of measures included in these action plans are decided at Member State level. This report provides an overview of the reported noise action plans up to April 2019, and the type of measures implemented to reduce environmental noise.

In terms of urban areas, the reported data shows that noise reduction measures at the source are by far the most employed (51%) followed by measures at the path (17%), education and communication measures (15%), urban planning and infrastructure change (10%), as well as other physical changes (7%). The measures employed mainly target road traffic noise since this is the most prevalent source of noise in cities. Within the measures at the source inside urban areas, renewing road surfaces or replacing rough pavements with smooth asphalt is the most used measure to reduce exposure to noise. Other measures highly reported in urban areas include the management of traffic flows and the reduction of the speed limit to 30 km/h. In particular, within urban areas we observe that there is a considerable share of measures aiming at raising awareness and changing people's behaviour in terms of usage of less noisy modes of transport (e.g. cycling, walking, and electric vehicles).

In the case of major roads, the actions that predominate are those related to measures on the propagation path (40%) followed by source orientated measures (38%). Noise barriers and traffic management measures are the most commonly reported. Actions related to land-use planning only account for a small percentage (13%).

Although measures at the path such as the installation of noise barriers is a frequently reported measure for reducing noise from major railways (32%), noise mitigation in railways is generally achieved by implementing measures at the source (52%), such as reducing the track roughness by conducting regular maintenance. Unlike the other major sources, the implementation of education and communication measures were not recorded from major railways.

The mitigation measures employed to reduce exposure to aircraft noise caused by major airports have a different nature than those employed for road or rail. In contrast to, e.g., continuous road traffic noise from a busy road, aircraft noise is intermittent noise, i.e., consecutive aircraft noise events are usually separated by a noise-free period. Aircraft noise comes from above, making it difficult to use path measures such as noise barriers. Therefore, the most predominant measures employed to combat aircraft noise are those at the source (70%). From those, measures related to traffic management as well as those incentivising or penalising some types of aircraft are among the most used. There are no reported measures regarding the availability of green space or appearance of the neighbourhood. On the other hand, a higher share of measures targeting communication of the public is used in major airports compared to major roads and major railways.

Finally, although action plans covering the largest urban areas and major transport sources should have been drawn up in accordance with the END, there is a significant number of countries for which such plans are missing.

Acknowledgements

This report has been written by the European Topic Centre on Air pollution, Transport, Noise and Industry pollution (ETC/ATNI).

The authors are Núria Blanes, Francisco Domingues, Maria José Ramos, Miquel Sáinz de la Maza, and Jaume Fons-Esteve (UAB).

Additional review has been provided by Eulàlia Peris (EEA).

1 Introduction

The Environmental Noise Directive (END) (2002/49/EC) sets legally binding obligations for reduction and management of environmental noise. The noise mapping exercise is seen as a precursor for guiding the implementation of noise reduction measures which should aim to reduce the impact of noise upon the affected population. Thus, based upon noise mapping results, action plans have to be drawn up for major transport sources and the largest urban areas. Furthermore, where areas are found to be of a high acoustic quality, in other words, free from noise pollution, they should also be protected by appropriate action plans.

Based on the minimum requirements of noise action plans under the END, generally the plans contain the following information:

- Noise reduction targets either in terms of dB reductions or reductions in the population exposed above a certain threshold
- Description of the measures that will be used to achieve reductions
- Identification of reduction priorities and schedule for implementation of measures
- Outline of expected costs of the measures proposed and financial means
- Roles in charge of implementation and monitoring of measures put in place
- Description of public consultation activities

In 2017 the EC published the second implementation review of the END (EC, 2017). The review was based on the implementation of the directive for the 2012 reporting phase of noise mapping. Where possible, it also evaluated the improvements with respect to the first phase of noise mapping of 2007.

The main messages regarding action planning are outlined below:

- Implementation of the action planning process was poor with less than 50% of required action plans completed as of November 2015. Possible reasons explaining poor implementation of action planning include knock-on effects from the delays in noise-mapping (as action plans need to be based on noise maps) and the short period given between the deadline for the preparation of noise maps and that for action plans (12 months).
- Approaches to action planning diverge between Member States. This is reflected in the types of noise reduction measures identified, the balance between expenditure / non-expenditure measures and the extent to which the plans are only strategic or also have an operational focus. Although action plans often include a summary of the consultation responses, it is often unclear how these responses have been taken into account in the plans.
- The administrative costs are low (€0.15 for noise maps and €0.03 for action plans per citizen, every five years). Cost-benefit analysis showed that where action plans - including measures for noise management - have been implemented, the Directive was efficient with a favourable cost-benefit ratio of 1:29.

Beyond the publication of the 2nd implementation review the recently published Environmental Implementation Review 2019 (EC, 2019) also highlights that action plans for noise management are still missing in thirteen Member States and seven countries still need to adopt required noise action plans.

This report analyses the noise action plans reported until 1 April 2019. The report has a special focus on the type of measures adopted and its link with the Environmental Noise Guidance (WHO, 2018),

where interventions are categorised according to available literature on the impact of noise reduction measures on health (Brown and van Kamp, 2017).

2 Data and methodology

2.1 Scope of the data

The format of the Noise Action Plans (NAP) pose a challenge to the systematic analysis and review of them. This is inherent to the type of document provided and the major issues could be listed as follows:

- The development of the NAP follows national, regional or local legislation and the forms of governance, among others. Consequently, there is a wide variety of approaches to them.
- There is not a common structure for the NAP, therefore the same information could be provided in different formats or in different sections within a document.
- The information is provided as text which implies that the extraction of relevant information requires reading each document.
- Documents can be provided in the country language.

To facilitate the reporting, and collection of information, a web form has been developed within the frame of ENDRM in Reportnet, which requires the following input information to MS (only the one relevant for this report is detailed):

- number of potential beneficiaries;
- cost (if available);
- public participation (consultation);
- measures to evaluate the NAP.

The analysis is based on data reported in Reportnet corresponding to DF7_10 Noise action plans (round 3) and delivered before 1 April 2019. Only data reported in web forms has been used for this analysis.

This systematic approach of the ENDRM through web forms does not provide yet the information structured in a form suitable for its analysis. Therefore, free text has been translated into key words related to different topics that allows a comparative analysis.

2.2 Information collected

2.2.1 Quantitative information

The quantitative information provided in the web forms are the following ones:

- cost of the action plan;
- number of people experiencing noise reduction;
- start date of the action plan;
- end date of the action plan.

2.2.2 Qualitative information

Web forms also collect qualitative information that needs to be further structured in order analyse and compare action plans. Among other issues the web forms gather information concerning the process of public consultation, and noise abatement measures.

The information on public consultation provided has been structured as shown in Table 2.1.

Table 2.1: Structure of the information extracted from the results on public consultation of action plans.

Topics	Information extracted (type of data)
Process of public consultation	Description of the public consultation process available (yes/no)
	Type of accessibility to relevant documentation (pre-defined list: public, restricted)
	Duration of the public consultation (quantitative).
	Main questions addressed in the public consultation are specified (yes/no)
	Results of public consultation are public (yes/no)
Stakeholders	Number of stakeholders (quantitative)
	Type of stakeholders: a. local authorities b. general public c. NGOs d. specific committees e. private companies
	Type of interaction. (pre-defined list): a. participatory process (active interaction) b. steering committee (meeting with selected stakeholders) c. public consultation d. website (passive interaction) / official communication
Evaluation of the results of the public consultation	There have been objections to the NAP (yes/no). If yes: How many? Open box to indicate: number of people, number of buildings, number of neighbours,...
	The NAP is reviewed after the public consultation (yes/no)
	The evaluation of the public consultation is included in the summary (yes/no)

As indicated above, the web form also collects a summary of the measures to be implemented. A systematic review of these summaries have been conducted noting each individual measure mentioned in the action plan. Therefore, the summary is converted in a list of measures that could be further analysed.

As an outcome of this analysis 53 individual measures were identified (see Annex 1). These measures have been aligned with the classification proposed by WHO (Table 2.3). This classification is intended to standardise the analysis of the impact, primarily on health, of different noise interventions. We have added two categories:

- A3 - Traffic density reduction. This type of measures did not fit on other classes.
- F - Monitoring and other measures. This could not be considered measures for noise reduction. However, often monitoring is mentioned as an approach to have evidence on the impact on the measures taken.

Table 2.2: Categorisation of noise interventions (adapted from WHO, 2018). A complete list of interventions found in NAPs is provided in Annex 1. In blue: additional categories adopted in the present report.

Type	Intervention category	Intervention sub-category
A	Source intervention	A1 : Change in emission levels of sources
		A2 : Time restrictions on source operations
		A3 : Traffic density reduction
B	Path interventions	B1 : Change in the path between source and receiver
		B2 : Path control through insulation of receiver's dwelling
C	New/closed infrastructure	C1 : opening of a new infrastructure noise source, or closure of an existing one
		C2 : planning controls between (new) receivers and sources
D	Other physical interventions	D: change in other physical dimensions of dwelling/neighbourhood
E	Education/communication interventions	E1 : change in behaviour to reduce exposures; avoidance or duration of exposure
		E2 : community education, communication
F	Monitoring	Monitoring

3 Coverage of the analysis

It is difficult to quantify the exact level of completeness of action plans due to diverging reporting approaches and formats of action plans. In addition, not all the submitted action plans contain the minimum requirements established by the END such as consultation process information. Although it is difficult to evaluate the completeness of the action plans submitted in 2019, we can highlight that there is a significant delay in the implementation of the action planning process in a large number of countries.

Action plans for the 2019 reporting year, in accordance with the END, were to be concluded by 19 January 2019. However, there is still a significant number of countries, 15 in total, for which such plans are missing as of 1 April 2019.

This report covers 272 noise action plans distributed by noise source as described in Table 3.1.

Table 3.1: Number of action plans and geographic coverage included in this report, grouped by noise source.

Source	Number of action plans	Coverage
Agglomerations	188	152 agglomerations, which correspond to 20,8 M inhabitants AT, BG, DK, FI, GB, HR, IE, IS, LV, NL, PL, SE
Major roads	45	AT, DK, ES, FI, GB, HR, IE, LT, LV, NL, PL, PT, SE
Major rails	12	AT, DK, FI, GB, HR, IE, LT, NL, PL, SE
Major airports	27	AT, DK, ES, FI, GB, IE, LV, NL, SE

4 Agglomerations

4.1 Coverage

According to the information provided by countries, 495 agglomerations fulfil the END requirements (coverage EU 28). This figure increases up to 511 if EEA 33 countries are considered. Only 37.4 % of these agglomerations (EU 28) have reported on action plans using the Reportnet web forms. The percentage is similar, 36.8%, if EEA 33 countries are considered. Taking into account the latest official delivery done by each MS (information reported until 1 April 2019), Denmark, Finland, Ireland and Latvia are the countries that provided action plans for all agglomerations.

4.2 Expenditures and number of people experiencing noise reduction

Expenditures of action plans in agglomerations are only available in 32% of web forms, which correspond to 9% of the total agglomerations. It should be noted that this information provided on voluntary basis since it is not mandatory.

The range of expenditures is quite broad, from 2 000 € in Finland to 500 M € in Latvia (Figure 4.1). However, these figures alone could not be compared since different factors may explain different figures:

- Figures have not been corrected for constant prices. Therefore, costs for the same action may differ between countries. Moreover, there is a 5-year gap between the oldest and newest action plan that have reported this information on the web forms.
- Number and type of actions. The expenditure is very much linked to the type of action, as illustrated in the examples of Table 4.1.

Another element that could be considered relevant is the duration of the action plan. However, not significant correlation has been found between duration and expenditure from the data reported by countries.

The number of people experiencing noise reduction ranges from 100 inhabitants (Finland and Netherlands), to 339 000 in Poland (Figure 4.2). This broad range reflects different objectives of each action plan, which are related to the dimension of the noise exposure at the time of planning or the occurrence of hot spots.

Figure 4.1: Boxplot of expenditures of action plans in agglomerations by country (n=66 agglomerations). Expenditure is presented in a logarithmic scale.

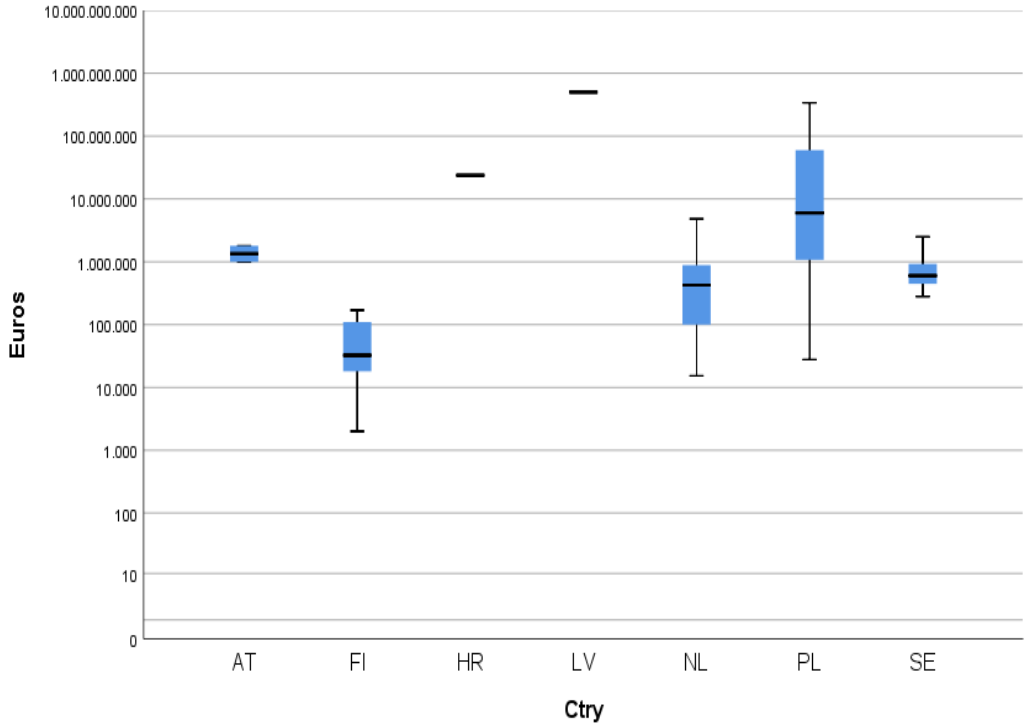


Figure 4.2: Boxplot of number of beneficiaries (people experiencing noise reduction) of action plans by country. Number of people is presented in a logarithmic scale.

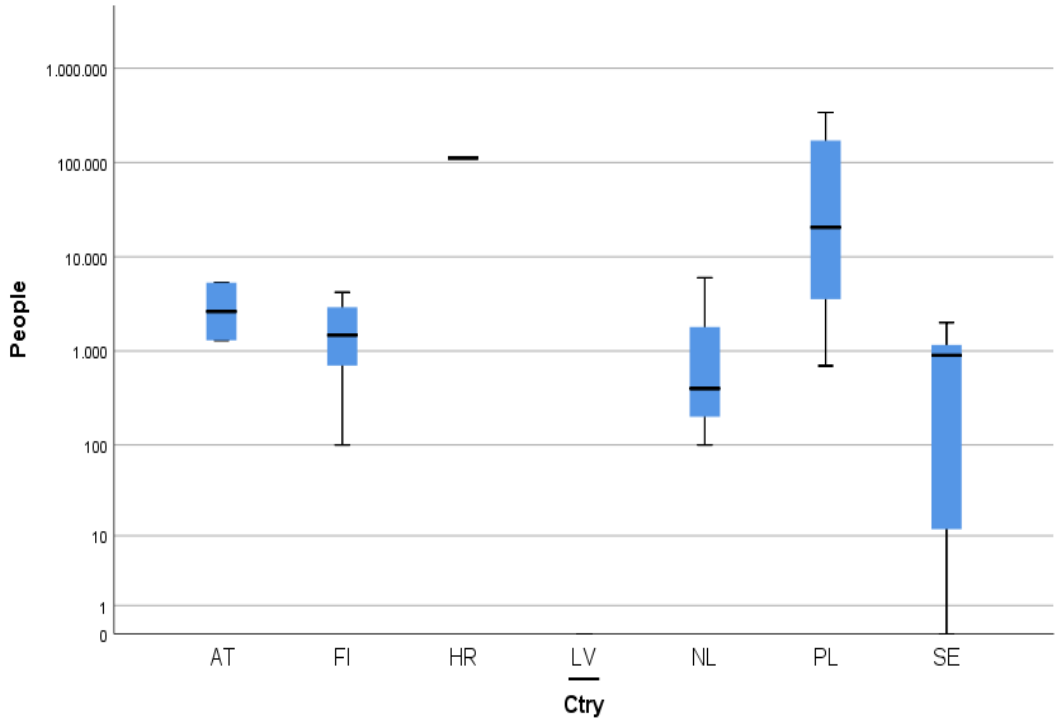


Table 4.1: Example of possible noise abatement measures, their potential for reduction in road traffic noise annoyance and the cost (per year) of making one person not annoyed anymore (reduce the noise annoyance by one). Source: CEDR, 2013.

Noise abatement measure	Reduction in annoyance	Cost of reducing annoyance by one (EUR per year)	Limitations on use
Vehicle noise reduction (5 dB)	31.5 M	16	None
Vehicle noise reduction (3 dB) = EC proposal	19.7 M	18	None
Thin layer asphalt	2.4 M	136	Not motorways (with high speed and density)
Porous asphalt single layer	1.1 M	290	Only motorways (high speed and space for drainage)
Façade insulation (2 windows), same effect as outdoor measures	0.8 M	360	None (indoor effect only)
Façade insulation (2 windows), effect 60% of outdoor measures	0.5 M	570	None (indoor effect only)
Porous asphalt double layer	0.3 M	940	Only motorways (high speed and space for drainage)
Noise barriers	0.2 M	4 200	Not in narrow streets

4.3 Public consultation

There is a broad range of practices, from simple opening the information to the public, to best practices related to the involvement of stakeholders and a development of a process of participation.

The characteristics of the public consultation are very much related to national legislations as observed in the available information on the web forms (Table 4.2).

The period of public consultation ranges from 15 days in Poland, to 59 days in Finland. During this period, all the analysed countries made the information available on a web site. Moreover, in all cases different actions have been taken with active involvement of different stakeholders:

- Single meeting to inform the public and, in some cases, also companies.
- Survey in parallel to the public consultation in order to raise awareness and to know better the opinion and perception of the general public. This has only been identified in Finland.
- Participatory process with a steering committee. This is the most elaborate consultation since it involves a group of stakeholders with several meetings during the process.

In terms of stakeholders involved in the consultation, general public and local authorities are always mentioned. In addition, companies are also specified in the consultation process in Bulgaria, Sweden and United Kingdom. NGOs are part of the consultation in five countries: Finland, Latvia, Poland, Sweden and United Kingdom. Consequently, Sweden and United Kingdom are the countries where a broader range of stakeholders are involved in the consultation process.

As a result of the public consultation 65% of the NAPs received comments. In 92% of cases these comments were considered and resulted in a reviewed action plan. Therefore, it could be concluded,

that there has been substantial input from different stakeholders which have been integrated in the final action plan.

Table 4.2: Overview of the main characteristics of the consultation process by country.

Country	Duration (days)	Type of consultation				Stakeholders			
		web	meeting	survey	participatory process	general public	local authorities	companies	NGO
Austria	17 - 42	●				●	●		
Bulgaria	31	●				●	●	●	
Denmark	72	●	●			●	●		
Croatia	32	●	●			●	●		
Finland	30-59	●	●	●		●	●		●
Iceland	28	●				●			
Latvia	31	●	●			●	●		●
Poland	15-33	●	●			●	●		●
Sweden	9-13	●			●	●	●	●	●
United Kingdom	42	●	●		●	●	●	●	●

4.4 Noise mitigation measures

In terms of urban areas, the reported data shows that noise reduction measures at the source are by far the most employed (51%) followed by measures at the path (17%), education and communication measures (15%), urban planning and infrastructure change (10%), as well as other physical changes (7%). The measures employed mainly target road traffic noise since this is the most prevalent source of noise in cities. Within the measures at the source inside urban areas, renewing road surfaces or replacing rough pavements with smooth asphalt is the most used measure to reduce exposure to noise. Other measures highly reported in urban areas include the management of traffic flows and the reduction of the speed limit to 30 km/h. In particular, within urban areas we observe that there is a considerable share of measures aiming at raising awareness and changing people's behaviour in terms of usage of less noisy modes of transport (e.g. cycling, walking, and electric vehicles).

There are substantial differences between countries, for example path interventions are dominant in Austria (54%) and Iceland (46%) -Figure 4.4.

Figure 4.3: Reported measures in noise action plans to mitigate noise inside agglomerations. Circles present the share of different typologies of measures. Bars depict the most frequent measures inside each typology.

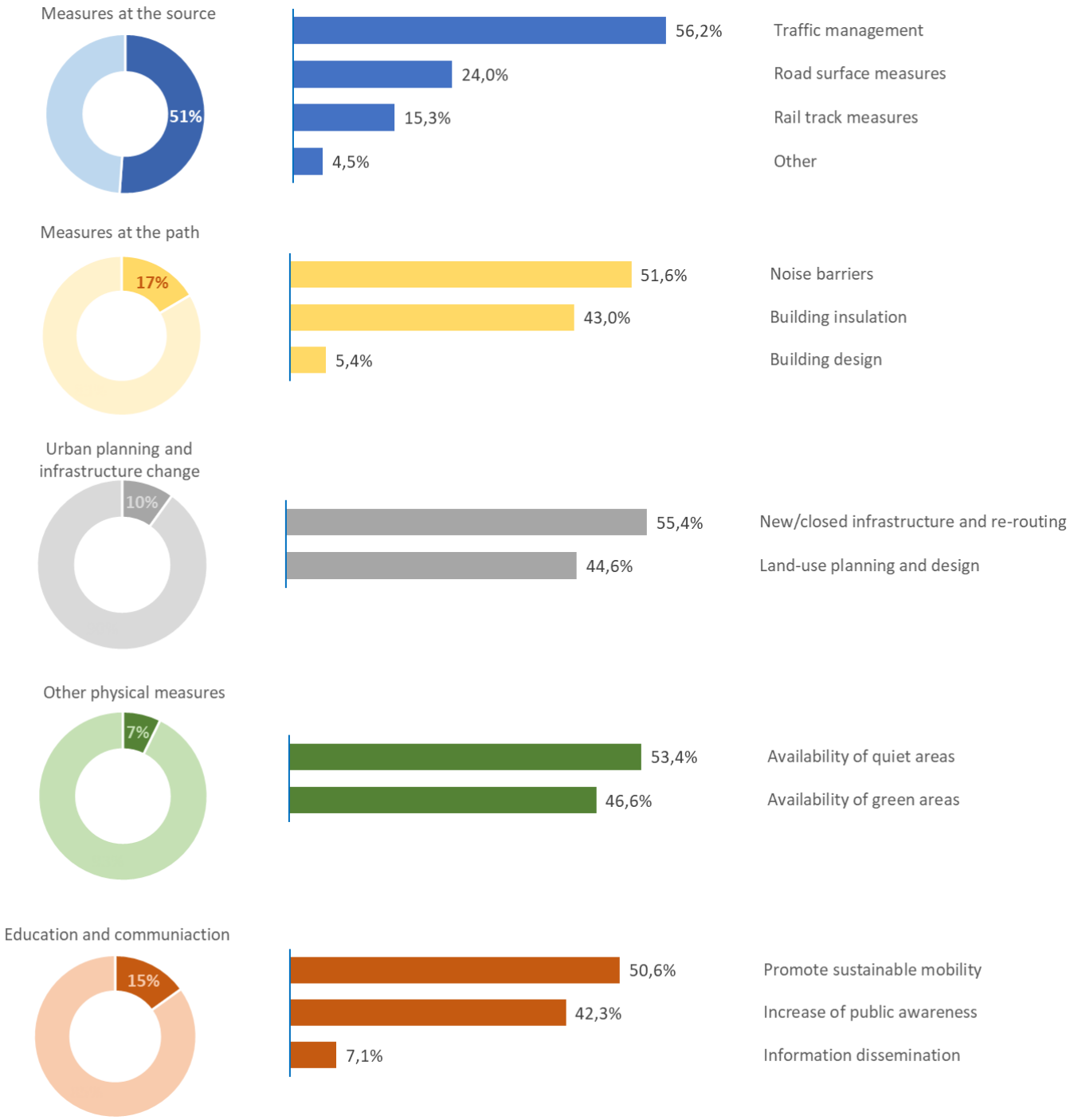
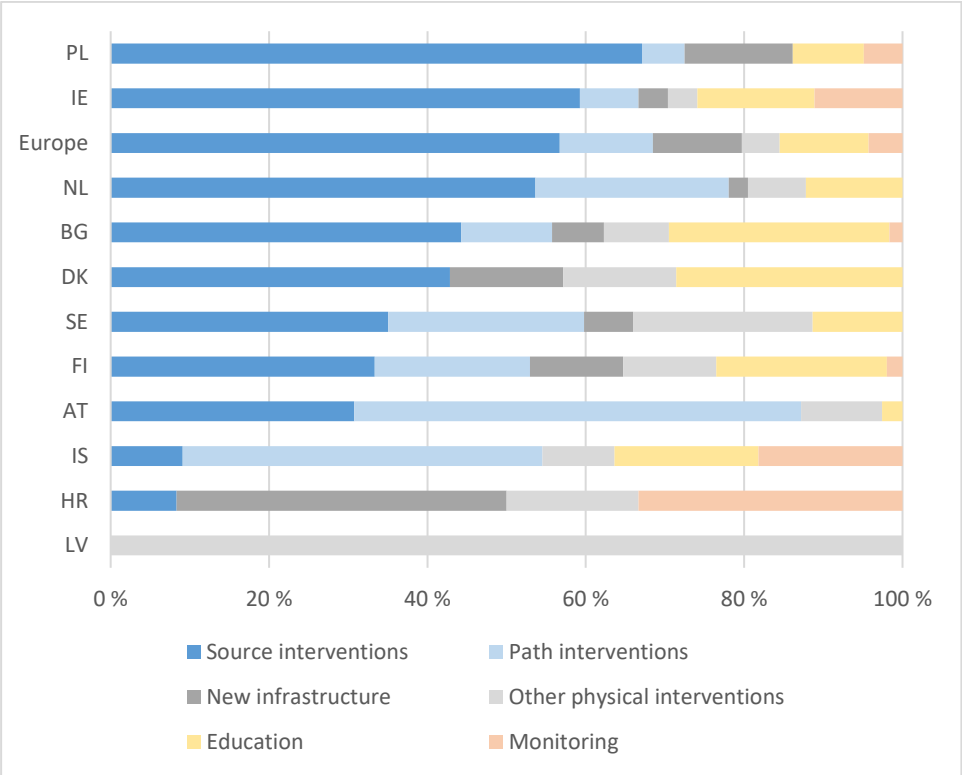


Figure 4.4: Summary of management actions by typology in agglomerations.

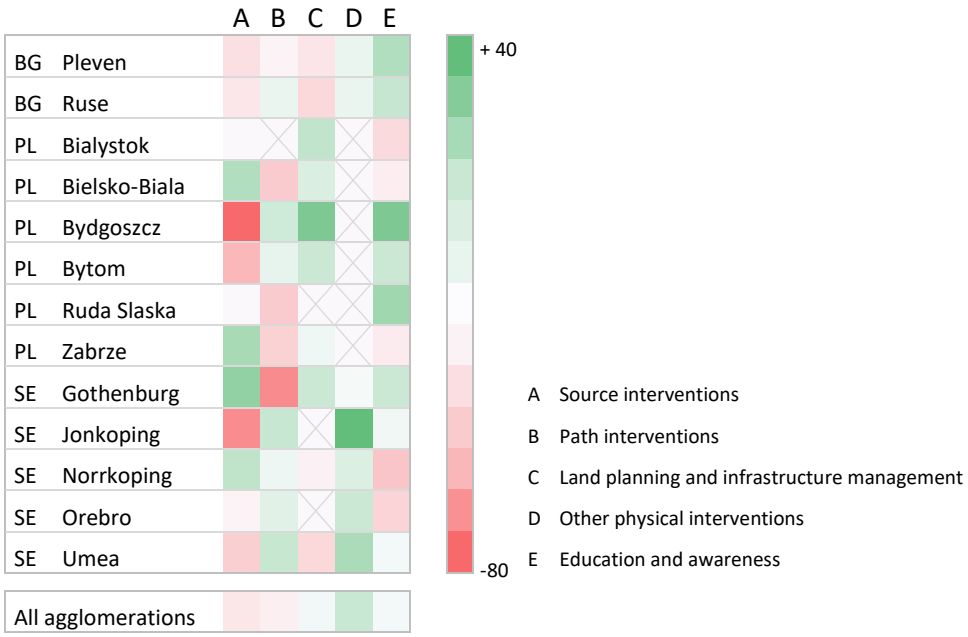


4.5 Changes

Comparing agglomerations that reported action plans for both years, i.e. 2014 and 2019, the following trends are observed (Figure 4.5):

- There has been changes on the type of actions taken to reduce noise exposure between 2014 and 2019. However, there is not a common pattern among cities in terms of which type of measures increase and which decrease. These variability reflects that noise management has a strong local component.
- Increase of green infrastructure and quiet areas (other physical measures) is observed in all the agglomerations from Bulgaria and Sweden. This measure has not been reported on any Polish city.
- Having a closer look to the specific actions reported, there is an important increase of measures oriented to raise public awareness, followed by the use of green areas as an abatement measure and improvement of the road surface. On the other side some measures clearly decline and are less reported in 2019: traffic management and promotion of sustainable mobility.

Figure 4.5: Change on the type of measures taken to reduce noise exposure between 2014 and 2019. Red: decrease on the percentage of measures taken within a certain intervention category. Green: increase on the percentage of measures taken within a certain intervention category in 2019, compared with 2014. Measures not reported at all in none of the two years are marked with an X. Values reflect differences on percentages between final year and initial year. Source: Noise Action Plans reported according to END (2014 and 2019).



5 Major roads

5.1 Coverage

About 45 action plans for major roads have been reported, covering the following countries: AT, DK, ES, FI, GB, HR, IE, LT, LV, NL, PL, PT, and SE.

5.2 Expenditures and number of people experiencing noise reduction

The cost of the action plans ranges from 41 000 € in Finland, to 261.7 M € in Netherlands (Table 5.1). Since the information on the length of major roads is incomplete, it is not possible to analyse a possible link between expenditure and km of major roads. As stated in previous noise sources any comparison should consider the time when expenditures were evaluated and differences between countries (parity).

Table 5.1: Expenditures and number of beneficiaries of action plans for major roads.

Country	Expenditures (€)	Beneficiaries (nr of people)
AT	9 540 000	4 704
ES	9 884 518	8 877
FI	41 770	16 178
GB	n.a.	57 000
HR	104 812 000	74 816
LT	n.a.	1 407
LV	31 864 200	333 546
NL	261 700 600	16 700
PL	129 165 355	64 793
PT	1 062 050	6 000
SE	53 000 000	30 000

5.3 Public consultation

The information related to public consultation is much more limited compared to agglomerations. Only four countries provide information on the duration, which ranges from 15 days in Croatia to 42 days in Austria. The type of consultation is predominantly on the web, although Poland mention a public hearing.

Table 5.2: Overview of the main characteristics of the consultation process by country. Not available: n.a.

Country	Duration (days)	Type of consultation				Stakeholders			
		web	meeting	survey	participatory process	general public	local authorities	companies	NGO
Austria	42	●				●	●		
Denmark	56	n.a.				n.a.			
Croatia	15-32	●	●			●	●		
Poland	22-35	●	●			●	●		

5.4 Noise mitigation measures

In the case of major roads, the actions that predominate are those related to measures on the propagation path (40%) followed by source orientated measures (38%). Noise barriers and traffic management measures are the most commonly reported, followed by improving road surface. Actions related to urban planning only account for a small percentage (13%).

There are substantial differences between countries, reflecting the relevance of local conditions. For example source oriented measures are less than 10% in Latvia, Lithuania and Sweden. Measures on the propagation path are predominant (>50%) in Denmark, Latvia, Lithuania, Portugal and Sweden. Finally, measures are dedicated to increase public awareness are relevant in Austria and Poland.

Figure 5.1: Reported measures in noise action plans to mitigate noise from major roads. Circles present the share of different typologies of measures. Bars depict the most frequent measures inside each typology.

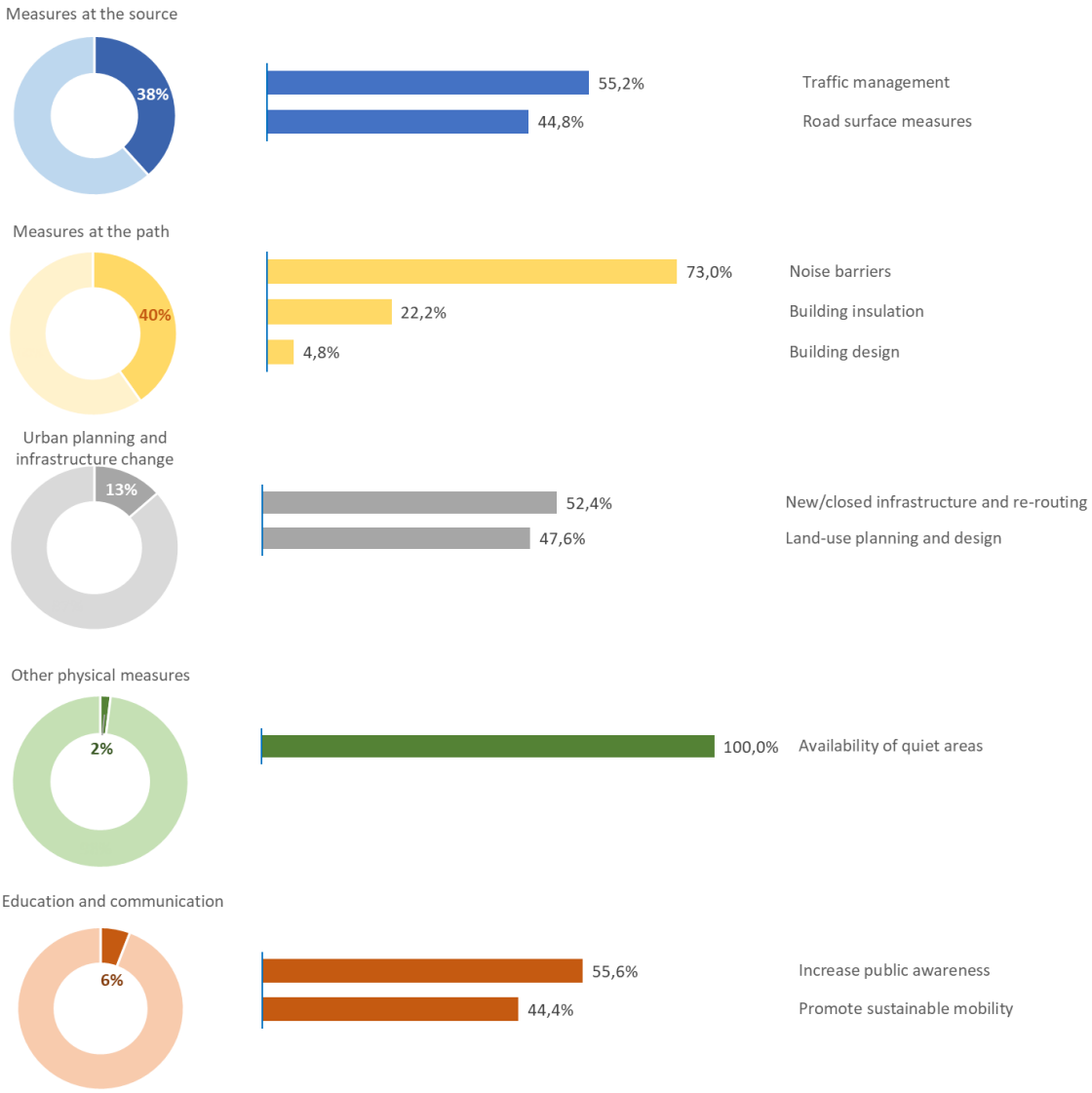
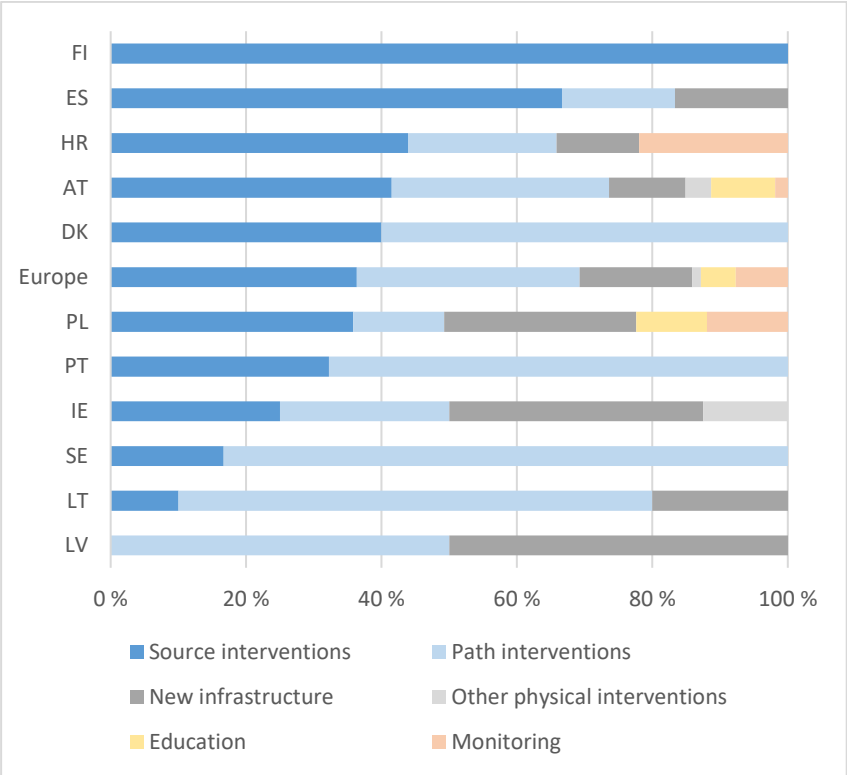


Figure 5.2: Summary of management actions by typology in major roads.

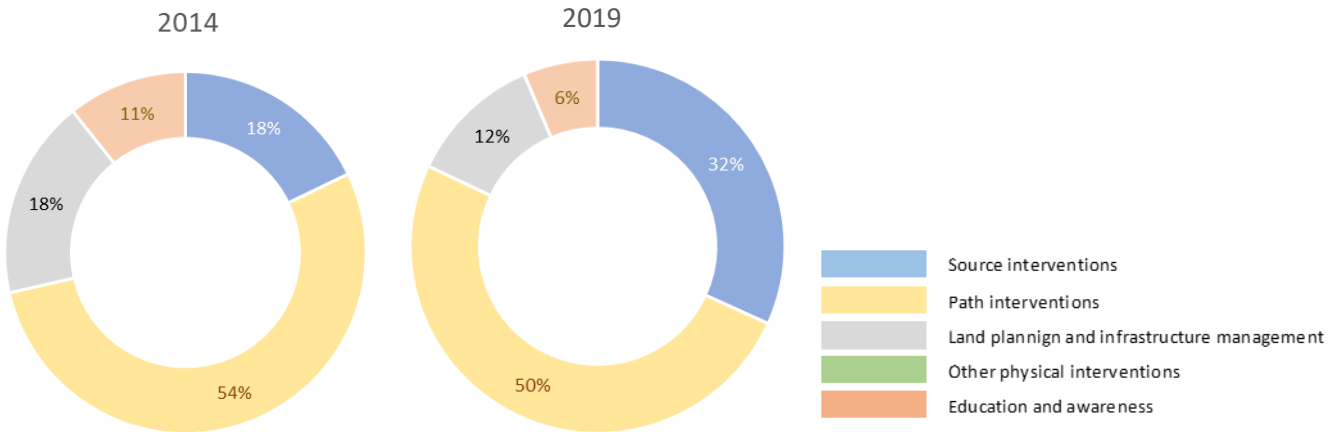


5.5 Changes

Only Poland and Sweden provided information on action plans for both years, 2014 and 2019.

The most remarkable trend is the increase of source interventions and the reduction of education and awareness actions. Having a closer look to the specific actions reported, there is an important increase of measures oriented to improve the road surface and provision of noise barriers. On the other side, traffic management and measures integrated in land use planning have been less reported in 2019.

Figure 5.3: Distribution of different type of measures according to action plans reported in 2014 and 2019 in Poland and Sweden.



6 Major railways

6.1 Coverage

About ten action plans for major rails have been reported, covering the following countries: AT, DK, FI, HR, IE, LT, NL, PL, and SE.

6.2 Expenditures and number of people experiencing noise reduction

The cost of the action plans ranges from 41 770 € in Finland, to 890 M € in Netherlands (Table 6.1). It should be noted that these figures are of similar order of the ones for major roads (Table 5.1). Since the information on the length of major rails is incomplete, it is not possible to analyse a possible link between expenditure and km of major railways. As stated in previous noise sources any comparison should consider the time when expenditures were evaluated and differences between countries (parity).

Table 6.1: Expenditures and number of beneficiaries of action plans for major rails.

Country	Expenditures (€)	Beneficiaries (nr of people)
DK	4 400 000	4 704
FI	41 770	5 500
GB	n.a.	5 000
HR	1 702 400	7 200
LT	n.a.	432
NL	890 000 000	600
PL	16 000	1 210 029
SE	40 000 000	24 000

6.3 Public consultation

The information related to public consultation is much more limited compared to major roads. Only three countries provide information on the duration, which ranges from 15 days in Croatia to 56 days in Denmark.

Table 6.2: Overview of the main characteristics of the consultation process by country. Not available: n.a.

Country	Duration (days)	Type of consultation				Stakeholders			
		web	meeting	survey	participatory process	general public	local authorities	companies	NGO
Austria	42	●				●	●		
Denmark	56	n.a.				n.a.			
Croatia	15	●	●			●	●	●	

6.4 Noise mitigation measures

Although measures at the path such as the installation of noise barriers is a frequently reported measure for reducing noise from major railways (27%), noise mitigation in railways is generally achieved by implementing measures at the source (52%), such as reducing the track roughness by conducting regular maintenance. Unlike the other major sources, the implementation of education and communication measures were not recorded from major railways.

There are substantial differences between countries. For example path interventions account for most of the 50% of measures in Denmark, Finland, Croatia and Netherlands (Figure 6.2).

Figure 6.1: Reported measures in noise action plans to mitigate noise from major rails. Circles present the share of different typologies of measures. Bars depict the most frequent measures inside each typology.

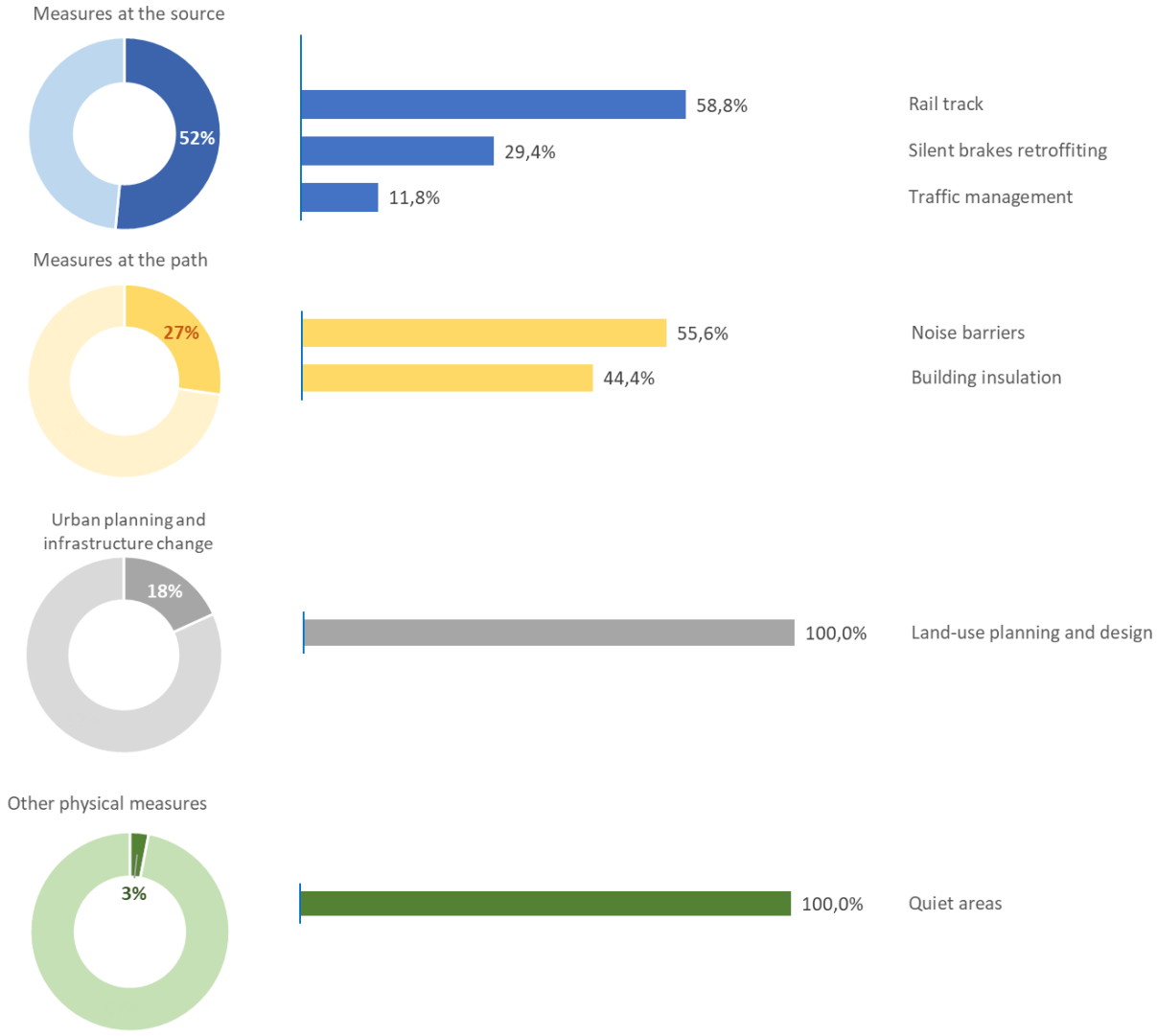
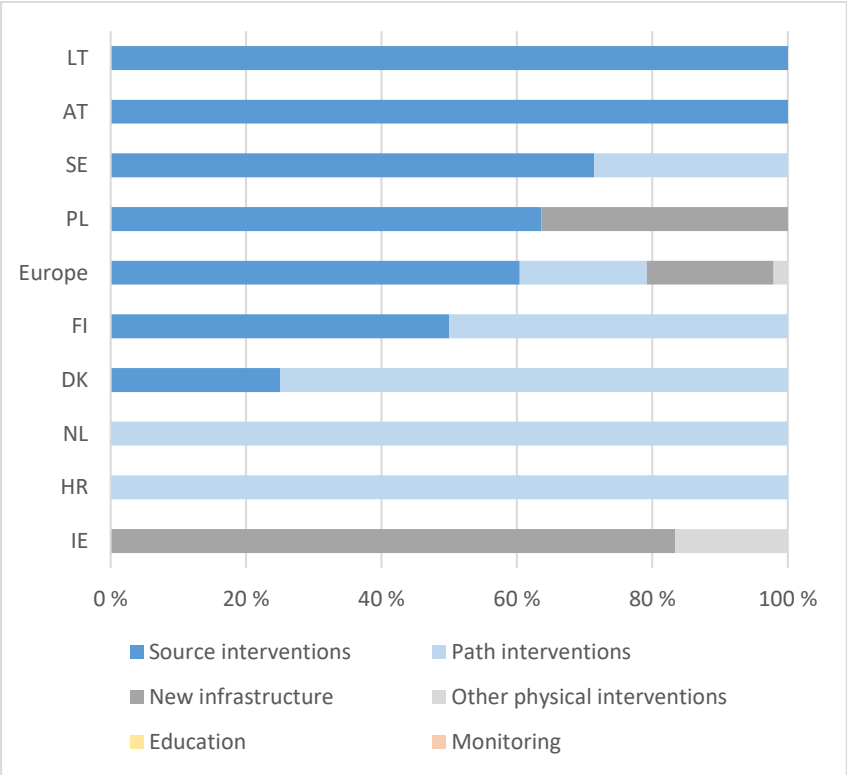


Figure 6.2: Summary of management actions by typology in major rails.

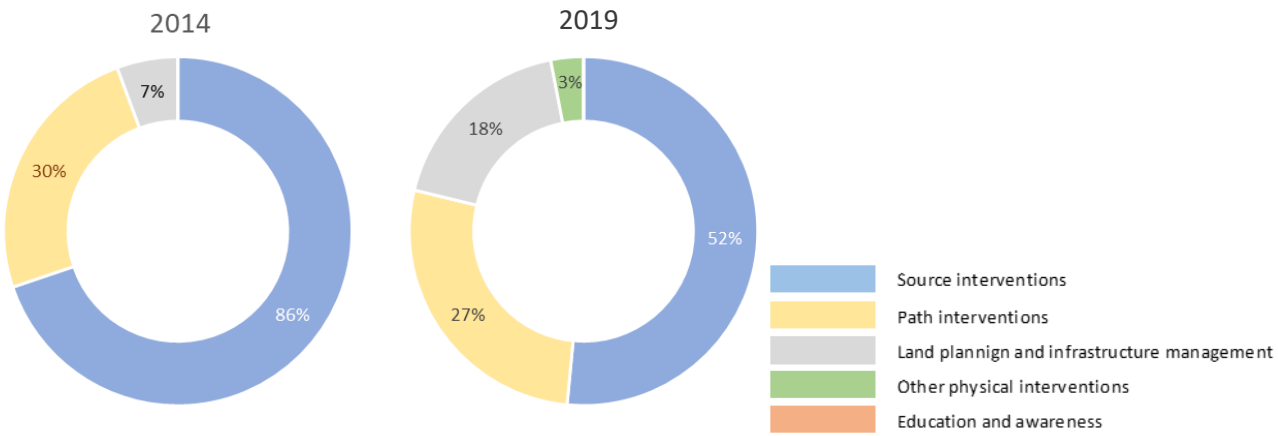


6.5 Changes

Only Lithuania, Poland and Sweden provided information on action plans for both years, 2014 and 2019.

There is an increase on land planning and infrastructure management, being reduced measures at source. Having a closer look to the specific actions reported, there is an important increase of measures oriented to improve rail tracks and traffic restrictions. On the other side noise barriers, which were included in action plans in 2014, are not mentioned at all in 2019.

Figure 6.3: Distribution of different type of measures according to action plans reported in 2014 and 2019 in Lithuania, Poland and Sweden



7 Major airports

7.1 Coverage

According to the information provided by countries, 81 major airports fulfil the END requirements. Only 27 major airports have been reported using the Reportnet web forms.

7.2 Expenditures and number of people experiencing noise reduction

The number of people that would benefit from the action plans is only available for United Kingdom, ranging from 3 000 people in Bristol Airport to 689 400 people in London Heathrow Airport. These figures reflect the combination of different factors, in particular noise traffic management and location of the airports.

Table 7.1: Expenditures of action plans of major airports

Airport	Expenditure (€)
Helsinki Vantaa Airport	30 000
Riga International Airport	18 350
Vienna International Airport	50 000 000

Table 7.2: Number of beneficiaries (people experiencing noise reduction) of action plans by major airport.

Airport	People experiencing noise reduction
Birmingham International Airport	56 000
East Midlands Airport	14 900
London Gatwick Airport	13 500
London Luton Airport	17 000
Manchester Airport	102 300
Helsinki Vantaa Airport	100 000
London Stansted Airport	8 700
Bristol Airport	3 000
London City Airport	32 500
London Heathrow Airport	689 400
Vienna International Airport	30 000
Newcastle International Airport	1 900

7.3 Public consultation

The information is only available for Netherlands and United Kingdom. In the latter case, a broader range of stakeholders are included and specific participatory process has been reported.

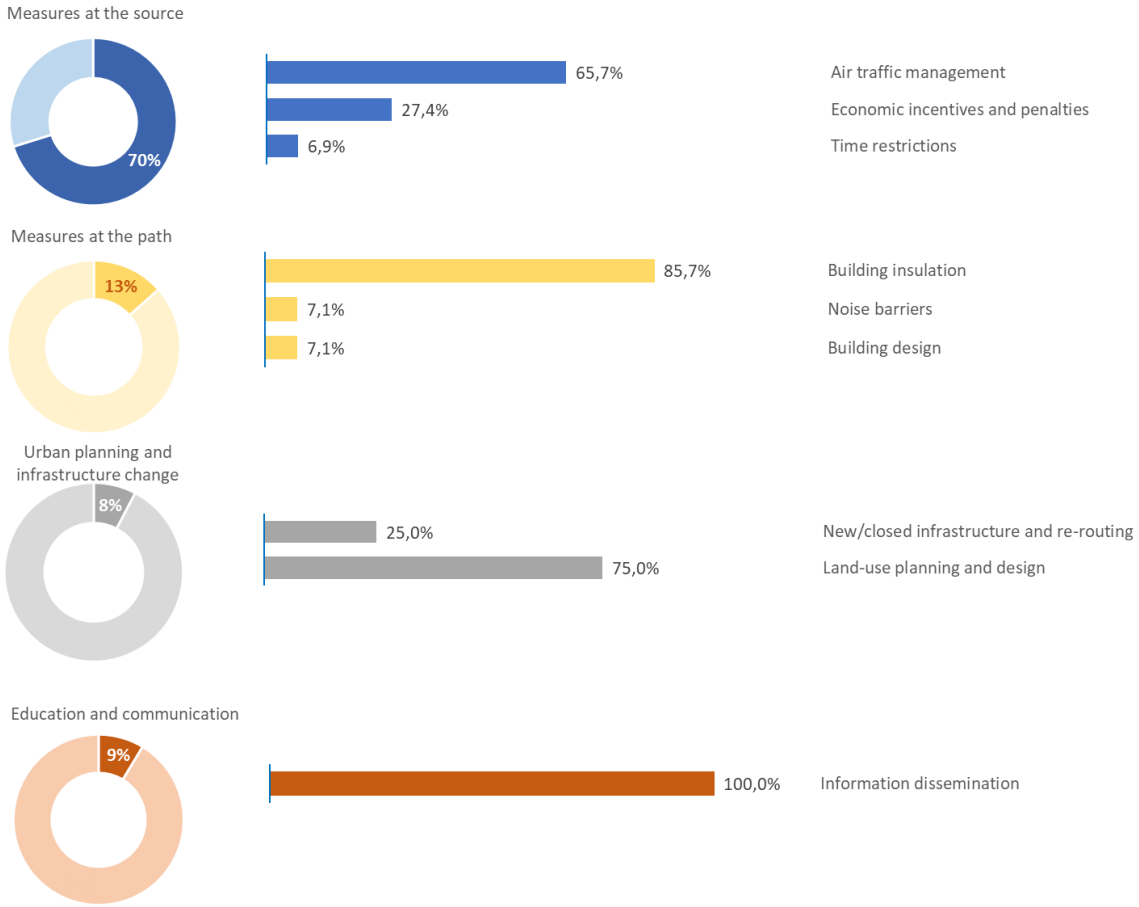
Table 7.3: Overview of the main characteristics of the consultation process by country. Not available: n.a.

Country	Duration (weeks)	Type of consultation				Stakeholders			
		web	meeting	survey	participatory process	general public	local authorities	companies	NGO
Netherlands	n.a.	●				●	●		
United Kingdom	10	●		●	●	●	●	●	●

7.4 Noise mitigation measures

The mitigation measures employed to reduce exposure to aircraft noise caused by major airports have a different nature than those employed for road or rail. In contrast to, e.g., continuous road traffic noise from a busy road, aircraft noise is intermittent, i.e., consecutive aircraft noise events are usually separated by a noise-free period. Aircraft noise comes from above, making it difficult to use path measures such as noise barriers, although building insulation is very relevant. Therefore, the most predominant measures employed to combat aircraft noise are those at the source (70%). Among these measures, those related to traffic management as well as those incentivising or penalising certain types of aircraft are among the most used. There are no reported measures regarding the availability of green space. On the other hand, measures focussing on dissemination of noise information to the public are used more frequently for major airports than for major roads and major railways.

Figure 7.1: Reported measures in noise action plans to mitigate noise from major airports. Circles present the share of different typologies of measures. Bars depict the most frequent measures inside each typology.



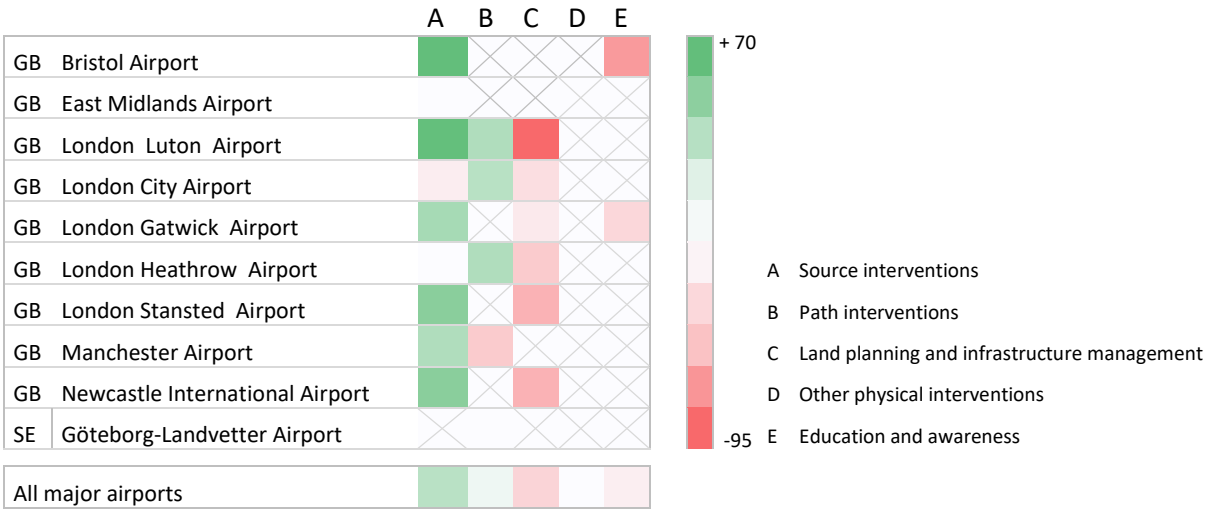
7.5 Changes

About 90% of the major airports reported both years, i.e. 2014 and 2019, are from United Kingdom. Therefore, the following results should be considered with caution since are mainly representing one country.

There is a general increase on both source and path interventions in most airports from United Kingdom. Land planning, and education and awareness clearly decrease in those airports that already reported these measures in 2014. Other physical interventions, e.g. quiet areas, have not been reported in any airport

Having a closer look to the specific actions reported, there is an important increase of measures oriented to provide incentives for less noisier airplanes, followed by building insulation and air operational measures.

Figure 7.2: Change on the type of measures taken to reduce noise exposure between 2014 and 2019. Red: decrease on the percentage of measures taken within a certain intervention category. Green: increase on the percentage of measures taken within a certain intervention category in 2019, compared with 2014. Measures not reported at all in none of the two years are marked with an X. Values reflect differences on percentages between final year and initial year. Source: Noise Action Plans reported according to END (2014 and 2019).



8 Action plans and health

The WHO has developed a set of environmental noise guidelines, based on the growing understanding of the health impacts of exposure to environmental noise. They provide robust public health advice, which is essential to drive policy action that will protect communities from the adverse effects of noise. These WHO guidelines provide recommendations for protecting human health from exposure to environmental noise originating from various sources. They not only offer robust public health advice but also serve as a solid basis for future updates, given the growing recognition of the problem and the rapid advances in research on the health impacts of noise. Their recommendations are based on systematic reviews of evidence that consider more health outcomes of noise exposure than ever before. Through their potential to influence urban, transport and energy policies, these guidelines contribute to the 2030 Agenda for Sustainable Development and support whose vision of creating resilient communities and supportive environments in the European Region.

This section review the recommendations provided by WHO against the main findings described in previous sections.

WHO recommends three guiding principles:

- **Reduce exposure** to noise, while **conserving quiet areas**. Most measures focus on noise source, followed by path interventions, in line with these recommendations. However, quiet areas are only referred in a small percentage of action plans (7% in agglomerations, to 2% in major rails).
- Promote interventions **to reduce exposure to noise** and **improve health.** There is hardly any reference to health. Only actions taken on rising awareness provide this connection between noise reduction and health improvement.
- **Coordinate approaches** to control noise source and other environmental health risks. The information provided by Member States, according to Annex V of the Directive, does not allow to identify such synergies between noise measures and other health issues.

- **Inform and involve communities.** This is only accomplished by a small number of action plans. However, since the information is also fragmented, results should be taken with caution.
-

Concerning specific recommendations for road traffic noise:

- Reduce noise levels below 53 dB L_{den} and 45 dB L_{night}. The information reported is quite fragmented. However, all the reported limit values are above these thresholds.
- Reduce noise both at the source and on the path by changes on the infrastructure. This recommendation is partly accomplished by all analysed action plans since measure at source and path are by far the most applied ones. However, infrastructure change accounts only for 13% of all measures.

Specific recommendation for railway noise are as follows:

- Reduce noise levels below 53 dB L_{den} and 45 dB L_{night}. When reported, all limit values are above these recommendations.
- According to WHO there is not enough evidence to recommend one type of intervention over another.

Major airports:

- Reduce noise levels below 45 dB L_{den} and 40 dB L_{night}. Very fragmented information. The few cases reported are above these targets.
- Changes on infrastructure: opening/closing runaways and flight arrangements. The analysed action plans follow these recommendations since regulation of routes (opening/closing runaways) is the most common measure. Followed by flight arrangements.

9 References

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Annex 1
List of mitigation measures

The table presents the list of measures identified in noise action plans and grouped by type of intervention and corresponding subcategory. The classification is adapted from WHO (2018).

Type of intervention	Subcategory	Measure
A. Source interventions	A1. Change in emissions levels of sources	Air operational measures Electric buses Improve public transport fleet Low noise rail Low noise tracks Low-emission buses Optimisation of modal split Rail damper Rail grinding Rail maintenance Rail track improvement Rail wheel absorbers Reduction of freight transport Regulation of routes Road surface Roundabouts Smart traffic management Speed limit Traffic calming Traffic control Traffic flow Traffic management (not specific) Traffic restriction Tyres
	A2. Time restriction on source operations	Air operational measures Airport curfew Heavy vehicle curfew Restrictions Traffic restrictions Truck restrictions
	A3. Mobility	Reducing traffic density - Encourage cycling and walking Reducing traffic density - Promoting public transport Reducing traffic density - Traffic management and parking

Type of intervention	Subcategory	Measure
B. Path interventions	B1. Change in the path between source and receiver	Noise barriers
	B2. Path control through insulation of receiver's dwelling	Building design Building insulation Insulation of building Sound-proof windows
C. Land planning and change on infrastructures	C1. Opening a new infrastructure noise source, or closing an existing one	New by-pass road New flight path New roads Subway expansion Traffic re-routing
	C2. Planning controls between (new) receivers and sources	Buffer requirement Land use planning
D. Other physical interventions		Green areas Quiet areas
E. Education and communication interventions	E1. Change in behaviour to reduce exposures; avoidance or duration of exposure	Electric vehicles Incentive for environmental friendly transport modes Promote sustainable mobility Promotion of electrical vehicles
	E2. Community education, communication	Dissemination of noise information Increase public awareness

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