Eionet Report - ETC/ATNI 2020/7

Noise Action Plans

Impact of END on managing exposure to noise in Europe. Update of Noise Action Plans 2019

December 2020

Authors:
Jaume Fons-Esteve (UAB), Núria Blanes (UAB), Francisco Domingues (UAB), Maria José Ramos (UAB), Miquel Sáinz de la Maza (UAB)

ETC/ATNI consortium partners:
NILU – Norwegian Institute for Air Research, Aether Limited, Czech Hydrometeorological Institute (CHMI), EMISIA SA, Institut National de l'Environnement Industriel et des risques (INERIS), Universitat Autònoma de Barcelona (UAB), Umweltbundesamt GmbH (UBA-V), 4sfera Innova, Transport & Mobility Leuven NV (TML)

European Environment Agency
European Topic Centre on Air pollution, transport, noise and industrial pollution

Cover design: EEA
Cover photo © Aleksejs Bergmanis, Creative Commons Zero (CC0) license
Layout: EEA/ETC ATNI

The withdrawal of the United Kingdom from the European Union did not affect the production of the report.
Data reported by the United Kingdom are included in all analyses and assessments contained herein, unless otherwise indicated.

Author(s)
Jaume Fons-Esteve, Universitat Autònoma de Barcelona, UAB
Núria Blanes, Universitat Autònoma de Barcelona, UAB
Francisco Domingues, Universitat Autònoma de Barcelona, UAB
Maria José Ramos, Universitat Autònoma de Barcelona, UAB
Miquel Sáinz de la Maza, Universitat Autònoma de Barcelona, UAB

ETC/ATNI c/o NILU
ISBN 978-82-93752-27-1

European Topic Centre on Air pollution,
transport, noise and industrial pollution
c/o NILU – Norwegian Institute for Air Research
P.O. Box 100, NO-2027 Kjeller, Norway
Tel.: +47 63 89 80 00
Email: etc.atni@nilu.no
Web : https://www.eionet.europa.eu/etcs/etc-atni

Meta information on this EIONET Report

Task reference

AP	Task #	Task Title	ETC Task leader	EEA contact Persons
2020	1.1.5.2	Noise data dissemination	Núria Blanes	Eulàlia Peris

Type, titles and series number of report *(EIONET report no. and ISBN-no. will be given by NILU)*

EIONET Report – ETC/ATNI 2020/7	**ETC/ATNI c/o NILU: ISBN 978-82-93752-27-1**
Title:	Noise Action Plans in Europe
Sub title:	Impact of END on managing exposure to noise in Europe. Update of Noise Action Plans 2019
Number: (*)	ETC/ATNI 2020/7

(*) Obtaining a series number: See instructions at the Eionet Forum IG "ETC/ATNI Consortium":
https://forum.eionet.europa.eu/etc-atni-consortium

Authors

	Name	Institute	ORCID-iD (https://orcid.org/)
Lead Author:	Jaume Fons-Esteve	UAB	https://orcid.org/0000-0002-5513-2970
Co-authors:	Núria Blanes	UAB	https://orcid.org/0000-0002-1873-8113
	Francisco Domingues	UAB	https://orcid.org/0000-0003-4627-8895
	Maria José Ramos	UAB	
	Miquel Sáinz de la Maza	UAB	https://orcid.org/0000-0001-9434-9788

Reviewers (Internal and external task reviewers)

Within Task	Ext. Task	Ext. ETC	Reviewer(s)	Institute	Motivation / Comment for involvement
*(mark with **x**)*					*(expert, user, program manager, audience, etc.)*
X		**X**	Eulàlia Peris	EEA	EEA project manager
		X	Alena Bartonova	NILU	ETC manager

Status & Deadlines

(**)	Planned deadline according Action Plan	Actual date of delivery
"First Draft for approval by EEA"	15.11.2020	15.11.2020
"Final Draft for approval by EEA"	15.11.2020	15.12.2020
"Final Version - Approved by EEA"	25.01.2021	25.01.2021
Publication		20.05.2021

(**) Deliver to Eionet Forum IG "ETC/ATNI Consortium" in its appropriate pre-defined Task-subfolder at:
https://forum.eionet.europa.eu/etc-atni-consortium/library

Web publication guidance:
You find guidance on the production and review procedures and on styles and templates in the document **Report production and review guidelines of the ETC/ATNI** (PDF) at the EEA web pages.
The EIONET Report - ETC/ATNI 2020/7 will be published at EEA web pages.
https://www.eionet.europa.eu/etcs/etc-atni/products/atni-reports.

Document history

Lead author to confirm: I hereby confirm that I have familiarised myself with the EEA Writing Manual (to be found at: https://forum.eionet.europa.eu/etc-atni-consortium/library/general-etc-atni).	YES: X

Make sure to deliver completed drafts and versions to Eionet Forum IG "ETC/ATNI Consortium" in its appropriate pre-defined IP- and Task-subfolder at https://forum.eionet.europa.eu/etc-atni-consortium/library

Version	Authors/Reviewers	Date	Comments
1.0	Jaume Fons-Esteve	31.10.2020	Structure and outline of the report
1.1	Jaume Fons-Esteve, Núria Blanes	15.11.2020	Final version
1.2	Jaume Fons-Esteve, Núria Blanes	03.12.2020	Integration of comments.
1.3	Eulalia Peris	15/12/2020	Final revision
	Alena Bartonova	31/03/2021	Final review before publication
	Jaume Fons	12/05/2021	Final version

Be aware that this document history list will be removed from the final version of the report.

REQUIRED INFORMATION NEEDED FOR THE PUBLICATION :

SUMMARY (used in item listings and search results)**:**

The Environmental Noise Directive (END) sets legally binding obligations to reduce and manage environmental noise. The competent authorities have to draw up action plans for major transport sources and the largest urban areas based upon noise mapping results. This report provides an overview of the reported noise action plans up to January 2020, and the type of measures implemented to reduce environmental noise.

TAGS (Tags are commonly used for ad-hoc organisation of content) **:**

Environmental Noise Directive (Directive 2002/49/EC), environmental noise, noise action plans, noise measures, noise pollution

ABSTRACT :

Based upon noise mapping results, the competent authorities have to draw up action plans for major transport sources and the largest urban areas. Furthermore, areas of high acoustic quality, in other words, free from noise pollution, should also be protected by appropriate action plans. While the requirements are set in the Directive, the specific types of measures included in these action plans are decided at Member State level.

Data on action plans submitted by countries under the END, up to January 2020, show that noise reduction at the source (e.g. improving road and rail surfaces, air traffic management, reducing

speed limits, retrofitting, managing traffic flows) is an extensively reported mitigation measure for all sources of noise inside urban areas and major airports. Measures at the path, namely noise barriers, are most frequently reported for major road and major rails (outside urban areas). Land use and urban planning, which are linked to city design (e.g. protecting sensitive receivers using street design and providing quiet zones) are also reported for all noise sources. Still, they represent a small percentage of the mitigation measures generally chosen to address noise problems.

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

Contents

Summary

The Environmental Noise Directive (END) sets legally binding obligations to reduce and manage environmental noise. Therefore, Member States shall designate the competent authorities and bodies responsible for implementing this Directive at the appropriate levels, including the authorities responsible for action plans for major transport sources and the largest urban areas -based upon noise mapping results. Noise sources, as defined by the END, include major roads with more than three million vehicle passages a year; major railway with more than 30 000 train passages per year; major airports with more than 50 000 movements per year (a movement being a take-off or a landing), excluding those purely for training purposes on light aircraft; and noise from roads, railways, airports and industries inside of agglomerations -part of a territory, delimited by the Member State, having a population in excess of 100 000 persons and a population density such that the Member State considers it to be an urbanised area.

Action plans have to be reported every five years, starting in 2009. Furthermore, areas of high acoustic quality, in other words, free from noise pollution, should also be protected by appropriate action plans. Specific types of measures included in these action plans are decided at the Member State level. EEA member countries other than EU Member States also report on a voluntary basis.

After three rolling cycles of the END (2009-2013, 2014-2018, 2019-2023 time periods), we see that countries are more and more aligning their actions to this 5-year cycle. The action plans are to be reported as web forms since 2012, although some countries still submit separate text files. A first assessment of the 2019 data delivery was produced in 2019. Since then, i.e. nine months later, about 91 more action plans have been provided. Therefore, the current report extends the previous assessment to 315 noise action plans, covering 17 countries (15 from EU 27 -EEA member countries other than EU Member States report on a voluntary basis). However, the current report is still far to be complete since it covers less than 50 % of the action plans to be reported.

Beyond updating previous figures, this report provides new contents: a) an assessment of the implementation and evaluation of action plans; b) an assessment of the co-occurrence of noise mitigation measures, i.e. the identification of groups of measures that tend to be used together; and c) a revision of the classification and typology of measures in the context of the new noise reporting data model and Reportnet 3.0.

In terms of urban areas (171 agglomerations), the reported data shows that noise reduction measures at the source are by far the most employed (50 %), followed by measures at the path (16 %), education and communication measures (16 %), urban planning and infrastructure changes (11 %), as well as other physical changes (8 %). Measures at the source are frequently combined, i.e. effective noise mitigation at the source requires the use of several measures simultaneously (particularly traffic management and improvement of the road surface). The development of new infrastructure is not an isolated practice, and it is done in combination with traffic management and noise barriers.

In major roads, the actions that predominate are those related to measures on the propagation path (48 %), followed by source oriented measures (34 %). We have found very few co-occurrences of different measures. The most significant one was between new infrastructure and traffic management.

Measures at the path, like installation of noise barriers, are the most frequently reported type of measure to mitigate noise from major railways (48 %), followed by implementing measures at the source, such as reducing the track roughness by conducting regular maintenance (37 %). We did not find any significant use of combinations of individual measures.

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 (65 %). From those, measures related to traffic management and those incentivising or penalising some types of aircraft are among the most used. There are no reported measures regarding the availability of green space. On the other hand, a higher share of measures targeting communication to the public is used in major airports compared to major roads and major railways. The system of sanctions and taxes is associated with other measures, e.g. complaint management, or banning aircraft depending on their certification.

The information related to the evaluation of the action plans is still quite fragmented. The most common approach is to evaluate the implementation according to the spending of the corresponding budget, which is audited according to the country legislation and practices.

Noise is an important health and wellbeing determinant for which WHO has developed guidelines. However, the noise action plans currently do not provide any assessment from this perspective.

Finally, although action plans covering the largest urban areas and major transport sources should have been drawn up following the END reporting cycle, there is a significant number of EU-27 Member States for which such plans are missing as web forms: 269 agglomerations, 12 EU Member States for major roads, 11 EU Member States for major rail, and 48 major airports.

Acknowledgements

This report has been elaborated by Jaume Fons-Esteve, Núria Blanes, Francisco Domingues, Maria José Ramos and Miquel Sáinz de la Maza from Universitat Autònoma de Barcelona (UAB), in the context of the European Topic Centre on Air Pollution, Transport, Noise and Industrial Pollution (ETC/ATNI) of the European Environment Agency (EEA).

The EEA task manager was Eulàlia Peris Aguiló.

1 Introduction

The Environmental Noise Directive (END) (EU, 2002) sets legally binding obligations to reduce and manage environmental noise. The Member States shall designate the competent authorities and bodies responsible for implementing this Directive at the appropriate levels, including the authorities responsible for action plans for major transport sources and the largest urban areas -based upon noise mapping results. Noise sources, as defined by the END, include major roads with more than three million vehicle passages a year; major railway with more than 30 000 train passages per year; major airports with more than 50 000 movements per year (a movement being a take-off or a landing), excluding those purely for training purposes on light aircraft; and noise from roads, railways, airports and industries inside of agglomerations -part of a territory, delimited by the Member State, having a population in excess of 100 000 persons and a population density such that the Member State considers it to be an urbanised area.

Action plans have to be reported every five years, starting in 2009. Furthermore, areas of high acoustic quality, in other words, free from noise pollution, should also be protected by appropriate action plans. Specific types of measures included in these action plans are decided at the Member State level. EEA member countries other than the EU Member States also report on a voluntary basis.

Given the relevance of the action plans and the complexity to analyse them, i.e. most of the information is provided as text, efforts have been made to streamline its reporting by providing web forms and systematise its analysis by developing a typology and classification of noise mitigation measures. The most recent reports already reflect the advance on understanding how countries apply the END and take action for noise mitigation (Blanes et al., 2019; EEA, 2020). However, there is still a substantial gap in data completeness and a complete understanding of critical elements (e.g. how measures are evaluated or which criterion is used to plan individual measures).

Since the publication of the reports mentioned above, 91 new action plans have been delivered as web forms (31.01.2020). Therefore, we have taken the opportunity to update the previous report to advance the understanding of how measures are planned and implemented. This is reflected in this report by a specific analysis on which type of measures are more frequently used together and how the action plans are evaluated. Moreover, the development of a new INSPIRE compliant data model in the context of Reportnet 3.0 has been an opportunity to revisit the current classification of measures which had some ambiguities in certain classes. The reviewed classification of measures has run parallel with the current report; therefore, the report is based on the existing classification. However, a specific section describes the improvements to be implemented in the next reporting cycle starting 2024.

Finally, as part of making information more accessible and facilitating dissemination, countries fact sheets have been developed to synthesise the available information.

2 Data and methodology

2.1 Coverage of the analysis

This report mainly focuses on the action plans that countries had to draw up by 18.01.2019 (reference year 2019) and compare them with the measures provided by action plans drawn up by 18.01.2014 (reference year 2014), the reporting cycles set up by END.

Because some countries do not provide data by the stated deadlines, the EEA does regular updates on the data to include the latest submissions. The data used in this report refers to all the submissions received for the reporting of action plans up to 31.01.2020.

As mentioned before, this report updates the analysis done by Blanes et al. (2019), which considered data submitted up to 01.04.2019. Since then, 91 new action plans have been delivered. These NAP are late deliveries corresponding to the 2019 deadline set by the END. Regarding action plans from 2012, no new action plans have been reported since 2019.

The 91 new action plans included in this report are distributed as follows (Figure 2.1 and Table 2.1):

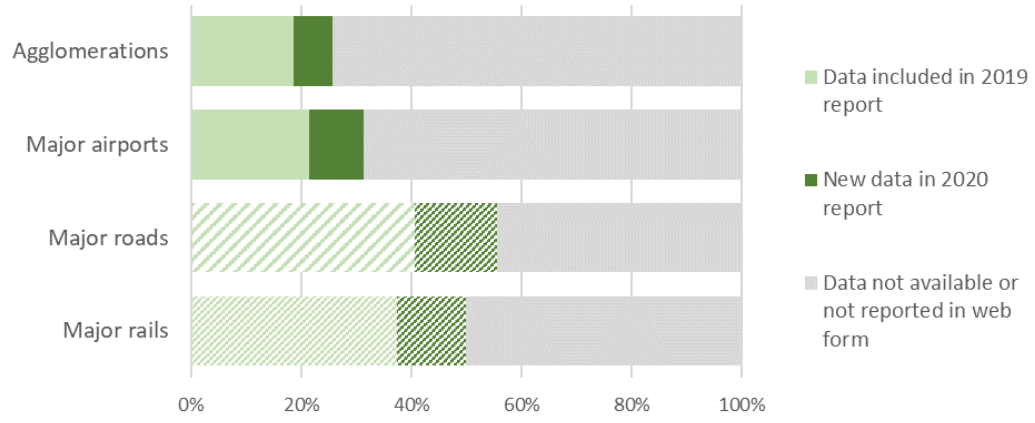
- 30 action plans from agglomerations
- 7 action plans from major airports
- 42 action plans from major roads
- 12 action plans from major rails

In summary, this report covers 315 noise action plans from which 224 were already included in Blanes et al. (2019) for the 2019 reference year. All the new action plans are from the EU 27 Member States ([1]). Since data was reported before the Brexit, data provided by the United Kingdom is included.

Compared with the data available as 30.04.2019 (Blanes et al., 2019), the coverage has increased as follows (data for EU27 and the United Kingdom):

- Agglomerations. Increased from 30 % (140 agglomerations) to 36 % (168 agglomerations ([2])).
- Major roads. An increase from 12 to 16 countries (12 countries have not yet reported in a web form).
- Major rails. Increased from 10 to 14 countries (11 countries have not yet reported in a web form).
- Major airports. Increased from 28 % (24) to 36 % (31 major airports).

Figure 2.1: Coverage of the data included in Blanes et al., 2019 (2019 report), and new data updated in the current report as a percentage of the total data to be reported. Major roads and major rails are reported at the country level: patterned bars indicate that data provided for individual countries may not be complete (not covering the full geographic extent). Data reported always refer to data reported as a web form. Reference year: 2019. Coverage: EU 27.



[1] This report adopts the official grouping of countries as of November 2020: EU27 and EEA32. The United Kingdom reported before the Brexit; therefore, data is included as a separate country of the groups mentioned above.

[2] Additionally, there are also three new agglomerations from Iceland, which add up to 171 agglomerations referred in Table 2.1.

Table 2.1: Number of action plans and geographic coverage included in this report, grouped by a noise source. These figures cover all action plans reported as web forms as 31/01/2020 (reference year 2019). Note: The difference between the number of action plans for agglomerations and the number of agglomerations is explained because some agglomerations reported separately NAP per each noise source for the same period).

Source	Number of action plans		Coverage
	Total analysed	Submitted after 30.04.2019	
Agglomerations	190	30	171 agglomerations correspond to 37,3 million people, from AT, BE, BG, HR, DK, EE, FI, FR, IE, IS, LV, NL, PL, PT, ES, SE, and UK.
Major roads	80	42	These action plans cover 16 countries, with a full geographic extent for AT, EE, FI, and LT. The coverage is incomplete for BE, DK, ES, FR, HR, IE, LV, NL, PL, PT, SE, and UK.
Major rails	23	12	These action plans cover 13 countries, with a complete geographic extent for AT, FI, HR, IE, LT, and LV. The coverage is incomplete for DK, ES, FR, NL, PL, SE, and UK.
Major airports	22	7	31 Major airports from AT, DK, FI, IE, LV, NL, PT, ES, SE, and UK.

All these figures refer to action plans reported as web forms. As shown in Figure 2.1, there is still a substantial gap in the complete availability of action plans, particularly for agglomerations and major airports.

Details for each noise source are provided in each noise source section's introductory part under Chapter 3.

2.2 Scope of the data

The Noise Action Plans (NAP) reporting format poses a challenge to a systematic analysis and review. The following issues play a role (Blanes et al., 2019):

- 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.
- Although minimum requirements for the submission of NAPs are listed in Annex V of the END, 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.

A webform was developed in 2012 (second reporting cycle) within the frame of the Electronic Noise Data Reporting Mechanism (ENDRM) in Reportnet to facilitate the reporting and collection of information. The information available in these web forms (relevant for this report) is as follows:

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

The structure of Reportnet still allows countries to provide this information as separate text files. However, this report has only analysed the information provided in web form.

This systematic approach of the ENDRM through web forms does not provide the full information structured properly for its analysis. Therefore, the free text has been translated into keywords related to different topics that allow comparative analysis.

2.3 Information collected

2.3.1 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;

2.3.2 Qualitative information

Web forms also collect qualitative information that needs to be further structured in order to analyse and compare action plans. Among others, the web forms gather information concerning the process of public consultation and on noise abatement measures, which are of relevance for this report.

The information on public consultation provided has been structured as shown in Table 2.2.

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

Table 2.2: Structure of the information extracted from the results on the 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)
Implementation and evaluation of action plans	Description on how the degree of implementation of action plans are evaluated.

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 into 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.

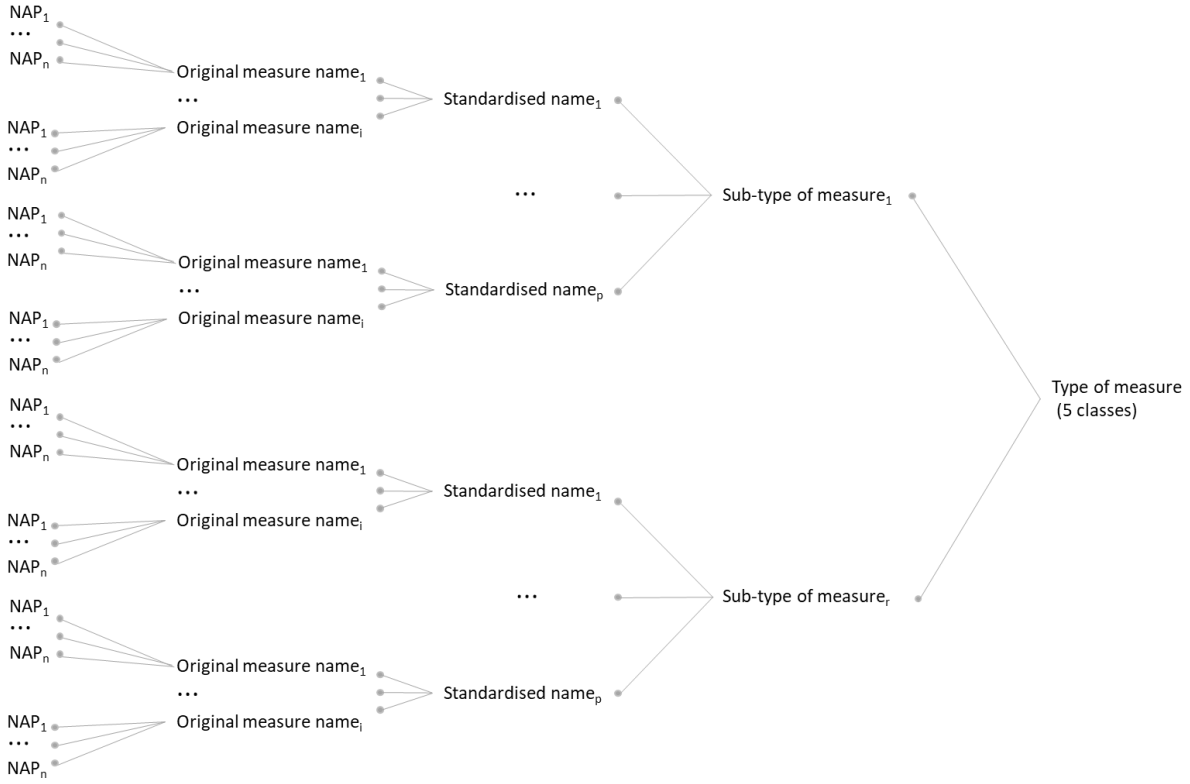
With such an approach, a hierarchical system has been implemented which facilitates the traceability of the data: from the exact terms used in the action plans, to the final nomenclature used to systematise its analysis. Moreover, this approach would facilitate any further revision.

Table 2.3: 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 subcategory
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

With such an approach, a hierarchical system has been implemented which facilitates the traceability of the data: from the exact terms used in the action plans, to the final nomenclature used to systematise its analysis (Figure 2.2). Moreover, this approach would facilitate any further revision.

Figure 2.2: Overview of the workflow and the system implemented to ensure traceability of the measures reported by countries, as narrative text, to the structured classification of measures to reduce noise. NAP, noise action plan reported by countries as a web form in Reportnet.



2.4 Analysis of co-occurrences of measures

Given the diversity of measures used for noise mitigation (see Annex 1) an immediate question is if these measures are planned independently or some measures tend to be more frequently used together.

Correlation is one of the most used measures of co-occurrence. However, we need to consider if the frequency of measures reported per agglomeration or per country are suitable for such analysis. As presented in the previous figure, measures are primarily binary data: presence or absence of a particular measure in a given agglomeration, major airport or country.

We adopted the method described by Veech (2013) that was first developed to identify the co-occurrence of species among several samples. Here, we assimilate noise mitigation measures to species.

3 Noise action plans analysis

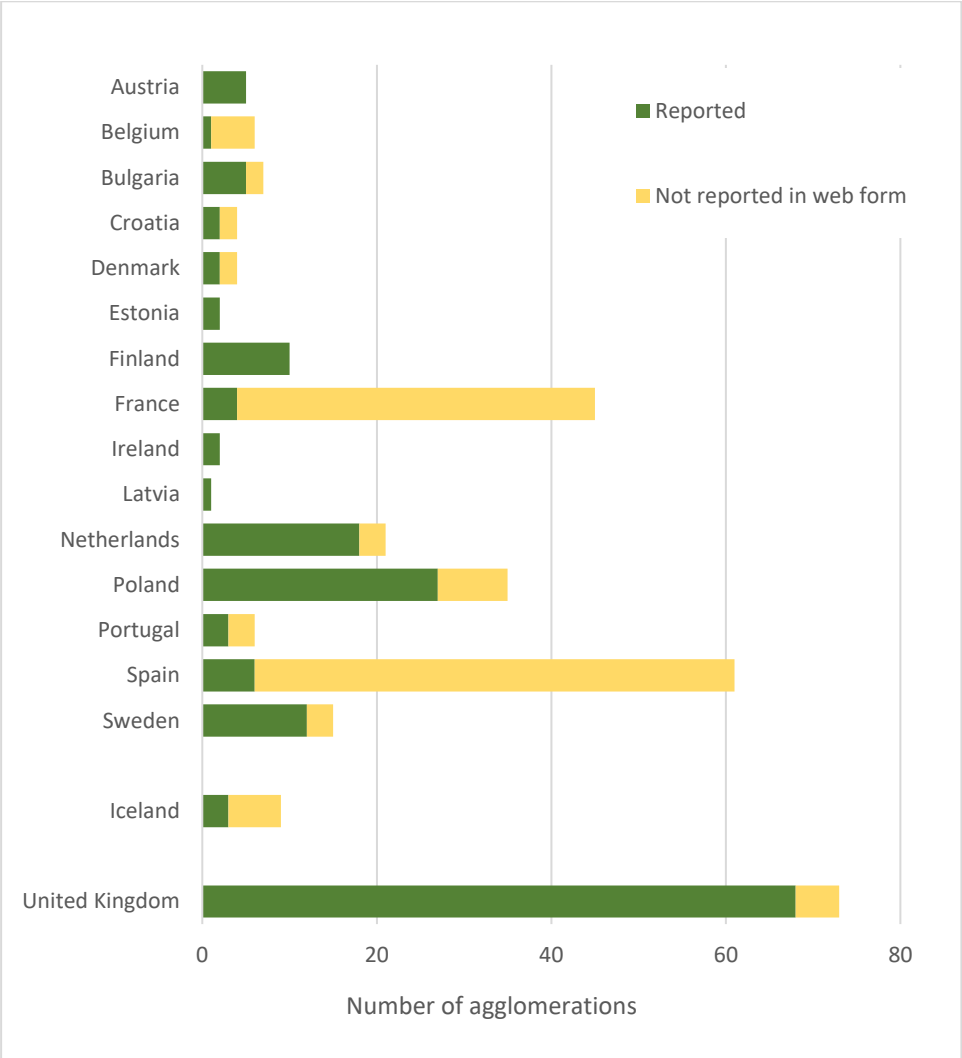
3.1 Agglomerations

3.1.1 Coverage

According to the information provided by countries, 388 agglomerations with over 100 000 inhabitants have to report NAPs as required by END (coverage EU 27). This figure increases up to 416 if EEA 32 countries are considered. Only 29 % of these agglomerations (EU 27) have reported on action plans using the Reportnet web forms. The percentage is similar, 27 %, if EEA 32 countries, excluding Turkey, are considered. Finally, the United Kingdom provided web forms for 68 agglomerations (92 % of the total to be reported). Considering all the countries together (EEA 32, excluding Turkey, and including the United Kingdom), the coverage is about 36 %.

Considering the latest official delivery done by each EEA member state (information reported until 31.01.2020), Austria, Estonia, Finland, France, Ireland, and Latvia are the countries that provided action plans for all agglomerations.

Figure 3.1: Completeness of the action plans reported as web forms per country (reference year 2019). The figure does not include countries that have not reported any agglomeration as a web form. Groups of countries: EU 27, EEA 32 (EU 27 + Iceland in the figure), and the UK.



In general, each country has delivered one action plan per agglomeration, with two exceptions:

- Austria has delivered one separate action plan per noise source inside agglomerations.
- Netherlands provided individual action plans per LAU and agglomeration.

3.1.2 Expenditures and the number of people experiencing noise reduction

Expenditures of action plans in agglomerations are only available in 35 % of web forms, which correspond to 10 % of the total agglomerations. It should be noted that this information is not mandatory.

The range of expenditures is quite broad, from 2 000 € in Finland to 500 million € in Latvia. 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 has 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 3.1.

Another element that could be considered relevant is the duration of the action plan. However, a 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 the Netherlands) to 339 000 in Poland (Figure 3.2). 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.

3.1.3 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 the development of a process of participation.

The characteristics of the public consultation are very much related to national legislation, as observed in the available information on the web forms (Table 3.2).

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 the active involvement of different stakeholders:

- Single meeting to inform the public and, in some cases, also companies.
- Survey in parallel to the public consultation to raise awareness and 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, the general public and local authorities are always mentioned. In addition, companies are also specified in the consultation process in Bulgaria, Sweden and the United Kingdom. NGOs are part of the consultation in five countries: Finland, Latvia, Poland, Sweden and the United Kingdom. Consequently, Sweden and the United Kingdom are the countries where a broader range of stakeholders are involved in the consultation process.

Figure 3.2: Boxplot of the number of beneficiaries (people experiencing noise reduction) of action plans by country. The number of people is presented on a logarithmic scale. Only countries that provided at least one web form.

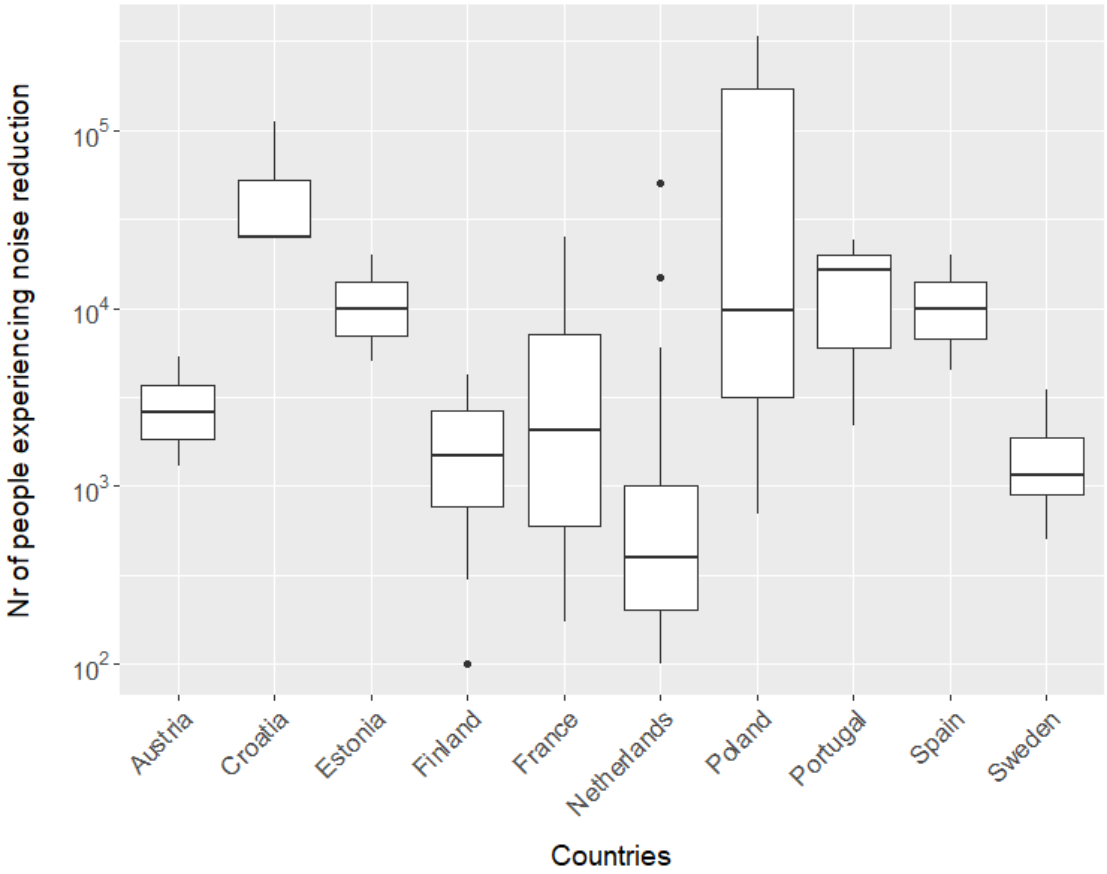


Table 3.1: Examples of noise abatement measures, their potential for reducing road traffic noise annoyance and the cost (per year) of making one person not annoyed anymore (reduce the noise annoyance by one). Source: CEDR, 2013.

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

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 into the final action plan.

Table 3.2: Overview of the main characteristics of the consultation process by country. n.a., not reported. Only countries that provided at least one web form.

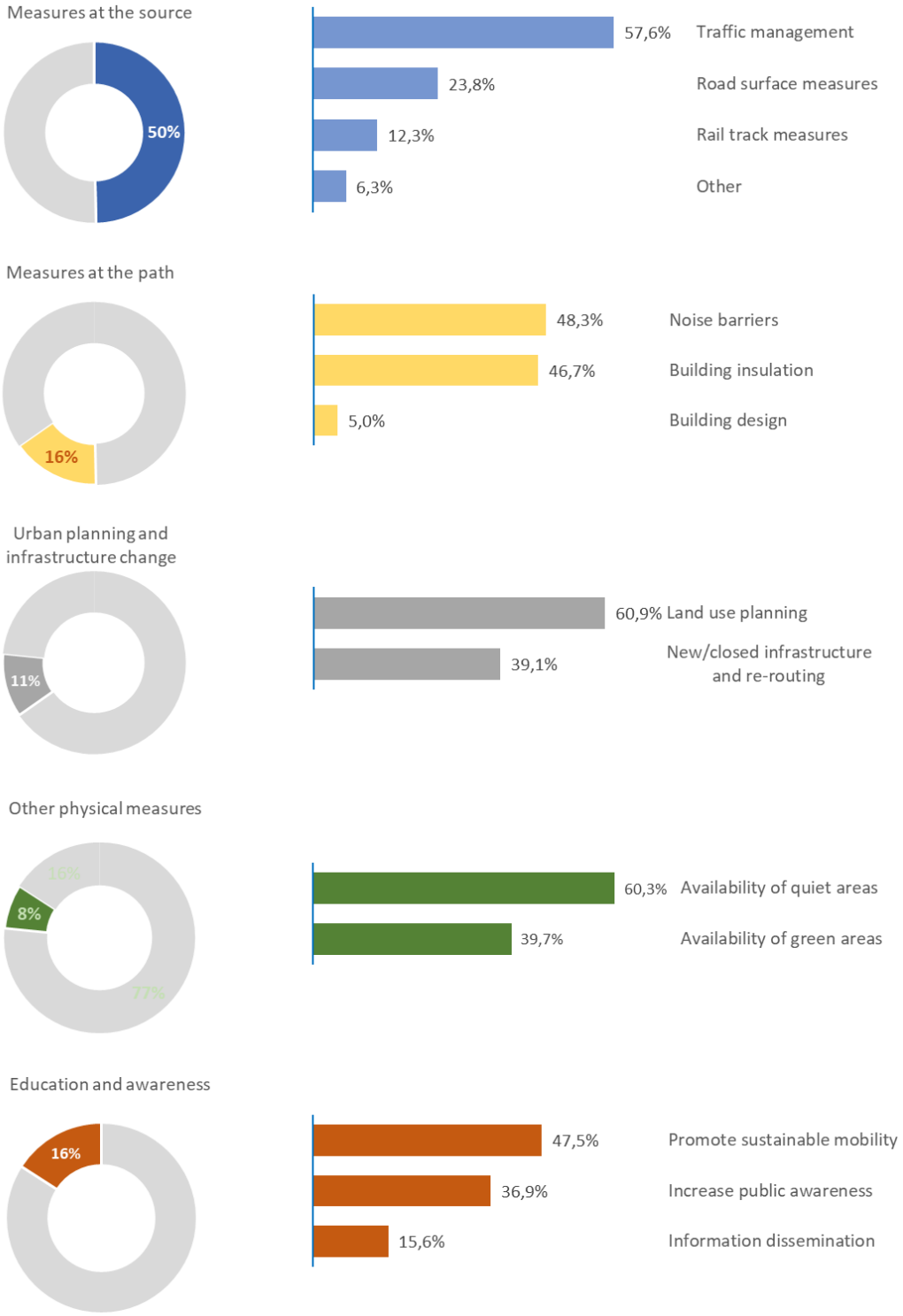
Country	Duration (days)	Type of consultation				Stakeholders			
		web	meeting	survey	participatory process	general public	local authorities	companies	NGO
Austria	17 - 42	●				●	●		
Belgium	31	●				●	●		
Bulgaria	31	●				●	●	●	
Croatia	32	●	●			●	●		
Denmark	72	●	●			●	●		
Estonia	31					●	●		
Finland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

3.1.4 Noise mitigation measures

Noise reduction measures at the source are by far the most employed (50 %) followed by measures at the path (16 %), education and communication measures (16 %), urban planning and infrastructure change (11 %), as well as other physical changes (8 %) - Figure 3.3.

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, traffic management is the most referred group of actions, followed by renewing road surfaces or replacing rough pavements with smooth asphalt. Traffic management includes 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).

Figure 3.3: Measures reported 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.



Given the diversity of measures used to reduce noise inside agglomerations, we explored if there are groups of measures that are more frequently applied together.

Figure 3.4 presents the frequency of co-occurrence of pairs of measures. The values indicate the percentage of agglomerations where two given measures appear together (p< 0,05). It could be observed that measures at the source are highly related, in particular road surface measures.

Therefore, measures at the source are frequently used in combination -there is not one single measure that could solve the problem.

Road surface management and traffic management are the two measures that appear more frequently associated with other measures. In fact, both traffic management and road surface measures are the pair that are more frequently used together (about 29 % of agglomerations).

Development of new infrastructure (e.g. new bypass route) is often applied in combination with measures at the source, like traffic management and noise barriers. These co-occurrences would indicate that the development of new infrastructure is part of a mobility plan which includes redirecting the traffic.

Although these co-occurrences are relevant, the frequency is relatively low, always below 30 %, indicating that there is a broad range of measures that most of the times are combined according to local specificities, which vary from one place to another.

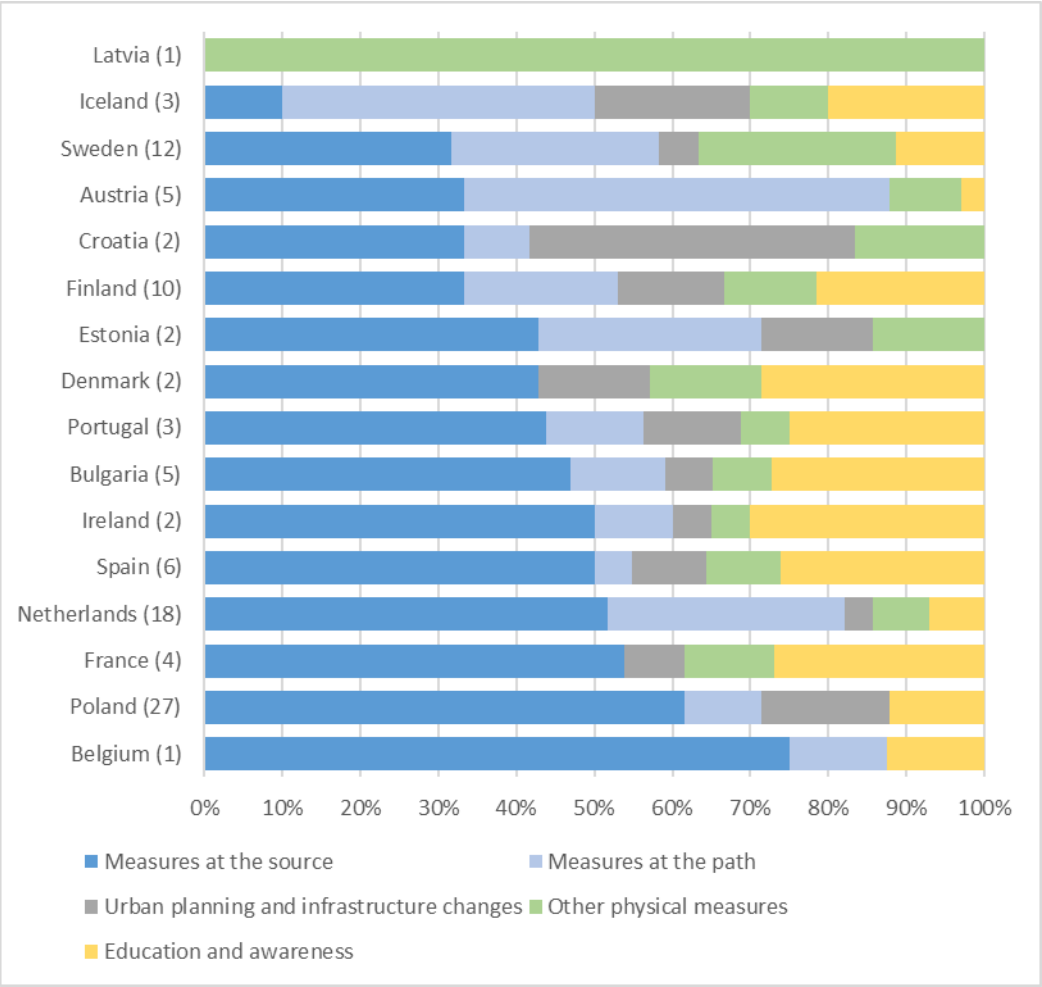
This diversity is corroborated when comparing the combination of measures at the country level (Figure 3.5). For example, path interventions are dominant in Austria (54 %) while it has only a small contribution in Spain (7 %). Latvia only reported measures related to the designation of quiet areas (other physical measures).

Figure 3.4: Co-occurrence of noise mitigation measures inside agglomerations. Values indicate the percentage of agglomerations where two measures are planned together (p < 0,05).

		Rail track	Road surface measures	Traffic management	Traffic calming	Noise barriers	Land use	Promote sustainable mobility
Measures at the source	Road surface measures	17						
	Traffic management	11	27					
	Traffic calming		29	19				
	Cycling & walking infrastructure		13					
Measures at the path	Noise barriers			21				
Urban planning	New infrastructure		19	12	13	14		
	Land use			17				
Education & awareness	Promote sustainable mobility						15	
	Raising awareness							12

There is the specific case of the United Kingdom, where the report only explains the logic of interventions and a list of possible measures depending on the local circumstances. However, the report does not provide the exact description of the specific measures that will be implemented in the given time frame.

Figure 3.5: Summary of management actions by typology in agglomerations. Number in parentheses indicates the number of agglomerations analysed within each country. Coverage: EEA32, except Turkey and the United Kingdom.



3.1.5 Changes in planned measures 2014-2019

This section compares measures reported in action plans that countries had to draw up by 18.01.2019 (reference year 2019) with the measures from action plans drawn up by 18.01.2014 (reference year 2014) -both deadlines set up by the END reporting cycles.

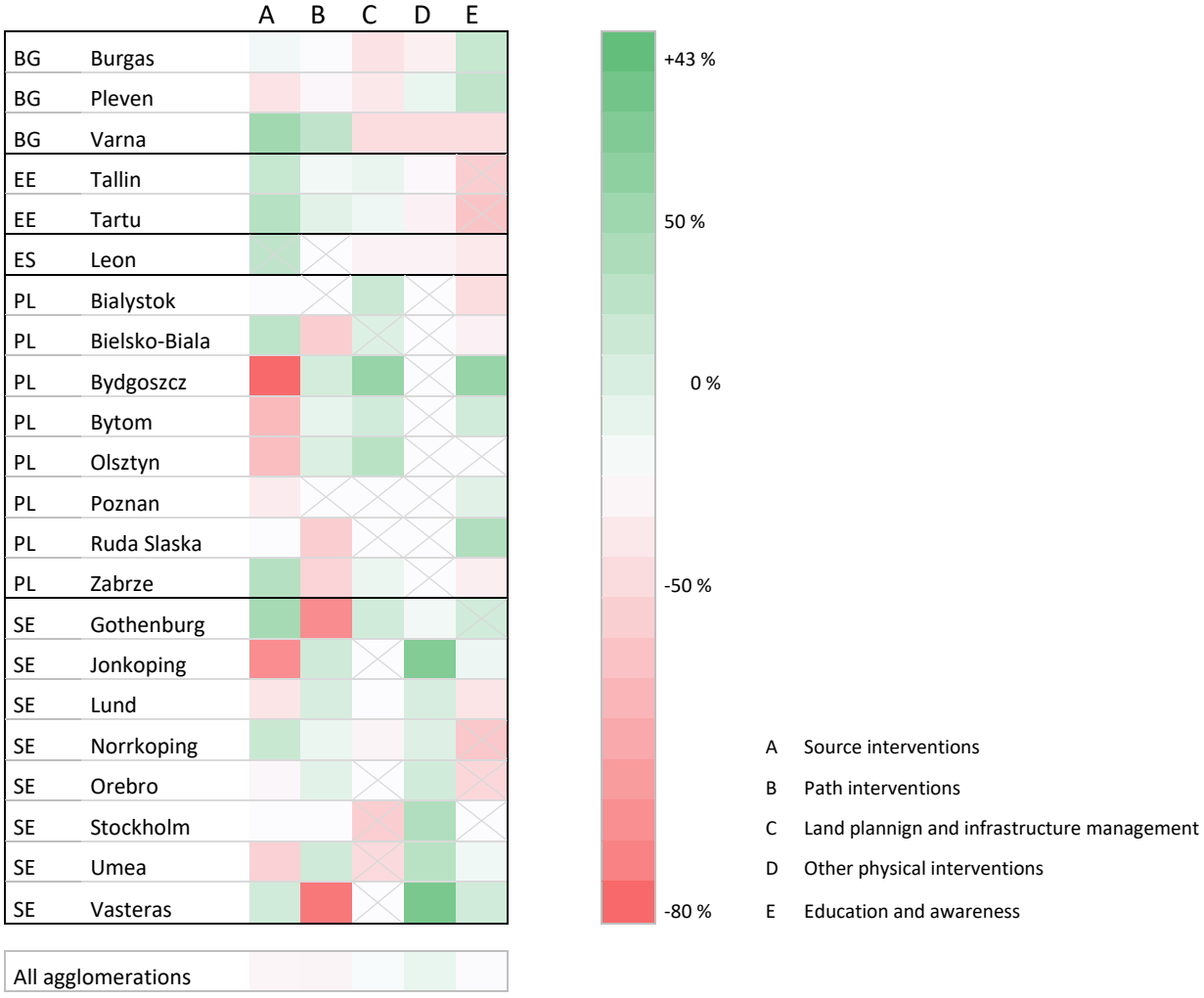
For comparability reasons, changes analysed in this section are limited to the availability of information for both years 2014 and 2019. Therefore, the conclusions are constrained to 22 agglomerations from 5 countries.

As can be seen in Figure 3.6, there are no general trends that would apply to all agglomerations. However, some country patterns are visible:

- Bulgaria. There is a decrease in measures related to land use planning
- Estonia. There is an increase in source interventions and, at the same time, decrease of the relevance of measures related to education and awareness.
- Poland. There is a consistent increase in all analysed agglomerations of measures related to the integration of noise into land use planning.
- Sweden. Increase of designation and protection of quiet areas.

These changes result in different prioritisation when selecting individual measures, as reflected in Figure 3.7. Road surface measures are becoming more prominent. On the other side, measures related to traffic management and the promotion of sustainable mobility are the ones with a higher decrease in its use.

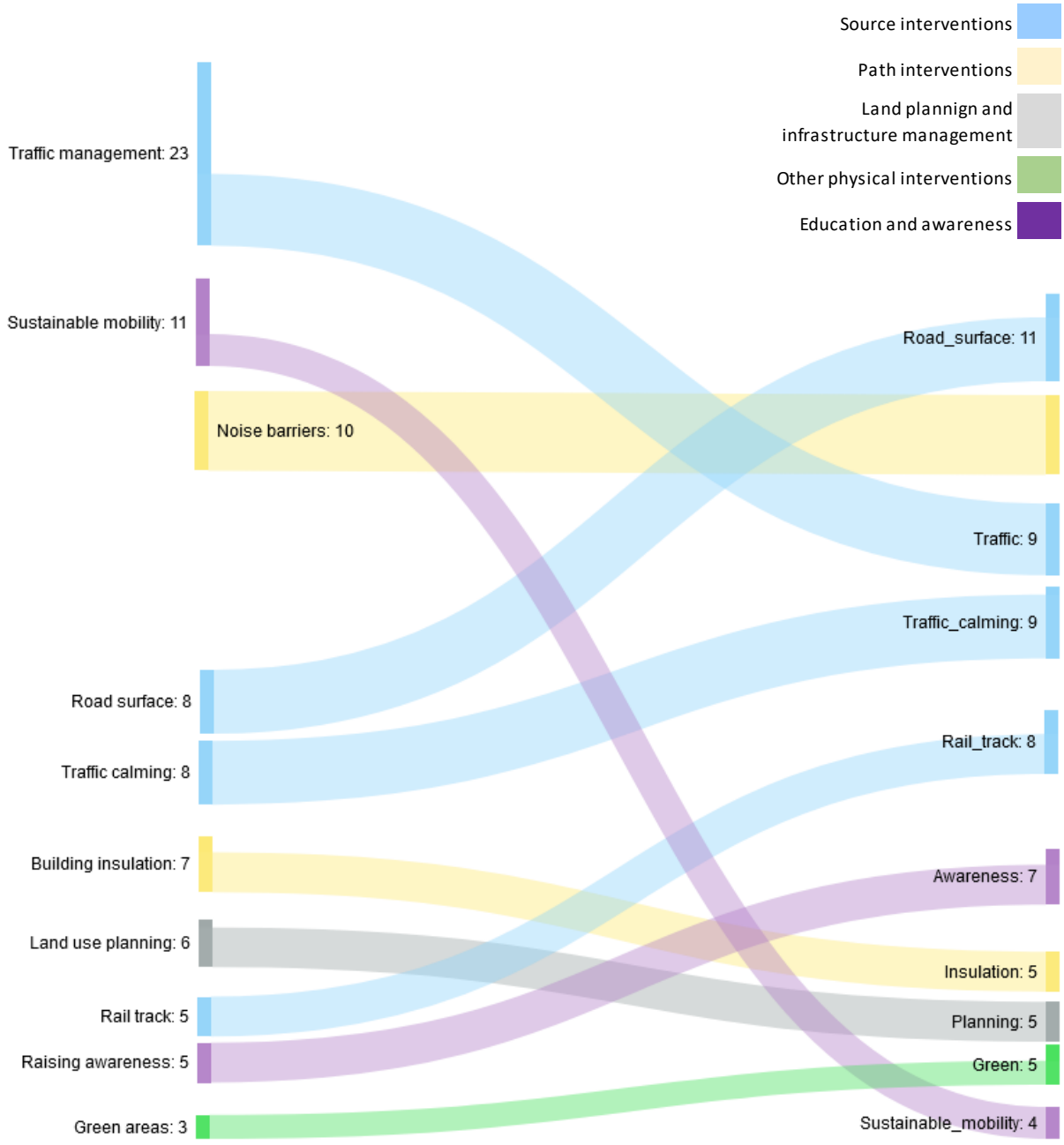
Figure 3.6: Change in the type of measures to reduce noise exposure between 2014 and 2019. Red: decrease in the percentage of planned measures within a certain intervention category. Green: increase in the percentage of planned measures within a certain intervention category in 2019, compared with 2014. Measures not reported at all in none of the two years are marked with an X. Values reflect differences on percentages between the final year and initial year. Source: Noise Action Plans reported according to END (2014 and 2019).



These changes should be considered as a result of several factors:

- A decrease in certain measures could indicate that the measures were already implemented in the previous period, and these measures are not mentioned as a new action to be taken. This could be the case of traffic management.
- A mismatch between the duration of the action plan and the requirements of the END. There has been an improvement by aligning the action plans with the reporting frequency required by the END.
- Differences in reporting and collecting the information. Since the measures are reported as descriptive text, it may happen that individual measures are reported differently or have been recorded in different sub-group of measures. This is further discussed in section 5.

Figure 3.7: Most frequent referred measures in 2012 action plans (left) and 2019 action plans (right). Colours indicate the typology of the measures. The number after the measure indicates the frequency of the measure. Data refers to the 22 agglomerations listed in Figure 3.6.



3.1.6 Implementation and evaluation of action plans

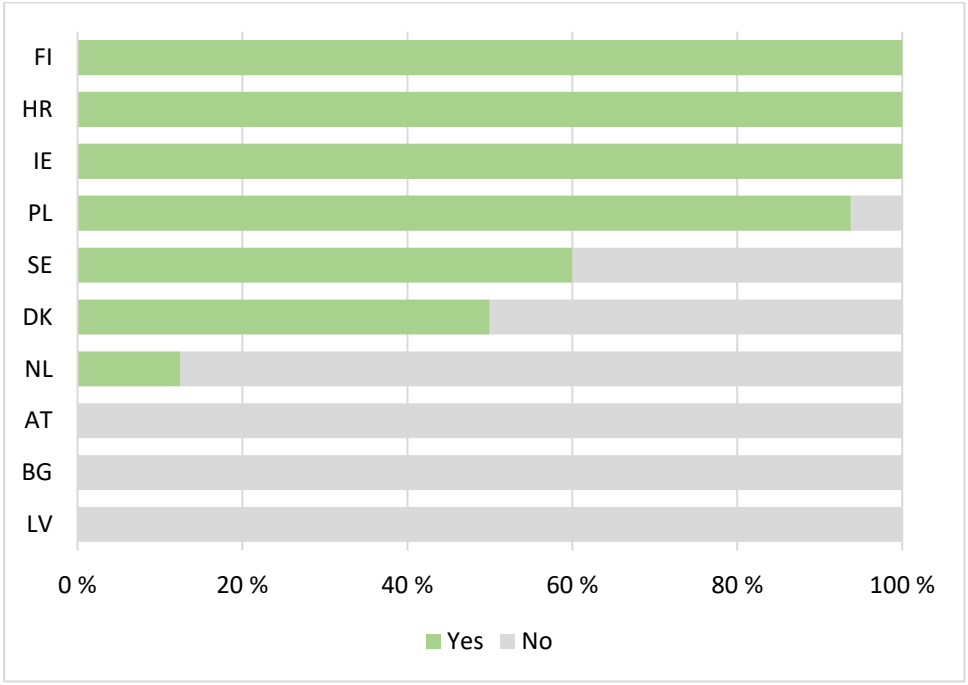
About 59 % of the agglomerations reported on web forms provide information on the evaluation mechanism of the degree of implementation (EU 27, Figure 3.8). Finland, Croatia and Ireland provide information for all reported agglomerations. On the other side, Austria, Bulgaria and Latvia do not provide any information.

The most common approach is to evaluate the implementation according to the spending of the corresponding budget, which is audited according to the country legislation and practices.

Another relevant aspect is how the agglomerations evaluate the results of implementing the action plans. The level of response is the same as the one provided for the evaluation of implementation (Figure 3.8). A detailed analysis reveals the following approaches:

- Noise monitoring is becoming more and more used as a means to evaluate the action plans.
- There is an additional range of practices which cover specific evaluation committees (adapted to different national practices), use of indicators (reduction of the population exposed), and surveys to the population.
- In very few cases, targets are provided.
- Impact on health is not mentioned at all.

Figure 3.8: Percentage of agglomerations that have some evaluation mechanism of the action plan by country. The figure only includes the countries that reported on web forms. Yes, evaluation reported; No, there is no evaluation mechanism reported.



3.2 Major roads

3.2.1 Coverage

About 80 action plans for major roads have been reported, covering the following countries: AT, BE, DK, EE, ES, FI, FR, HR, IE, LT, LV, NL, PL, PT, SE, and UK (Figure 3.9).

Figure 3.9: Coverage of the noise action plans for major roads reported on web forms. Completeness: green, data for a specific country is complete (full geographic extent); orange, data reported for one particular country is incomplete (part of the country is not reported).

	Number of NAPs	Completeness
Austria	**8**	
Belgium	1	
Croatia	6	
Denmark	1	
Estonia	**1**	
Finland	**1**	
France	11	
Ireland	1	
Lithuania	**1**	
Latvia	1	
Netherlands	5	
Poland	16	
Portugal	20	
Spain	4	
Sweden	1	
United Kingdom	2	

3.2.2 Expenditures and the number of people experiencing noise reduction

The cost of the action plans ranges from 41.000 € in Finland to 334 M € in France (Table 3.3). Since the information on the length of major roads covered by the action plans is incomplete, it is not possible to analyse a possible link between expenditure and km of major roads. As is the case for the other noise source categories, any comparison should consider the time when expenditures were evaluated and differences between countries (purchase power parity).

The number of reported beneficiaries range from 4 000 people in Finland to 309 000 in Poland.

Table 3.3: Expenditures and the number of beneficiaries of action plans for major roads. Only countries that reported at least one web form.

Country	Expenditures (1 000 000 €)	Beneficiaries (number of people)
Austria	32	32 000
Belgium	23	23 000
Estonia	3	3 000
Spain	33	33 000
Finland	0,04	4 000
France	334	334 000
Croatia	105	105 000
Latvia	32	32 000
Netherlands	280	280 000
Poland	30	309 000
Sweden	24	24 000
United Kingdom	53	53 000

3.2.3 Public consultation

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

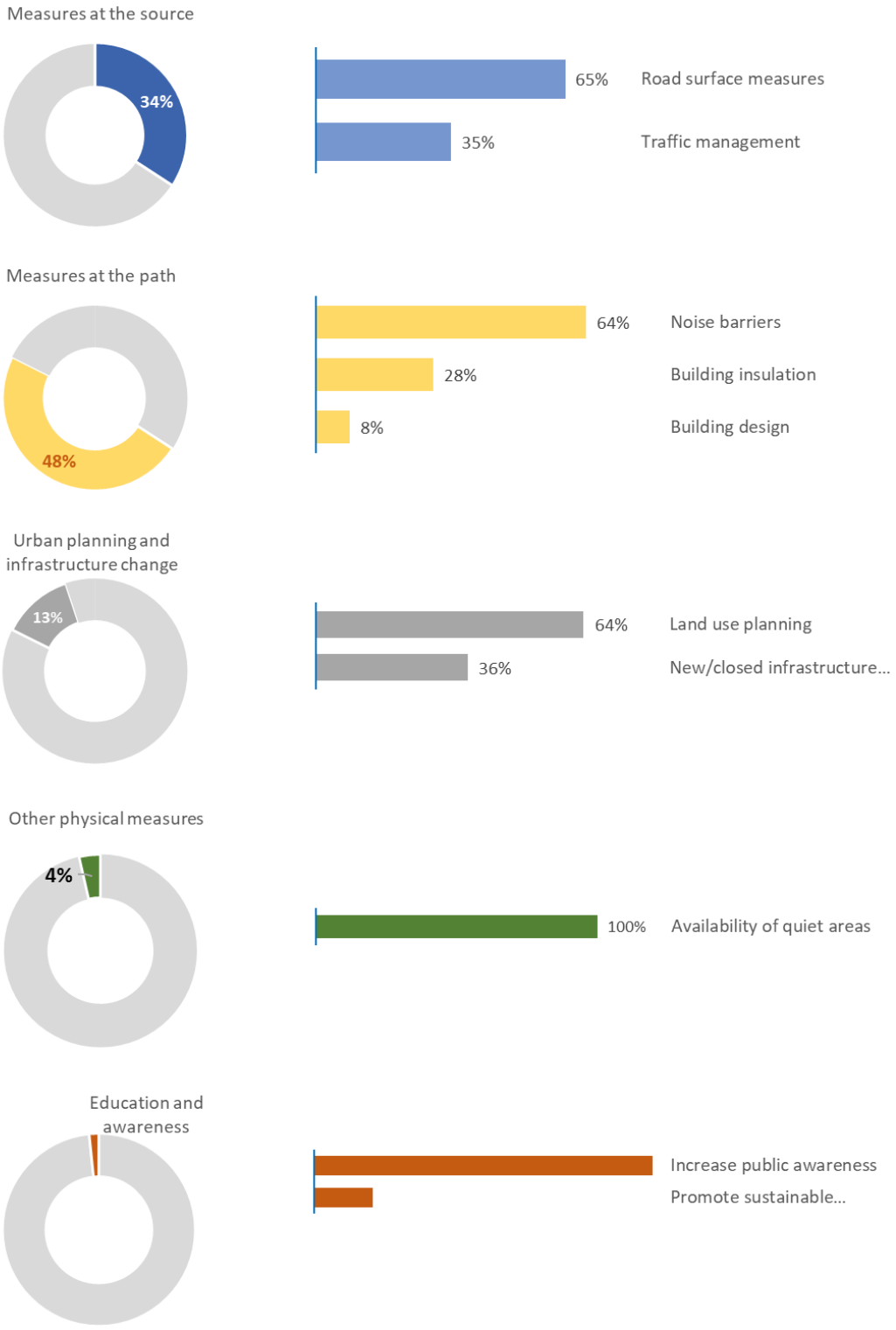
Table 3.4: Overview of the main characteristics of the consultation process by country. Not available: n.a. Only countries that reported at least one web form.

Country	Duration (days)	Type of consultation				Stakeholders			
		web	meeting	survey	participatory process	general public	local authorities	companies	NGO
Austria	42	●				●	●		
Belgium	31	●				n.a.			
Denmark	56	n.a.				n.a.			
Estonia	31	●				n.a.			
Croatia	15-32	●	●			●	●		
France	31	●				n.a.			
Poland	22-35	●	●			●	●		
Spain	31	●				n.a.			

3.2.4 Noise mitigation measures

The most frequent planned actions to mitigate noise from major roads are related to measures on the propagation path (48 %) followed by source orientated measures (34 %). 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 %) - Figure 3.10.

Figure 3.10: 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. Coverage: AT, BE, DK, EE, ES, FI, FR, HR, IE, LT, LV, NL, PL, PT, SE, and UK.



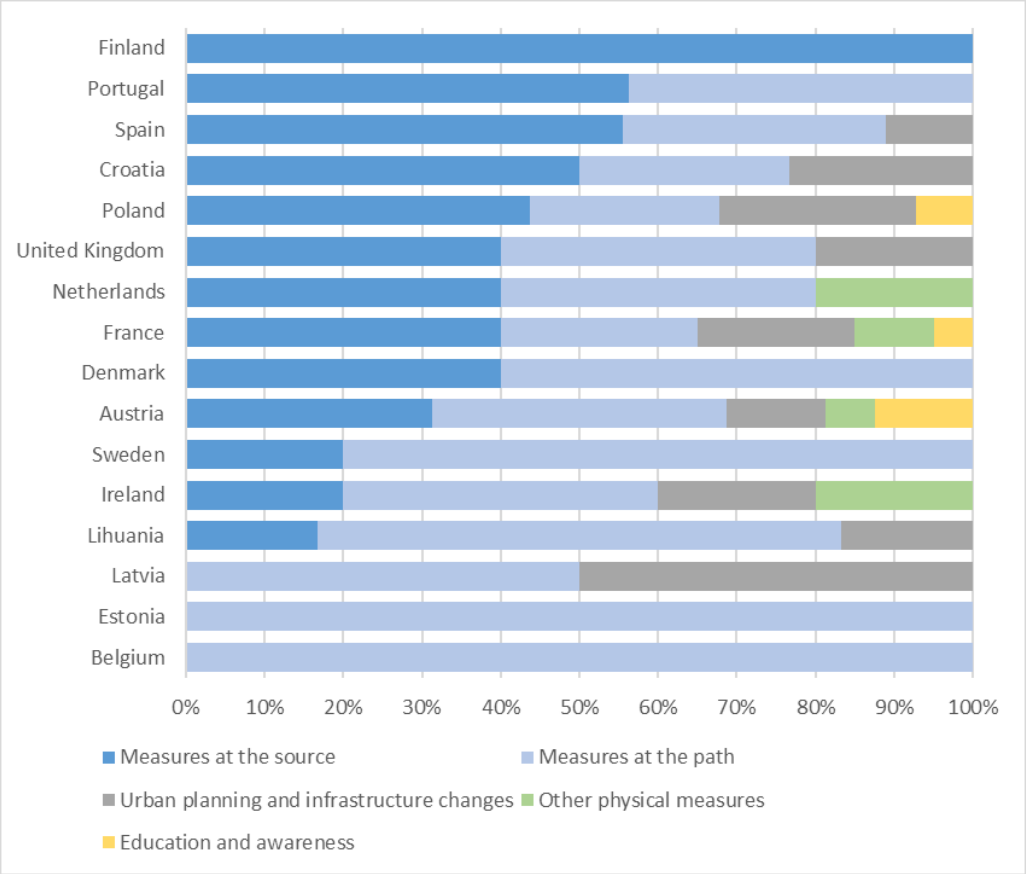
The co-occurrence, or the degree of co-occurrence between pairs of measures, is very low in the case of major roads (Figure 3.11). The most relevant outcome is that developing new infrastructure to divert the traffic is planned together with traffic management (20 % of action plans) and measures oriented to traffic calming (14 % of action plans, p<0,05).

There are substantial differences between countries, reflecting the relevance of local conditions and practices (Figure 3.12). For example, Latvia, Estonia or Belgium do not report at all measures at the source. Measures on the propagation path are predominant (>50 %) in Finland, Portugal, Spain and Croatia. Finally, measures dedicated to increasing public awareness are relevant in Austria, France, and Poland.

Figure 3.11: Co-occurrence of noise mitigation measures for major roads. Values indicate the frequency of action plans where two measures appear together (p < 0,05).

		Traffic management	Traffic calming	Time restrictions	New infrastructure
Measures at the source	Time restrictions		0,07		
Urban planning	New infrastructure	0,19	0,14	0,07	
	Land use			0,07	
Education and awareness	Promote sustainable mobility		0,07		0,07

Figure 3.12: Summary of management actions by typology in major roads (EEA 32, except Turkey, and the United Kingdom, only countries that reported at least one web form).



3.2.5 Changes on planned measures 2014-2019

This section compares measures reported in action plans that countries had to draw up by 18.01.2019 (reference year 2019) with the measures from action plans drawn up by 18.01.2014 (reference year 2014) -both deadlines set up by the END reporting cycles.

Changes between measures reported in 2014 and 2019 reflect the diversity of situations in each country (Figure 3.13). As a general trend, there is an increase in measures oriented to integrate noise into land use planning, except in Poland. In parallel, there is a decrease in measures related to education and awareness. The different patterns between types of measures may indicate that while some actions are planned at the long term (e.g. land use) or need a periodic update (road surface), education and awareness may be more targeted at short term objectives, not repeating over the time.

These changes result from different prioritisation when selecting individual measures, as reflected in Figure 3.14. Similarly to agglomerations, actions targeted to improve road surface are significantly increasing, being the measure most widely applied. Integration of noise into land use planning is also gaining more relevance. On the contrary, actions oriented to sustainable mobility or traffic management are decreasing between 2014 and 2019.

Figure 3.13: Change on the type of measures to reduce noise exposure between 2014 and 2019. Red: decrease in the percentage of planned measures within a certain intervention category. Green: increase in the percentage of planned measures 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 the final year and initial year. Source: Noise Action Plans reported according to END (2014 and 2019).

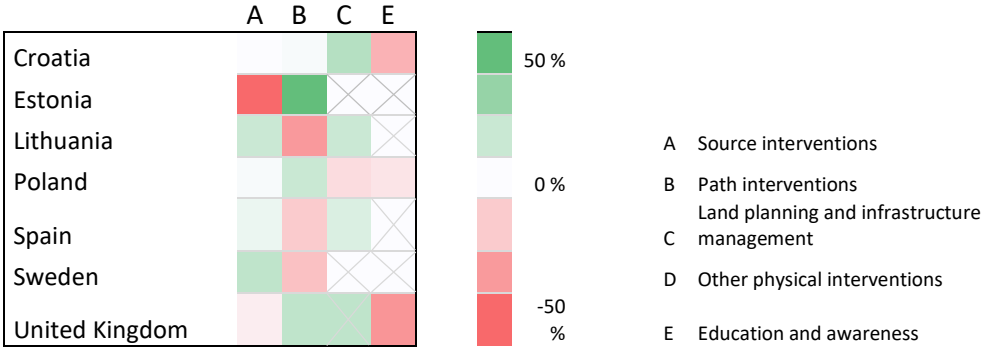
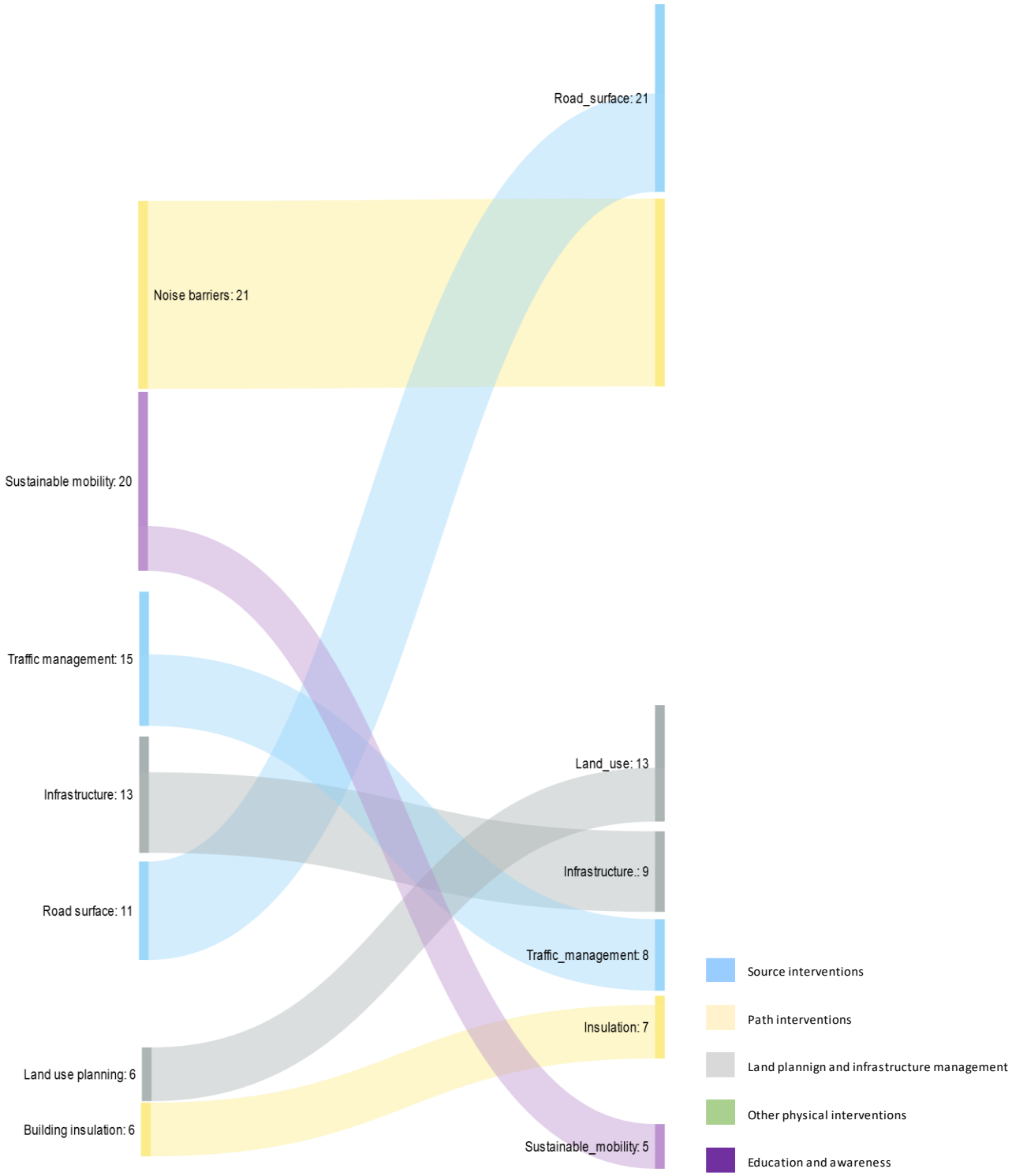


Figure 3.14: Most frequent referred measures in 2014 action plans (left) and 2019 action plans (right). Colours indicate the typology of the measures. The number after the measure indicates the individual measure frequency—aggregated data from Croatia, Estonia, Lithuania, Poland, Spain, Sweden and the United Kingdom.



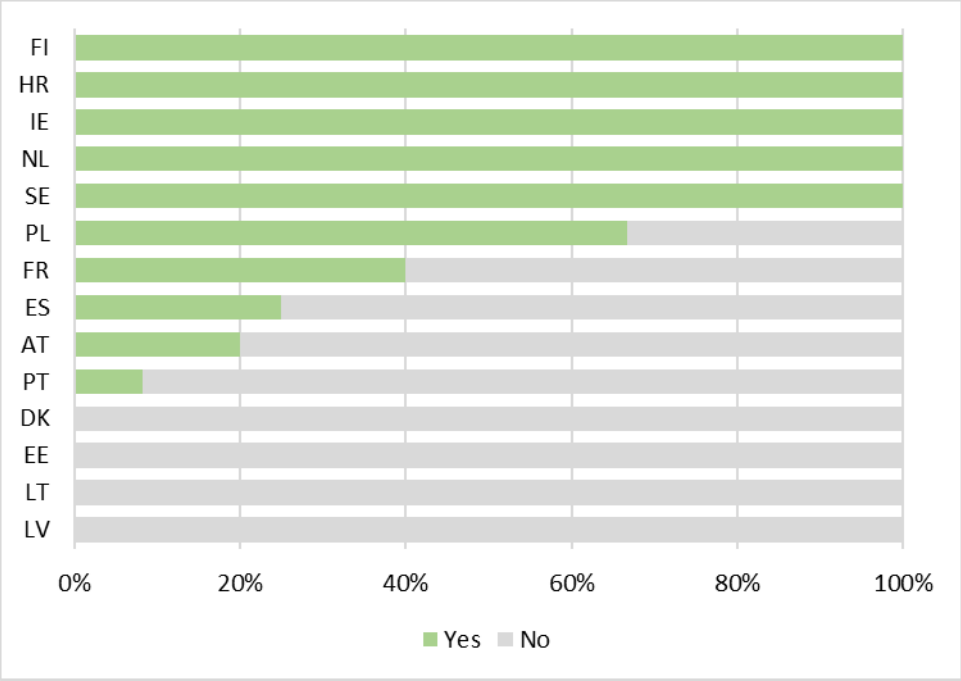
3.2.6 *Implementation and evaluation of action plans*

About 53 % of the action plans reported on web forms provide information on the evaluation mechanism of the degree of implementation (EEA 27, Figure 3.15). Finland, Croatia, Ireland, Netherlands and Sweden provide information for all reported major roads (web forms). On the other side Denmark, Estonia, Latvia, and Lithuania do not give any information.

The most common approach is to evaluate the implementation according to the spending of the corresponding budget, which is audited according to the country legislation and practices.

Another relevant aspect is the evaluation of the results of implementing the action plans. The level of response is the same as the one provided for the evaluation of implementation (Figure 3.15). The most common approaches are monitoring the levels of noise and the evaluation of the population exposed on the following reporting period. Targets and the impact on health are not mentioned at all.

Figure 3.15: Percentage of major road action plans per country that reported some evaluation mechanism. The figure only includes those countries that reported web forms. Yes, the evaluation provided; No, there is no evaluation mechanism reported.



3.3 Major railways

3.3.1 *Coverage*

About 23 action plans for major rails have been reported as web forms, covering the following countries: AT, DK, ES, FI, FR, HR, IE, LT, LV, NL, PL, SE, and UK (Figure 3.16). However, only half of the countries provided complete information, i.e. the NAPs reported covered the full length of railways to be reported: Austria, Croatia, Finland, Ireland, Lithuania, and Latvia.

Figure 3.16: Coverage of the noise action plans for major railways reported as web forms. Completeness: green, data for a specific country is complete (full geographic extent); orange, data reported for one particular country is incomplete (part of the country is not reported).

	Number of NAPs	Completeness
Austria	**1**	
Croatia	**1**	
Denmark	1	
Finland	**1**	
France	6	
Ireland	**1**	
Lithuania	**1**	
Latvia	**1**	
Netherlands	1	
Poland	6	
Spain	1	
Sweden	1	
United Kingdom	1	

3.3.2 Expenditures and the number of people experiencing noise reduction

The cost of the action plans ranges from 5.000 € in the United Kingdom (information not complete) to 890 M € in the Netherlands (Table 3.5). It should be noted that these figures are of a similar order to the ones for major roads (Table 3.3). Since the information on the length of major rails covered by the action plans 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 (purchase power parity).

Table 3.5: Expenditures and number of beneficiaries of action plans for major rails. In bold, countries where data is complete. Not available: n.a.

Country	Expenditures (€)	Beneficiaries (nr of people)
Croatia	**1.702.400**	**7.200**
Denmark	4.400.000	n.a.
Finland	**41.770**	**5.500**
France	9.930.000	n.a.
Lithuania	**n.a.**	**432**
Latvia	**4.837.200**	**37.298**
Netherlands	890.000.000	600
Poland	837.902.902	3.041.637
Spain	6.010.840	3.263
Sweden	40.000.000	24.000
United Kingdom	5.000	n.a.

3.3.3 Public consultation

The information related to public consultation is much more limited compared to major roads. Only six countries provide information on the duration. The duration of the public consultation ranges from 15 days in Croatia to 60 days in France and the United Kingdom.

Table 3.6: Overview of the main characteristics of the consultation process by country. Not available: n.a. Only countries that reported relevant web forms.

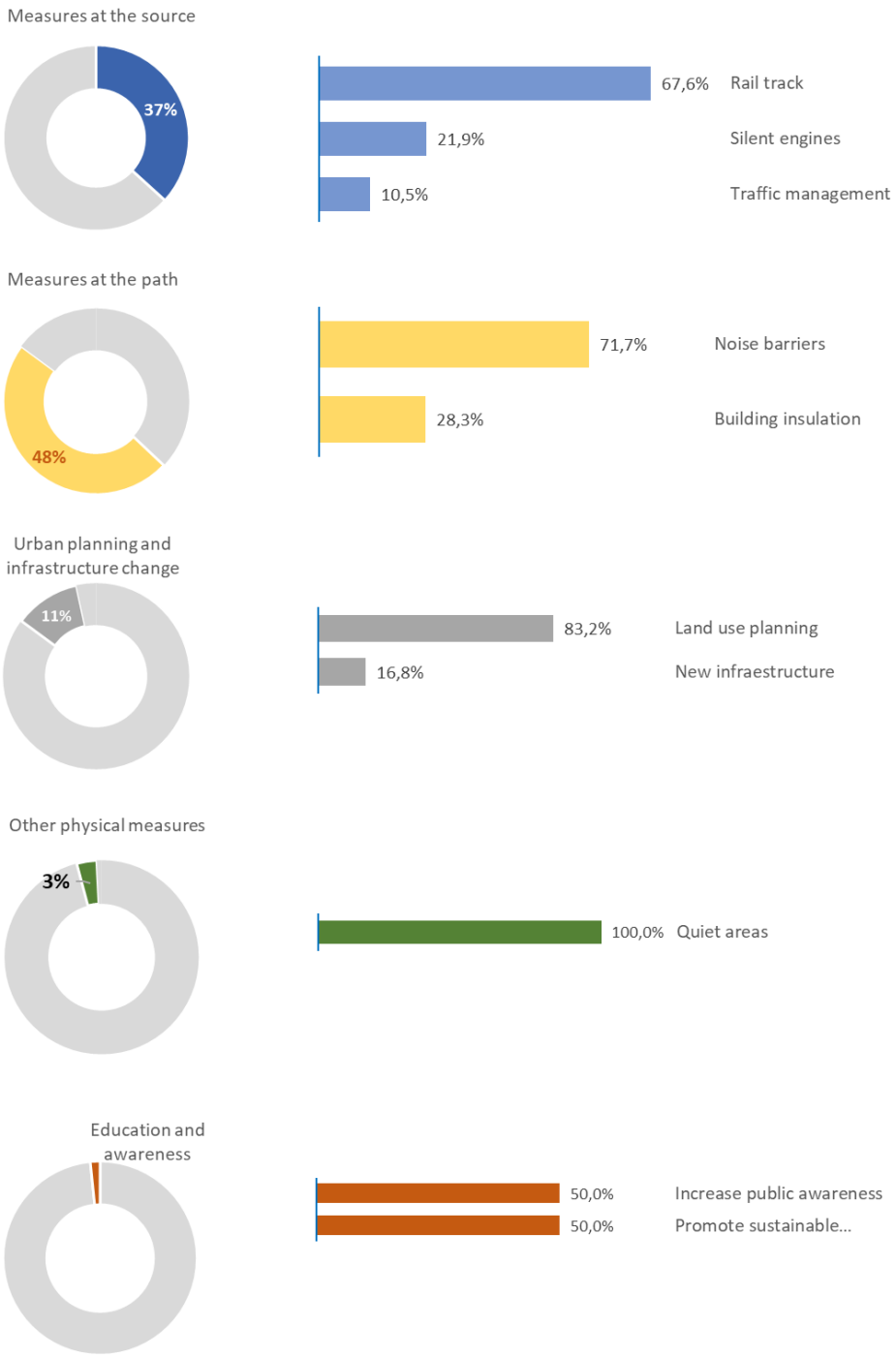
Country	Duration (days)	Type of consultation				Stakeholders			
		web	*meeting*	*survey*	*participatory process*	*general public*	*local authorities*	*companies*	*NGO*
Austria	42	●				●	●		
Croatia	15	●	●			●	●	●	
Denmark	56	n.a.				n.a.			
Finland	n.a.	●				●			
France	60	●				●			
Ireland	n.a.	n.a.				n.a.			
Lithuania	n.a.	n.a.				n.a.			
Latvia	n.a.	●				●	●	●	
Netherlands	n.a.	n.a.				n.a.			
Poland	n.a.	●	●			●	●	●	●
Spain	31	●				●			
Sweden	n.a.	n.a.				n.a.			
United Kingdom	60	●	●			●	●		

3.3.4 Noise mitigation measures

Measures at the path, like installation of noise barriers, is the most frequently reported type of measures (48 %), followed by implementing measures at the source (37 %), such as reducing the track roughness by conducting regular maintenance (Figure 3.17).

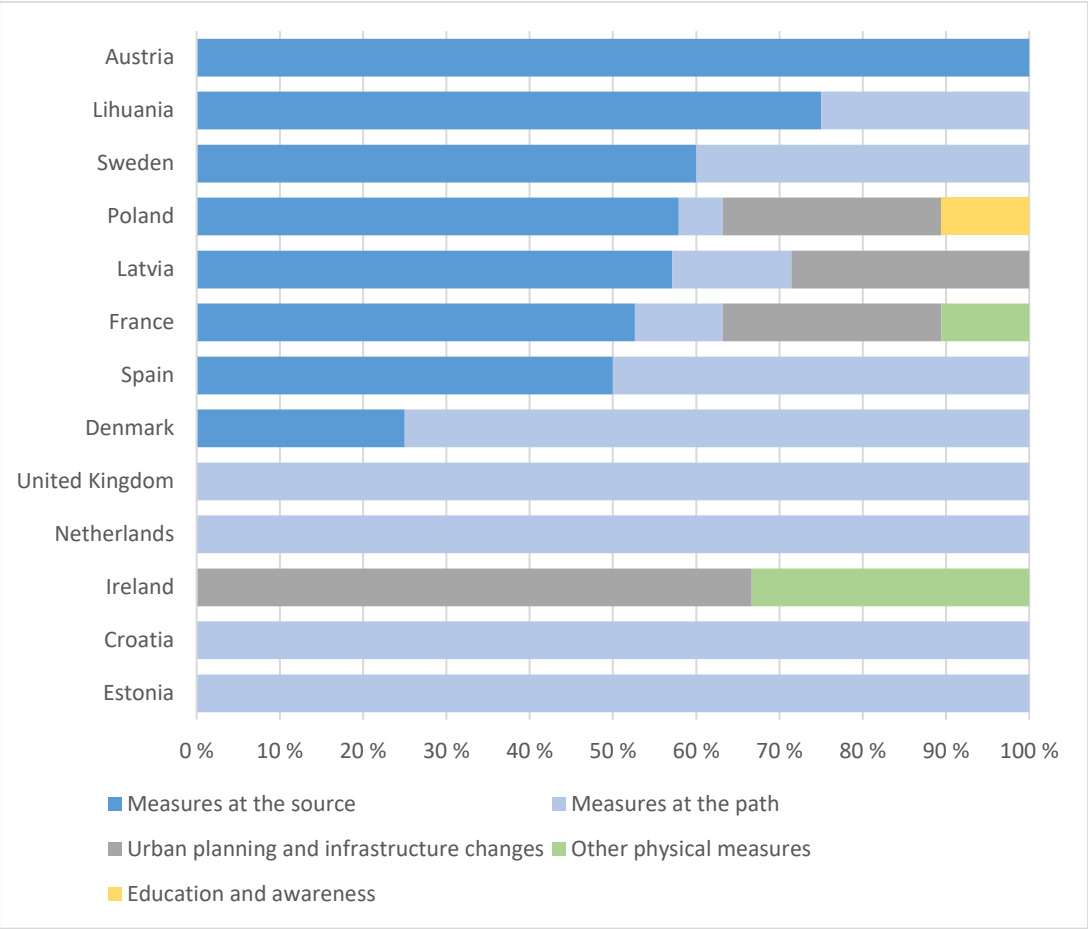
No significant co-occurrence of individual measures has been found.

Figure 3.17: 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. Coverage: AT, DK, EE, ES, FI, FR, HR, IE, LT, LV, NL, PL, SE, and UK.



There are substantial differences between countries, not only on the dominant type of measure but also the diversity of measures considered. For example, France, Latvia and Poland are the countries that used a greater variety of measures. While Croatia, Estonia, Netherlands or United Kingdom only planned measures at the path. (Figure 3.18).

Figure 3.18: Summary of management actions by typology in major rails (EEA 32, without Turkey, and United Kingdom). Only countries that reported relevant web forms.



3.3.5 Changes in planned measures 2014-2019

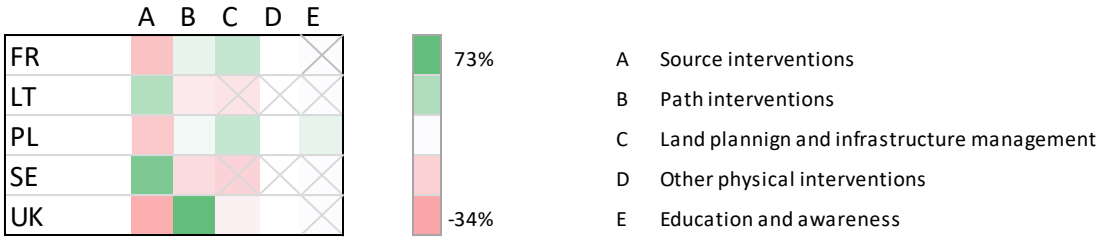
This section compares measures reported in action plans that countries had to draw up by 18.01.2019 (reference year 2019) with the measures from action plans drawn up by 18.01.2014 (reference year 2014) -both deadlines set up by the END reporting cycles.

Information on action plans for both years 2014 and 2019 is limited to France, Lithuania, Poland, Sweden and the United Kingdom. Only Lithuania provided data with the full geographic extent (Figure 3.19). Therefore, changes should be considered with caution since they only cover part of the railway network to be reported.

There are a few commonalities between countries. Lithuania and Sweden increase the measures at the source while decreasing the measures at the path or related to land use. This trend is the opposite to the one observed in France and Poland.

Looking at the individual actions, reported measures oriented to improve rail tracks significantly increase, which was already the most used measure in 2014 (Figure 3.20). The most remarkable change is the sharp decrease in the installation of noise barriers.

Figure 3.19: Change on the type of measures to reduce noise exposure between 2014 and 2019. Red: decrease in the percentage of planned measures within a certain intervention category. Green: increase in the percentage of planned measures 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 the final year and initial year. Source: Noise Action Plans reported according to END (2014 and 2019)



3.3.6 Implementation and evaluation of action plans

About 35 % of the action plans reported on web forms provide information on the degree of implementation's evaluation mechanism (EU 27, Figure 3.21). Austria, Croatia, Denmark, Finland, Ireland, Netherlands, and Sweden provide information for all reported major roads (web forms). On the other side France, Latvia, Lithuania, and Spain do not give any information.

The most common approach is to evaluate the implementation according to the spending of the corresponding budget, which is audited according to the country legislation and practices.

Another relevant aspect is the evaluation of the results of implementing the action plans. The level of response is the same as the one provided for the evaluation of implementation (Figure 3.21). The most common approach is the population exposed to the following reporting period, following by monitoring. Targets and the impact on health are not mentioned at all.

Figure 3.20: Most frequent referred measures in 2014 action plans (left) and 2019 action plans (right) to reduce noise from major rails. Colours indicate the typology of the measures. The number after the measure indicates the individual measure frequency—aggregated data from France, Lithuania, Poland, Sweden and the United Kingdom. Data from Poland, Sweden and the United Kingdom is not complete.

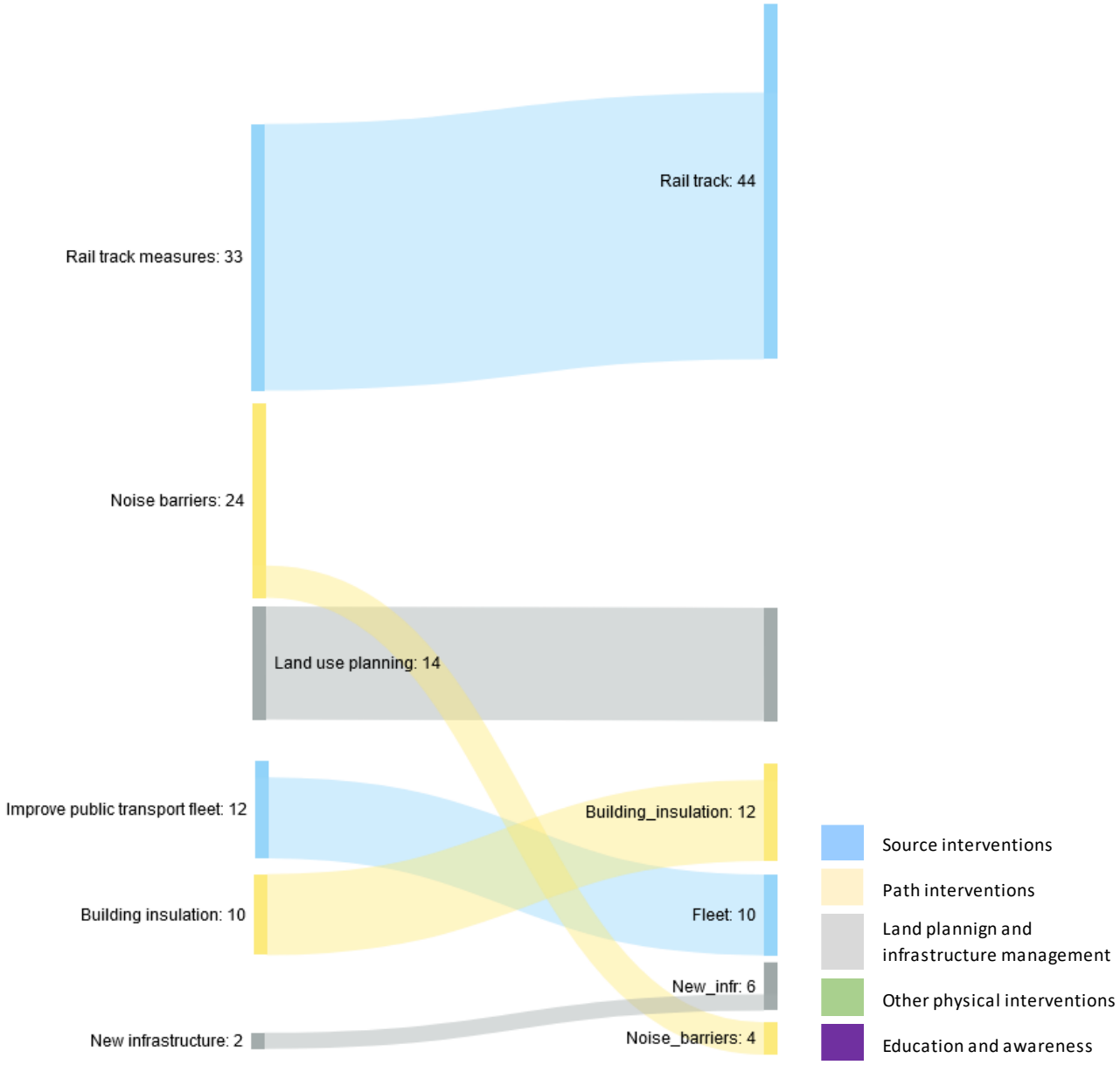
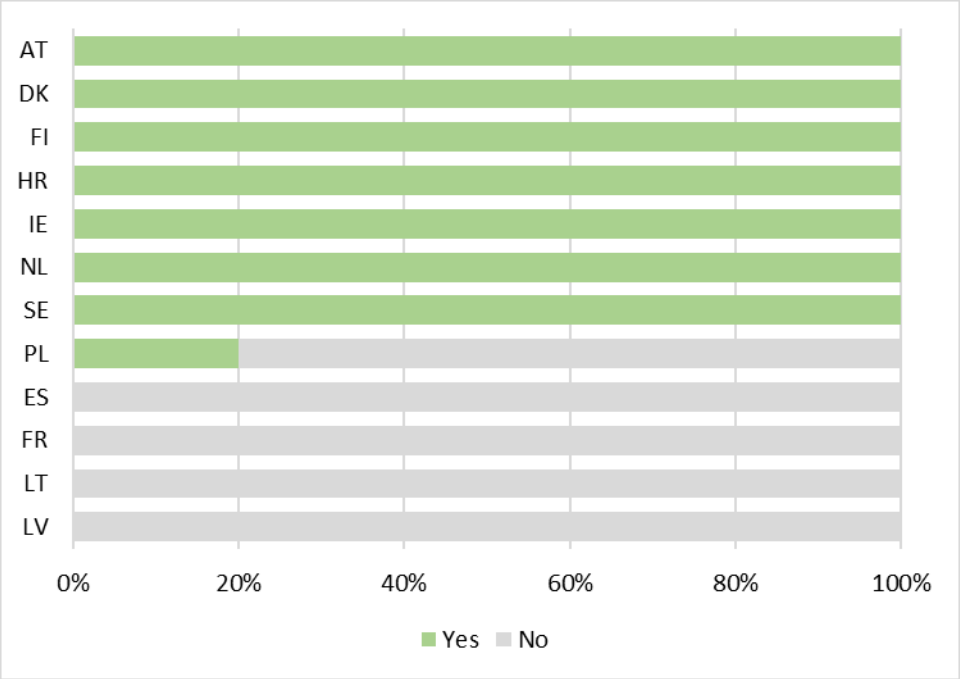


Figure 3.21: Percentage of major railways action plans per country that reported some evaluation mechanism. The figure only includes those countries that reported on web forms. Yes, the evaluation provided; No, there is no evaluation mechanism reported.



3.4 Major airports

3.4.1 Coverage

According to countries' information, 70 major airports fulfil the END requirements (EU 27). Only 22 major airports have been reported using the Reportnet web forms (Figure 3.22). Additionally, the United Kingdom reported 9 major airports. Therefore, 31 major airports have been analysed in total.

3.4.2 Expenditures and the number of people experiencing noise reduction

The cost of the action plans ranges from 18 350 € in Riga International Airport 50 M € in Vienna International Airport (Table 3.7). As stated in previous noise sources, any comparison should consider the type of actions included, the time when expenditures were evaluated, and differences between countries (purchase power parity).

The number of people that would benefit from the action plans ranges from 300 people in Porto to 689.400 people in London Heathrow Airport (Figure 3.23). These figures reflect the combination of different factors, in particular noise traffic management and the location of the airports.

Figure 3.22: Completeness of the action plans reported as web forms per country (reference year 2019). The figure does not include countries that have not reported any major airport as a web form. Groups of countries: EU 27, and the UK.

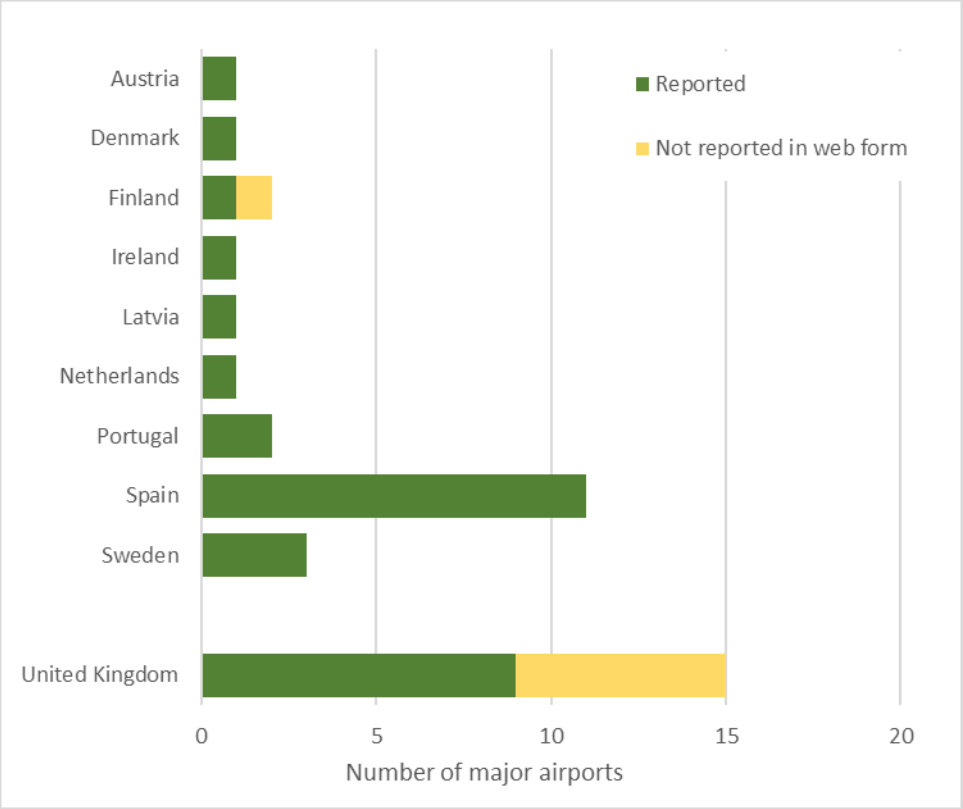
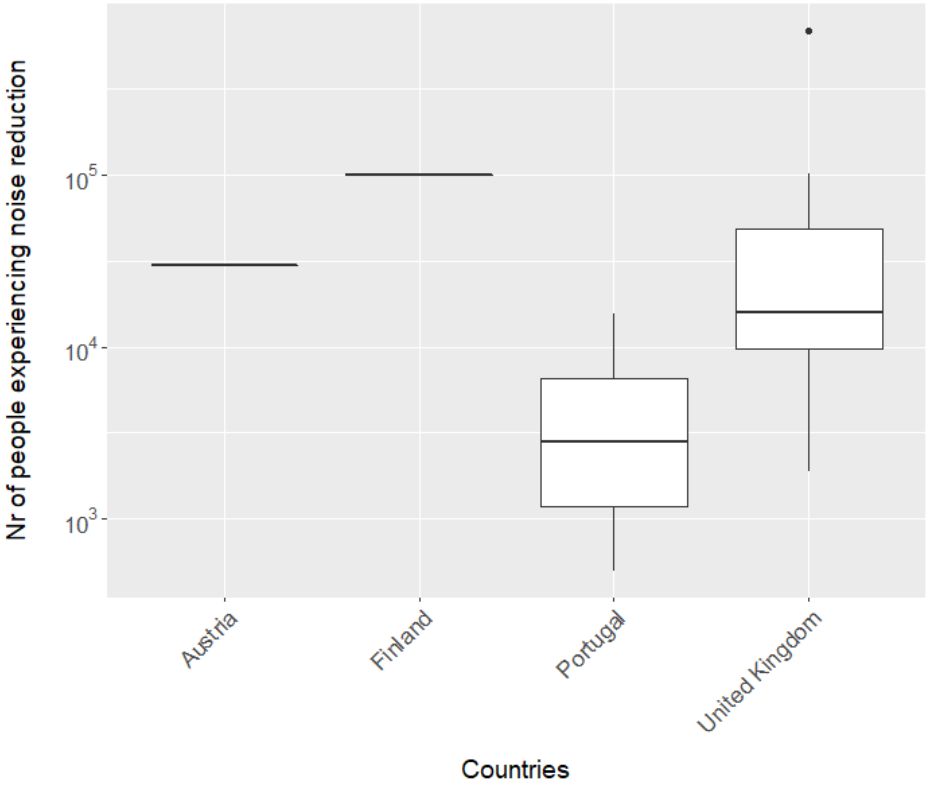


Table 3.7: Expenditures related to action plans of major airports

Airport	Expenditure (€)
Riga International Airport	18 350
Helsinki Vantaa Airport	30 000
Porto Francisco Sá Careniro Airport	2 226 545
Lisbon Portela Airport	3 591 058
Vienna International Airport	50 000 000

Figure 3.23: Boxplot of the number of beneficiaries (people experiencing noise reduction) of action plans by country. The number of people is presented on a logarithmic scale.



3.4.3 Public consultation

The information is only available for the Netherlands and the United Kingdom (Table 3.8). In the latter case, a broader range of stakeholders are included, and a specific participatory process has been reported.

Table 3.8: 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
Austria	n.a.	●			●	n.a.			
Denmark	2	●				●			
Ireland	n.a.	n.a.				n.a.			
Latvia	1	●	●			●	●	●	
Netherlands	n.a.	●				●	●		
Portugal	1	●				●			
Spain	n.a.	●				●			
Sweden	n.a.	●				●	●		
United Kingdom	10	●		●	●	●	●	●	●

3.4.4 Noise mitigation measures

The mitigation measures employed to reduce exposure to aircraft noise caused by major airports have a different nature than those used 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 (65 %) (Figure 3.24).

Among these measures, those related to traffic management and those incentivising or penalising certain types of aircraft are among the most used. There are no reported measures regarding the availability of green space.

The system of taxes and economic sanctions is the measure that appears more frequently associated with other measures, particularly with the compilation of sanctions (Figure 3.25). These economic measures are also planned in combination with banning aircraft depending on the certification and land use planning.

Although measures at the source are the most frequently planned measures, Austria and Sweden only reported measures at the path (Figure 3.26). Only Spain, Finland and Latvia reported integration of noise into land use planning.

Figure 3.24: 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. Data from 31 major airports.

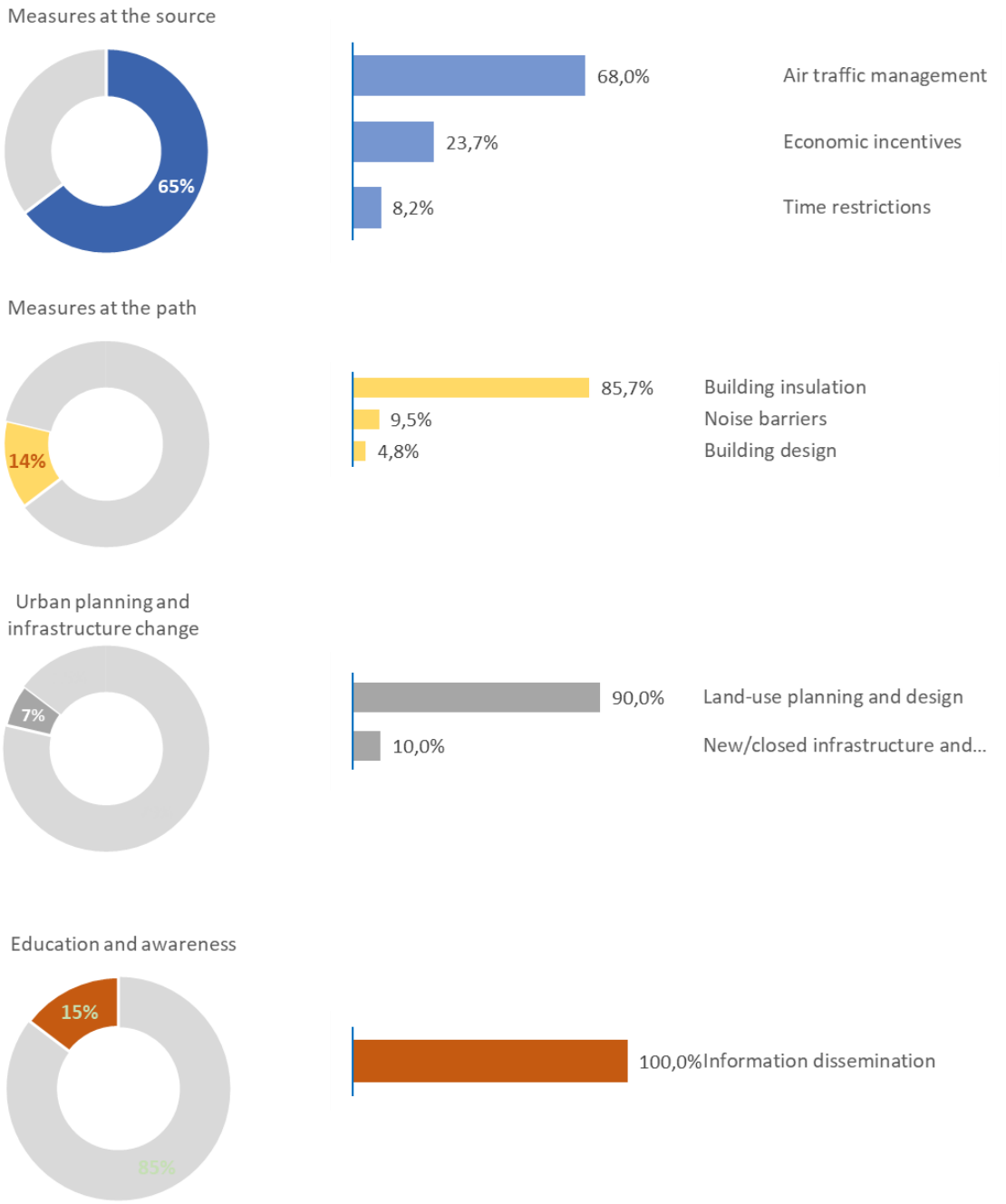
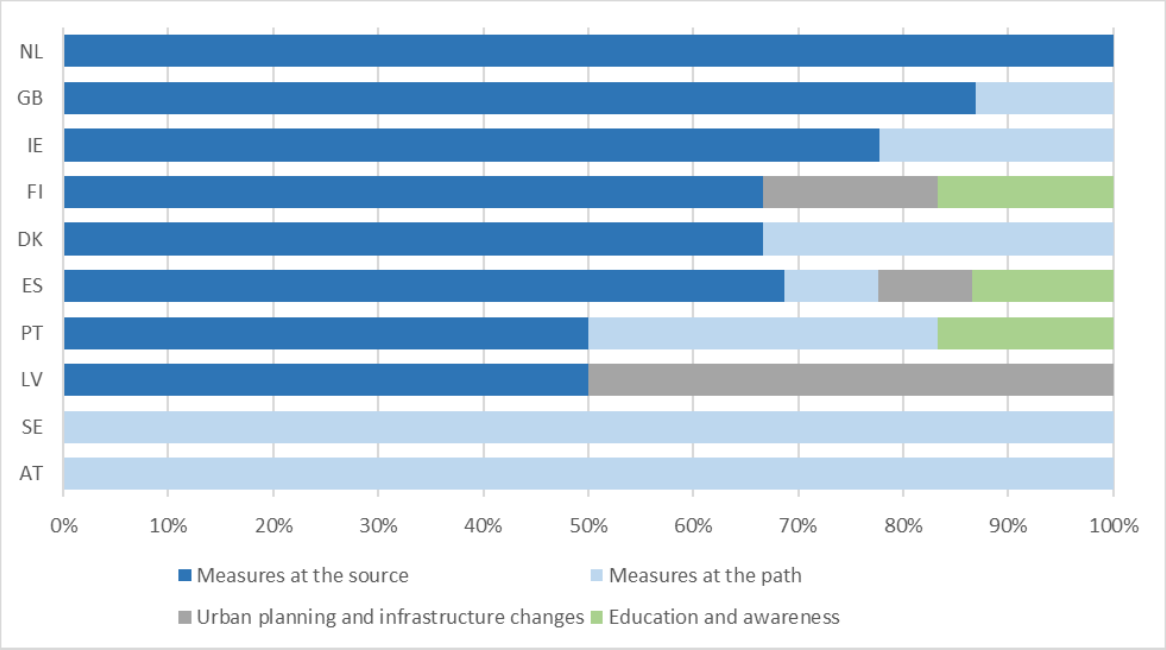


Figure 3.25: Co-occurrence of noise mitigation measures for major airports. Values indicate the frequency of action plans where two measures appear together (p < 0,05). Data from 31 major airports.

		Sanctions and taxes	Ban aircrafts depending on certification	Land use	Complaint management
Measures at the source	Ban aircrafts depending on certification	0,16			
Urban planning	Land use	0,16	0,08		
Education and awareness	Complaint management	0,20	0,10	0,10	
	Information dissemination	0,20	0,10	0,10	0,13

Figure 3.26: Summary of management actions by typology in major airports. Only countries that reported this information as web form.



3.4.5 Changes in planned measures 2014-2019

This section compares measures reported in action plans that countries had to draw up by 18.01.2019 (reference year 2019) with the measures from action plans drawn up by 18.01.2014 (reference year 2014) -both deadlines set up by the END reporting cycles.

About 75 % of the major airports reported both years, i.e. 2014 and 2019, are from the United Kingdom. Therefore, the following results should be considered with caution since they are mainly representing one country.

There is a general increase in both source and path interventions in most airports from the United Kingdom. Land planning, 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. There are no changes for the major airports from Sweden, which only reported measures at the path (Figure 3.27).

A close look at the specific actions reported shows a significant increase in measures oriented to provide incentives for less noisy aircraft, followed by building insulation (Figure 3.28).

Figure 3.27: Change in the type of measures taken to reduce noise exposure between 2014 and 2019. Red: decrease in the percentage of measures taken within a certain intervention category. Green: increase in 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 the final year and initial year. Source: Noise Action Plans reported according to END (2014 and 2019).

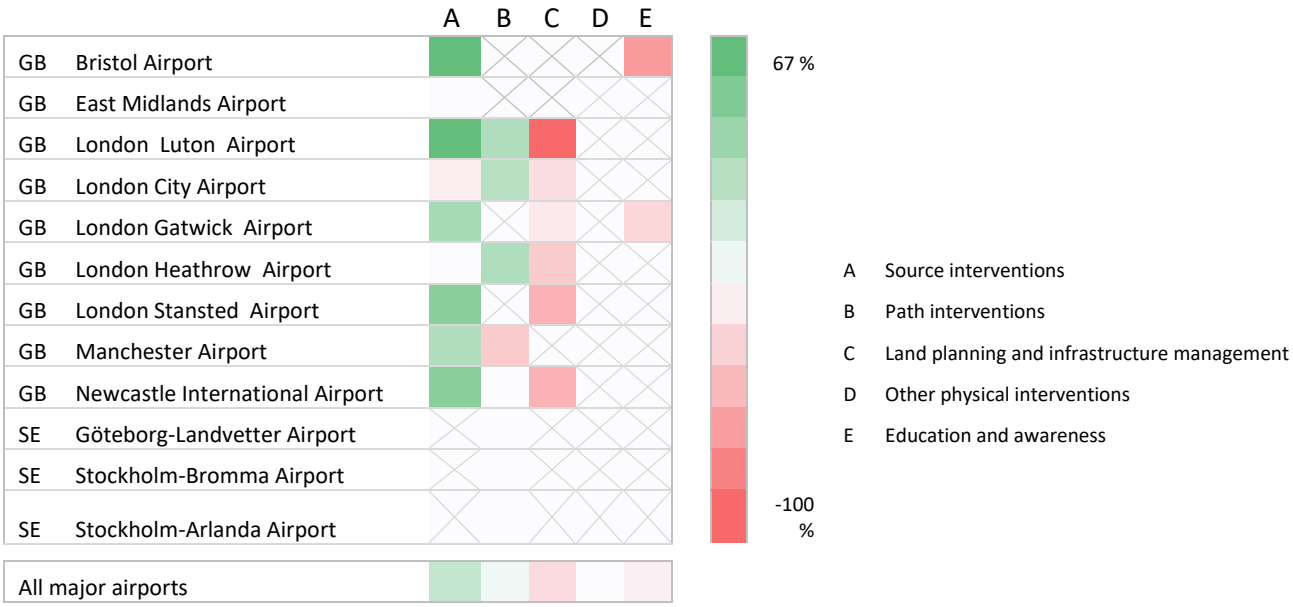
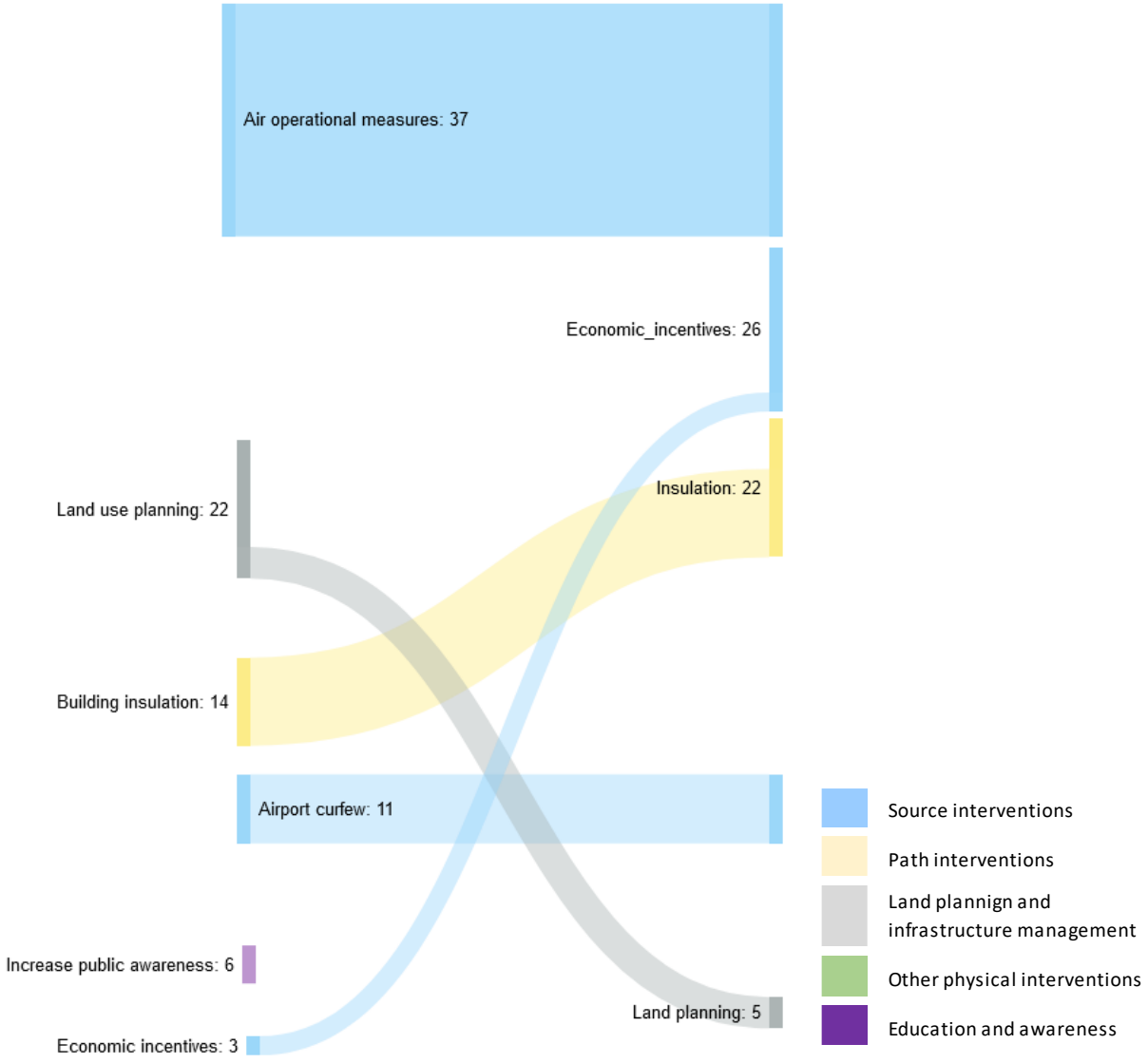


Figure 3.28: Most frequent referred measures in 2014 action plans (left) and 2019 action plans (right). Colours indicate the typology of the measures. The number after the measure indicates the individual measure frequency—aggregated data from Sweden and the United Kingdom.



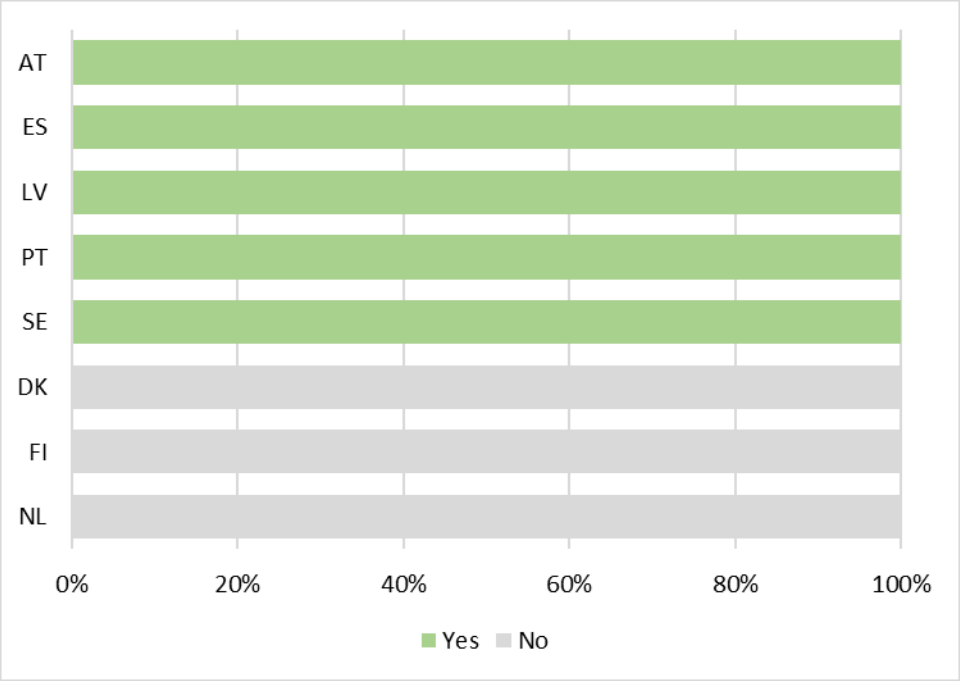
3.4.6 Implementation and evaluation of action plans

About 84 % of the action plans reported on web forms provide information on the degree of implementation's evaluation mechanism (EU 27, Figure 3.29). Austria, Latvia, Portugal, Spain, and Sweden provide information for all reported major airports (web forms). On the other side, Denmark, Finland, and the Netherlands do not give any information.

The most common approach is to evaluate the implementation according to the spending of the corresponding budget, which is audited according to the country legislation and practices.

Another relevant aspect is the evaluation of the results of implementing the action plans. The level of response is the same as the one provided for the evaluation of implementation (Figure 3.29). The most common approach is the number of people exposed on the next reporting period, followed by monitoring. Targets and the impact on health are not mentioned at all.

Figure 3.29: Percentage of major airports action plans per country that reported some evaluation mechanism. The figure only includes those countries that reported on web forms. Yes, evaluation provided; No, there is no evaluation mechanism reported.



4 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 to protect communities from the adverse effects of noise. These WHO guidelines offer recommendations for protecting human health from exposure to environmental noise originating from various sources. They provide robust public health advice and 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 reviews 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, 2 % in major rails).
- Promote interventions **to reduce exposure to noise** and **improve health.** There is hardly any reference to health in the noise action plans analysed. 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. According to Annex V of the Directive, the information provided by the EU Member States does not allow to identify such synergies between noise measures and other health issues.
- **Inform and involve communities.** A small number of action plans only accomplishes this. 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.

5 Improvements on the typologies of measures

5.1 Overview

One of the challenges of the analysis of the action plans is grouping the noise mitigation measures. This grouping is needed to have a consistent list for assessment (similar measures may be named differently), to facilitate the analysis by reducing the number of measures into similar typologies and linking them with the WHO's (see the previous section). Table 5.1 provides an overview of the current classification, and Annex 1 list all the individual measures identified in each category.

The most relevant issues identified are listed below:

- There is a wide diversity of measures related to traffic management currently addressed as a single typology.
- Promotion of public transport is not well addressed in the current classification since some specific measures could be included under “source measures” while others are more appropriate under “Education/communication interventions”.
- Integration of noise mitigation into land use planning is not addressed adequately, although this is becoming more and more implemented.

Consequently, three types of changes have been introduced:

- A third classification level to solve ambiguities and better reflect the noise source's specificities,
- Reclassification of some sub-groups ,
- Change of names for communication purposes.

Major changes in the classification are illustrated in Figure 5.1 -complete list of measures in Annex 2, and could be synthesised as follows:

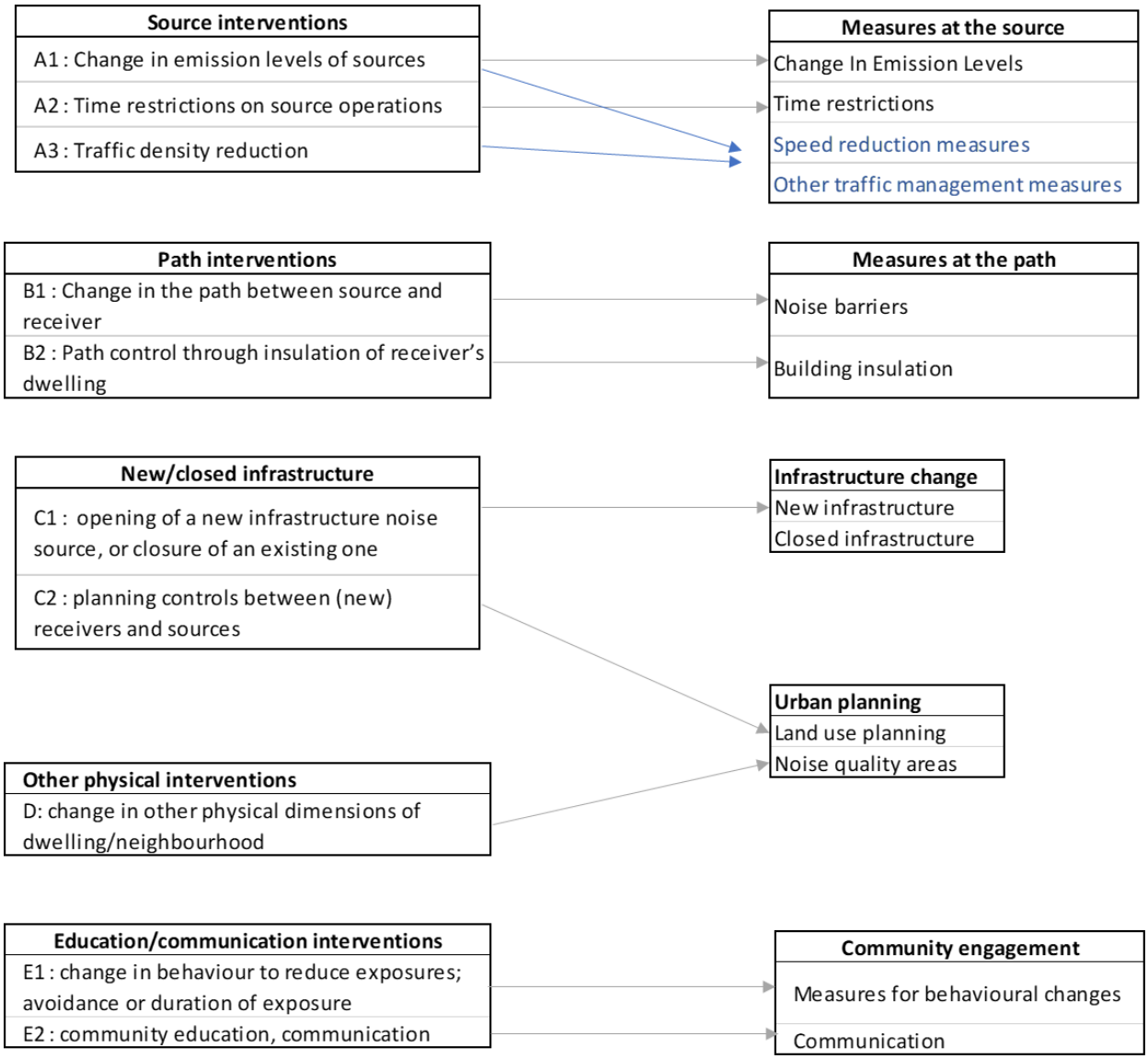
- Source interventions. Two new subcategories have been introduced to avoid ambiguity on traffic management (further described in the following section),
- Path interventions. Only names have been updated to improve communication,
- Regrouping and differentiating measures related to infrastructure change and land use planning. This is further described in the following section,
- Education/communication interventions. Only names have been updated to improve communication.

The proposed improvements have been developed together with the definition of the new noise data model and Reportnet 3.0. This review was not yet finished at the time of the current analysis of the action plans; therefore, the improved classification will be applied in the next reporting round.

Table 5.1: Overview of the classification of measures used in this report.

Intervention category	Intervention subcategory
Source intervention	A1 : Change in emission levels of sources
	A2 : Time restrictions on source operations
	A3 : Traffic density reduction
Path interventions	B1 : Change in the path between source and receiver
	B2 : Path control through insulation of receiver's dwelling
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
Other physical interventions	D: change in other physical dimensions of dwelling/neighbourhood
Education/communication interventions	E1 : change in behaviour to reduce exposures; avoidance or duration of exposure
	E2 : community education, communication

Figure 5.1: Existing classification of noise mitigation measures (left) and proposed updated classification (right).



5.2 Measures at the source

One of the issues is related to traffic management. Sub-category A3 addresses traffic density reduction (Table 5.1). However, some measures included in subcategory A1 could also be considered as traffic density reduction: traffic control, traffic flow (Table 5.2). Another problem is about «encouraging cycling and walking», or «promotion of public transport» since these measures could also fit into education and communication (category E, Table 5.1).

These inconsistencies are solved as follows (Table 5.3 for roads):

- Introduce the third level on the classification ("Groups of measures"), which makes more explicit the type of measures included under each heading,
- Group traffic management under two subcategories: «speed reduction» and «other traffic measures»,
- All the measures related to «promotion» are kept under Education/communication interventions (now Community engagement).

The same subcategories apply to the other noise sources (rail and air), introducing the noise-specific measures at the third level. Details are provided in Annex 2.

Table 5.2: Overview of measures at the path related to traffic management (roads).

Intervention subcategory	Measures
A1 Change in emission levels of sources	Reduction of freight transport Regulation of routes Smart traffic management Speed limit Traffic calming Traffic control Traffic flow Traffic management (not specific) Traffic restrictions
A3 Traffic density reduction	Reducing traffic density - Encourage cycling and walking Reducing traffic density - Promoting public transport Reducing traffic density - Traffic management and parking

Table 5.3: Proposed classification for source measures (roads). New subcategories compared with the current classification are highlighted.

Intervention subcategory	Groups of measures
Change In Emission Levels	Road surface measures Low-noise tyres Quiet engines Measures at the exhaust Renewal to quieter public transport fleet including components
Time restrictions	Time restriction for HGV Time restrictions for passenger vehicles
Speed reduction measures	Reduction of driving speeds and traffic signalling Roundabouts and junctions Physical measures for traffic calming Designation of traffic-calmed zones for road
Other traffic management measures	Enhancing public transport vehicles and infrastructures Enhancing infrastructure for cycling and walking Smart mobility Change/reduction in traffic lanes Bans and re-routing of heavy vehicles Bans and re-routing of passenger vehicles Parking management Congestion charges

5.3 Measures at the path

The classification of the path measures was already clear enough. Only the names of the subcategories have been changed to facilitate communication (Table 5.4). Level three of the classification is common to all noise sources.

Table 5.4: Proposed classification for measures at the path (all noise sources). New subcategories compared with the current classification are highlighted.

Current classification	Proposed changes	
B1: Change in the path between source and receiver	*Noise barriers*	Noise barriers and maintenance
		Green noise barriers and maintenance
B2: Path control through insulation of receiver's dwelling	*Building insulation*	Window insulation
		Other insulation

5.4 Infrastructure change and land use planning

The current classification groups opening/closing a new infrastructure and planning under the same category (New/closed infrastructure -Figure 5.1). Additionally, the protection of quiet areas is organised as a separate category (Other physical interventions). The new approach proposes to separate new/closed infrastructure, which relates to diverting the traffic to areas less sensitive to noise, to those measures that focus on zoning and protecting quiet areas (Table 5.5). All these measures could be considered as part of land planning. However, new/closed infrastructure focuses on diverting the traffic, while land planning measures are more focused on protection and improvement of the sound quality and quieter areas.

The categories and subcategories are the same for all noise sources. Specificities are included at the level of "groups of measures". Details for rails and airports are provided in Annex 2.

Table 5.5: Proposed classification for urban planning and infrastructure change measures (road sources).

Category	Subcategory	Groups of measures
Urban planning	Land use planning	Planning measures and ordinances between receivers and road sources
		Reduced noise for sensitive areas
		Buffer zones
	Noise quality areas	Availability of quiet areas
		Availability of green areas
		Soundscape measures
Infrastructure change	New infrastructure	Redirection to new bypass, bridges, roads
		New Tunnel
	Closed infrastructure	Closure of roads

5.5 Education and interventions

The classification of these measures remains unchanged. However, the terminology has been updated to be more precise and facilitate communication (Table 5.6). Level three of the classification is common to all noise sources.

Table 5.6: Proposed classification education/communication (road). New subcategories compared with the current classification are highlighted.

Current classification	Proposed changes	
E1: community education, communication	*Communication*	Information dissemination
		Complaint management
E2: change in behaviour to reduce exposures; avoidance or duration of exposure	*Measures for behavioural changes*	Promoting quiet mobility
		Promoting public transport
		Promoting of car sharing
		Education and awareness-raising activities

6 Conclusions

The implementation of the END requires EU Member States to take action to reduce noise exposure and to implement a standard reporting mechanism. After three rolling cycles of the END (2009-2013, 2014-2018, 2019-2023) we see that countries are more and more aligning their actions to this 5-year cycle. In contrast to these positive aspects, the reality demonstrates that overall, there are no significant changes in the reduction of populations exposed. One could argue that there is some impact since for most of the transport modes, the traffic increase in the last ten years has not resulted in an increase of the population exposed. However, the objective of the END is to reduce people exposed and, therefore, improve the health and quality of life of the European population, and achieving this goal is not being demonstrated.

Action plans are key to understand the measures and their effectiveness, and should indicate where additional actions are needed to improve the acoustic environment. From the analysis conducted in the current report, we can highlight:

- There is still a substantial gap on reported action plans, which may be explained by the complexity of the information, and specificities of national and local mechanisms. This is demonstrated by the low percentages of agglomerations reported in web forms. Therefore, the conclusions of the report should be taken with caution. Moreover, it reflects the need to improve the reporting mechanism.
- From the content perspective of the action plans, we identify several issues
    - Measures already implemented are currently not explicitly requested on the web form. Therefore, the information is not provided consistently across countries.
    - A single figure on costs is not relevant since it needs to be linked to the type of action and duration of the implementation.
    - The information on the evaluation of the measures is quite fragmented. It isn't easy to have a comprehensive overview of how this is conducted and which methods are used (e.g. cost-effectiveness analysis).
- Regarding the planned measures:
    - There is a broad range of measures that illustrate the variety of options available to reduce noise exposure. This list could be used as a catalogue to inspire different authorities when planning for noise reduction. Moreover, it is also relevant how diverse type of measures are combined to optimise the output (e.g. reduction at noise source with reduction at path). However, no innovative approaches have been reported.
    - Integration of measures into mobility plans and land use planning are more and more reported, also as a long term strategy. However, the information is often very vague, making it difficult an evaluation of the degree of integration into these plans.

Some of the problems identified are related to the reporting. The following aspects are relevant and will be integrated into the new reporting scheme under Reportnet 3.0:

- Explicit request of already implemented measures. This would facilitate to cross-check implemented measures with planned measures in the previous reporting period.
- An improved list of measures where some overlaps or not clear definitions are solved (see annex II). Also differentiate those measures envisaged at the long term.
- Explicit information on the process and mechanisms to evaluate the implementation and the results of the action plans.
- Expenditures need to be analysed per type of action (e.g. cost per x km of noise barriers) since aggregated figures could not be compared.

Abbreviations

EEA	European Environment Agency
EEA-32	32 EEA member countries: the 27 EU Member States plus Iceland, Lichtenstein, Norway, Switzerland and Turkey
END	Environmental Noise Directive
ENDRM	Electronic Noise Data Reporting Mechanism
ETC/ATNI	European Topic Centre on Air Pollution, Transport, Noise and Industrial Pollution
EU	European Union
EU-27	27 Member States of the EU
L_{den}	Day-evening-night noise level
L_{night}	Night noise level
NAP	Noise Action Plans
NOISE	Noise Observation and Information Service for Europe
WHO	World Health Organization

References

Blanes, N., et al., 2019, *Noise Action Plans. Managing exposure to noise in Europe*, Eionet Report - ETC/ATNI 2019/8 (https://www.eionet.europa.eu/etcs/etc-atni/products/etc-atni-reports/etc-atni-report-8-2019-noise-action-plans-managing-exposure-to-noise-in-europe) accessed 29 January 2021.

Brown, A.L. and van Kamp, I., 2017, 'WHO environmental noise guidelines for the European Region: a systematic review of transport noise interventions and their impacts on health', *International Journal of Environmental Research and Public Health* 14(8), pp. 873.

CEDR, 2013, *Value for money in road traffic noise abatement*, Final Report v2. CEDR Project Group Road Noise: subgroup tyre/vehicle noise (http://www.carreteros.org/explotacion/cedr/3_CEDR.pdf) accessed 29 January 2021.

EEA, 2020, *Environmental noise in Europe — 2020*, EEA Report No 22/2019, European Environment Agency (https://www.eea.europa.eu/publications/environmental-noise-in-europe) accessed 29 January 2021.

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

Veech, J.A., 2013, 'A Probabilistic Model for Analysing Species Co-Occurrence', *Global Ecology and Biogeography* 22(2), pp. 252-60.

WHO, 2018, *Environmental noise guidelines for the European region*, WHO Regional Office for Europe, Copenhagen (http://www.euro.who.int/en/health-topics/environment-and-health/noise/publications/2018/environmental-noise-guidelines-for-the-european-region-2018) accessed 29 January 2021.

Annex 1
List of mitigation measures

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

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 bypass 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 environmentally friendly transport modes Promote sustainable mobility Promotion of electric vehicles
	E2. Community education, communication	Dissemination of noise information Increase public awareness

Annex 2
Reviewed list of mitigation measures

Reviewed list of measures and corresponding categories as explained in section 5 and implemented in Reportnet 3.0.

Roads

Category	Subcategory	Groups of measures
Measures at the source	Change In Emission Levels	Road surface measures
		Low-noise tyres
		Quiet engines
		Measures at the exhaust
		Renewal to quieter public transport fleet including components
	Time restrictions	Time restriction for HGV
		Time restrictions for passenger vehicles
	Speed reduction measures	Reduction of driving speeds and traffic signalling
		Roundabouts and junctions
		Physical measures for traffic calming
		Designation of traffic-calmed zones for road
	Other traffic management measures	Enhancing public transport vehicles and infrastructures
		Enhancing infrastructure for cycling and walking
		Smart mobility
		Change/reduction in traffic lanes
		Bans and re-routing of heavy vehicles
		Bans and re-routing of passenger vehicles
		Parking management
		Congestion charges
Measures at the path	Noise barriers	Noise barriers and maintenance
		Green noise barriers and maintenance
	Building insulation	Window insulation
		Other insulation
Urban planning	Land use planning	Planning measures and ordinances between receivers and road sources
		Reduced noise for sensitive areas
		Buffer zones
	Noise quality areas	Availability of quiet areas
		Availability of green areas
		Soundscape measures
Infrastructure change	New infrastructure	Redirection to new bypass, bridges, roads
		New Tunnel
	Closed infrastructure	Closure of roads

Category	Subcategory	Groups of measures
Community engagement	Communication	Information dissemination
		Complaint management
	Measures for behavioural changes	Promoting quiet mobility
		Promoting public transport
		Promoting of car sharing
		Education and awareness-raising activities

Railways

Category	Subcategory	Groups of measures
Measures at the source	Change In Emission Levels	Rail track measures
		Retrofitting wheels or wheel components
		Low-noise brakes
		Quiet engines
		Renewal railway fleet
	Time restrictions	Time restrictions for passenger vehicles
		Time restriction for freight vehicles
	Speed reduction measures	Reduction of rail speeds and signalling
		Designation of traffic-calmed zones from rail
	Other traffic management measures	Change/reduction in rail tracks
		Track access charges
		Bans and re-routing of freight vehicles
		Bans and re-routing of passenger vehicles
Measures at the path	Noise barriers	Noise barriers and maintenance
		Green noise barriers and maintenance
	Building insulation	Window insulation
		Other insulation
Urban planning	Land use planning	Planning measures between receivers and railway sources
		Reduced noise for sensitive areas
		Buffer zones
	Noise quality areas	Availability of quiet areas
		Availability of green areas
		Soundscape measures
Infrastructure change	New infrastructure	New route
		New rail bypass/new viaduct
		New Tunnel
		Railway underground
	Closed infrastructure	Closure of railway route
		Closure of station
Community engagement	Communication	Information dissemination
		Complaint management
	Measures for behavioural changes	Education and awareness-raising activities
		Promoting the use of railway transport

Airports

Category	Subcategory	Groups of measures
Measures at the source	Change In Emission Levels	Quiet airplanes
	Time restrictions	Curfew hours
		Respite and noise sharing
	Management of air traffic operations	Management of air traffic routes
		Management of take-off and landing approaches
		Management of runway and ground operations
Measures at the path	Noise barriers	Noise barriers and maintenance
		Green noise barriers and maintenance
	Building insulation	Window insulation
		Other insulation
Urban planning	Land use planning	Planning measures between receivers and aircraft
		Reduced noise for sensitive areas
		Buffer zones
	Noise quality areas	Availability of quiet areas
		Availability of green areas
		Soundscape measures
Infrastructure change	New infrastructure	New air traffic route
		New runway
	Closed infrastructure	Closure of route
		Closure of runway
		Closure of airport
Community engagement	Communication	Information dissemination
		Complaint management
	Measures for behavioural changes	Education and awareness raising activities
		Promoting other modes of transport

Annex 3
Country summaries

These summaries only include those countries that have reported partial or complete data as web form. Therefore, the following countries are not included:

- EU 27 Member States: Cyprus, Czechia, Germany, Greece, Hungary, Italy, Luxembourg, Malta, Romania, Slovakia, and Slovenia.
- EEA 32 member countries non EU Member States: Norway, Switzerland, and Turkey.

Austria

Source	To be reported	Reported as a web form
Agglomerations	5	5
Major airports	1	1
Major roads	Yes	Complete
Major rails	Yes	Complete

Agglomerations

		Graz	Innsbruck	Linz	Salzburg	Vienna	%
Measures at the source	**Traffic management**						15
	Rail track						9
	Time restrictions						6
	Public transport						3
Measures at the path	**Insulation of buildings**						36
	Barriers						18
Other physical measures	Quiet areas						9
Education and awareness	Sustainable mobility						3

Major airports

		Vienna International Airport	%
Path interventions	**Insulation of buildings**		100

Major roads

		%
Measures at the source	**Traffic management**	16
	Traffic calming	6
	Time restrictions	6
	Road surface	3
Measures at the path	**Insulation of buildings**	22
	Barriers	16
Urban planning and infrastructure changes	Infrastructure	9
	Land use	3
Other physical measures	Quiet areas	6
Education and awareness	Sustainable mobility	9
	Awareness	3

Major rails

		%
Measures at the source	Quiet engines	60
	Rail track	40

Belgium

Source	To be reported	Reported as a web form
Agglomerations	6	1
Major airports	2	0
Major roads	Yes	Incomplete
Major rails	Yes	No

Agglomerations

		Brussels	%
Measures at the source	**Public transport**		38
	Traffic management		13
	Quiet engines		13
	Time restrictions		13
Measures at the path	Insulation of buildings		13
Education and awareness	Sustainable mobility		13

Major roads

		%
Measures at the path	Barriers	100

Bulgaria

Source	To be reported	Reported as a web form
Agglomerations	7	5
Major airports	1	0
Major roads	Yes	No
Major rails	Yes	No

Agglomerations

		Burgas	Pleven	Plovdiv	Ruse	Varna	%
Measures at the source	**Traffic** (park and ride)						12
	Road surface						11
	Cycling & walking						9
	Rail track						5
	Traffic management						5
	Public transport						3
	Traffic calming						2
	Time restrictions						2
Measures at the path	**Barriers**						12
Urban planning and infrastructure changes	Infrastructure						6
Other physical measures	Green areas						8
Education and awareness	**Awareness**						15
	Dissemination						9
	Complaints						2
	Promote sustainable mobility						2

Croatia

Source	To be reported	Reported as a web form
Agglomerations	4	2
Major airports	Not applicable	Not applicable
Major roads	Yes	Incomplete
Major rails	Yes	Complete

Agglomerations

		Osijek	Zagreb	%
Measures at the source	Rail track			8
	Road surface			8
	Traffic management			8
	Traffic calming			8
Measures at the path	Barriers			8
Urban planning and infrastructure changes	**Land use**			42
Other physical measures	**Quiet areas**			17

Major roads

		%
Measures at the source	**Traffic management**	20
	Road surface	17
	Traffic calming	10
	Time restrictions	3
Measures at the path	**Barriers**	23
	Insulation of buildings	3
Urban planning and infrastructure changes	Infrastructure	3
	Land use	20

Major rails

		%
Measures at the path	Barriers	100

Denmark

Source	To be reported	Reported as a web form
Agglomerations	4	2
Major airports	1	1
Major roads	Yes	Incomplete
Major rails	Yes	Incomplete

Agglomerations

		Aalborg	Aarhus	%
Measures at the source	**Road surface**			29
	Traffic calming			14
Urban planning and infrastructure changes	Land use			14
Other physical measures	Quiet areas			14
Education and awareness	**Promote sustainable mobility**			29

Major airports

		Copenhagen Airport	%
Source intervention	Traffic management		67
Path interventions	Barriers		33

Major roads

		%
Measures at the source	Road surface	20
	Traffic management	20
Measures at the path	**Insulation of buildings**	40
	Barriers	20

Major rails

		%
Measures at the source	Rail track	25
Measures at the path	Insulation of buildings	50
	Barriers	25

Estonia

Source	To be reported	Reported as a web form
Agglomerations	2	2
Major airports	Not applicable	Not applicable
Major roads	Yes	Complete
Major rails	Yes	Not reported

Agglomerations

		Tallin	Tartu	%
Measures at the source	Improve public transport			29
	Road surface			14
Measures at the path	Barriers			14
	Insulation of buildings			14
Urban planning and infrastructure changes	Land use			14
Other physical measures	Green areas			14

Major roads

		%
Path interventions	Barriers	100

Finland

Source	To be reported	Reported as a web form
Agglomerations	10	10
Major airports	2	1
Major roads	Yes	Complete
Major rails	Yes	Complete

Agglomerations

		Espoo	Helsinki	Jyvaskyla	Kauniainen	Kuopio	Lahti	Oulu	Tampere	Turku	Vantaa	%
Measures at the source	Traffic calming				■	■	■	■				8
	Road surface			■			■				■	6
	Rail track		■									4
	Quiet engines	■	■									4
	Public transport		■					■				4
	Traffic (PR)	■	■									4
	Traffic management						■					2
	Tyres		■									2
Measures at the path	**Barriers**	■		■	■		■			■	■	12
	Insulation of buildings					■	■		■			6
	Building design			■								2
Urban planning and infrastructure changes	Land use						■		■		■	8
	Infrastructure			■		■	■					6
Other physical measures	**Quiet areas**	■	■			■		■	■		■	12
Education and awareness	**Sustainable mobility**	■			■		■	■	■		■	12
	Awareness	■	■		■	■					■	10

Major airports

		Helsinki Vantaa Airport	%
Source intervention	**Traffic management**	■	50
	Economic instruments	■	17
Urban planning and infrastructure changes	Land use	■	17
Education/ communication interventions	Dissemination	■	17

Major roads

		%
Source intervention	Road surface	100

Major rails

		%
Measures at the source	Rail track	50
Measures at the path	Barriers	50

France

Source	To be reported	Reported as a web form
Agglomerations	45	4
Major airports	9	0
Major roads	Yes	Incomplete
Major rails	Yes	Incomplete

Agglomerations

		Cahors	Cergy-Pontoise	Henin-Beaumont	Nice	%
Measures at the source	**Road surface**	■	■	■	■	15
	Traffic management				■	8
	Traffic calming		■		■	8
	Cycling & walking		■		■	8
	Rail track		■			4
	Tyres				■	4
	Quiet engines		■			4
	Traffic (PR)				■	4
Urban planning and infrastructure changes	Infrastructure	■				4
	Land use				■	4
Other physical measures	Quiet areas		■	■		8
	Green areas				■	4
Education and awareness	**Sustainable mobility**		■		■	12
	Awareness		■		■	8
	Dissemination		■		■	8

Major roads

		%
Source intervention	**Road surface**	25
	Traffic calming	10
	Traffic management	5
Path interventions	**Insulation of buildings**	20
	Barriers	5
New/ closed infrastructure	**Infrastructure**	20
Other physical interventions	Quiet areas	10
Education/ communication interventions	Sustainable mobility	5

Major rails

		%
Measures at the source	**Rail track**	47
	Quiet engines	5
Measures at the path	Barriers	5
	Insulation of buildings	5
Urban planning and infrastructure changes	**Infrastructure**	16
	Land use	11
Other physical measures	Green areas	5
	Quiet areas	5

Iceland

Source	To be reported	Reported as a web form
Agglomerations	9	4
Major airports	Not applicable	Not applicable
Major roads	Not applicable	Not applicable
Major rails	Not applicable	Not applicable

Agglomerations

		Mosfellsbaer	Reykjavik	Seltjarnarnes	%
Measures at the source	Public transport				10
Measures at the path	Building design				20
	Insulation of buildings				20
Urban planning and infrastructure changes	Land use				20
Other physical measures	Quiet areas				10
Education and awareness	Sustainable mobility				20

Ireland

Source	To be reported	Reported as a web form
Agglomerations	2	2
Major airports	1	1
Major roads	Yes	Incomplete
Major rails	Yes	Complete

Agglomerations

		Cork	Dublin	%
Measures at the source	**Traffic management**			25
	Road surface			10
	Traffic calming			10
	Cycling & walking			5
Measures at the path	Barriers			10
Urban planning and infrastructure changes	Land use			5
Other physical measures	Quiet areas			5
Education and awareness	**Sustainable mobility**			15
	Complaints			10
	Awareness			5

Major airports

		Dublin Airport	%
Source intervention	**Traffic management**		60
	Economic instruments		10
Path interventions	Insulation of buildings		10
	Building design		10
Education/ communication interventions	Complaints		10

Major roads

		%
Measures at the source	Traffic management	20
Measures at the path	Barriers	20
	Building design	20
Urban planning and infrastructure changes	Land use	20
Other physical measures	Quiet areas	20

Major rails

		%
Urban planning and infrastructure changes	Land use	67
Other physical measures	Quiet areas	33

Latvia

Source	To be reported	Reported as a web form
Agglomerations	1	1
Major airports	1	1
Major roads	Yes	Incomplete
Major rails	Yes	Complete

Agglomerations

		Riga	%
Other physical measures	Quiet areas		100

Major airports

		Riga International Airport	%
Source intervention	Time restrictions		50
Urban planning and infrastructure changes	Infrastructure		50

Major roads

		%
Path interventions	Building design	25
	Insulation of buildings	25
New/ closed infrastructure	Land use	50

Major rails

		%
Measures at the source	Rail track	43
	Quiet engines	14
Measures at the path	Barriers	14
Urban planning and infrastructure changes	Infrastructure	14
	Land use	14

Lithuania

Source	To be reported	Reported as a web form
Agglomerations	4	0
Major airports	Not applicable	Not applicable
Major roads	Yes	Complete
Major rails	Yes	Complete

Major roads

		%
Measures at the source	Traffic management	17
Measures at the path	Barriers	33
	Building design	17
	Insulation of buildings	17
Urban planning and infrastructure changes	Infrastructure	17

Major rails

		%
Measures at the source	Traffic management	50
	Quiet engines	25
Measures at the path	Insulation of buildings	25

Netherlands

Source	To be reported	Reported as a web form
Agglomerations	21	18
Major airports	1	1
Major roads	Yes	Incomplete
Major rails	Yes	Incomplete

Agglomerations

See next page

Major airports

		Amsterdam Airport Schiphol
		%
Source intervention	Traffic management	100

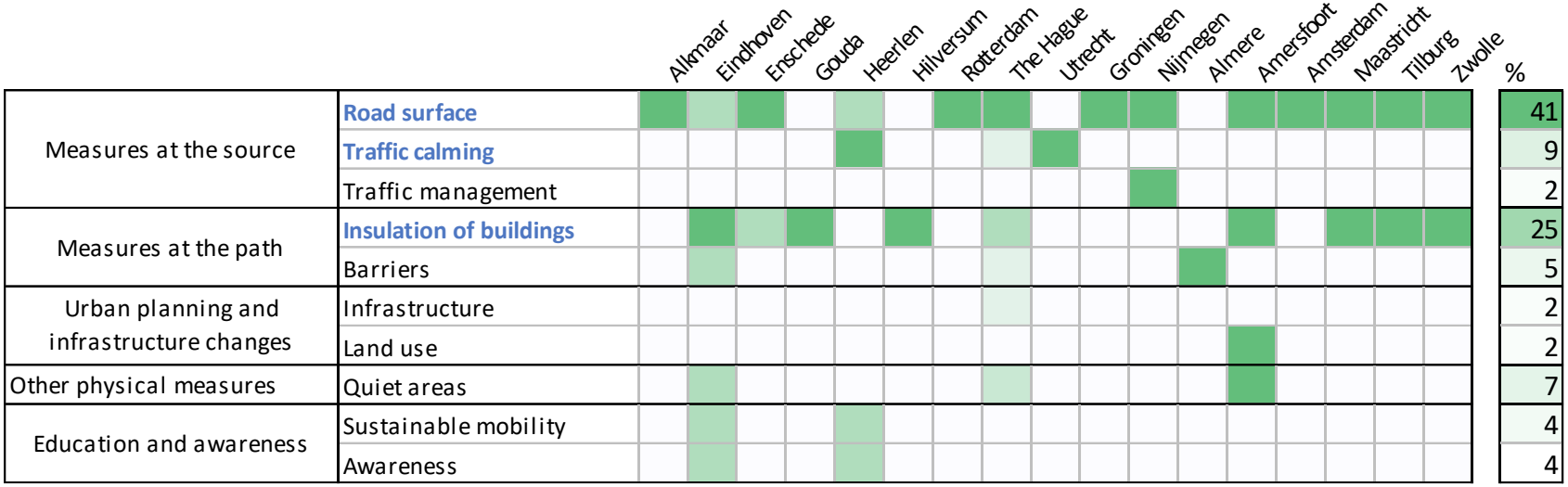
Major roads

		%
Measures at the source	Road surface	40
Measures at the path	Barriers	20
	Insulation of buildings	20
Other physical measures	Quiet areas	20

Major rails

		%
Measures at the path	Barriers	100

Agglomerations



Poland

Source	To be reported	Reported as a web form
Agglomerations	35	27
Major airports	1	0
Major roads	Yes	Incomplete
Major rails	Yes	Incomplete

Agglomerations

See next page

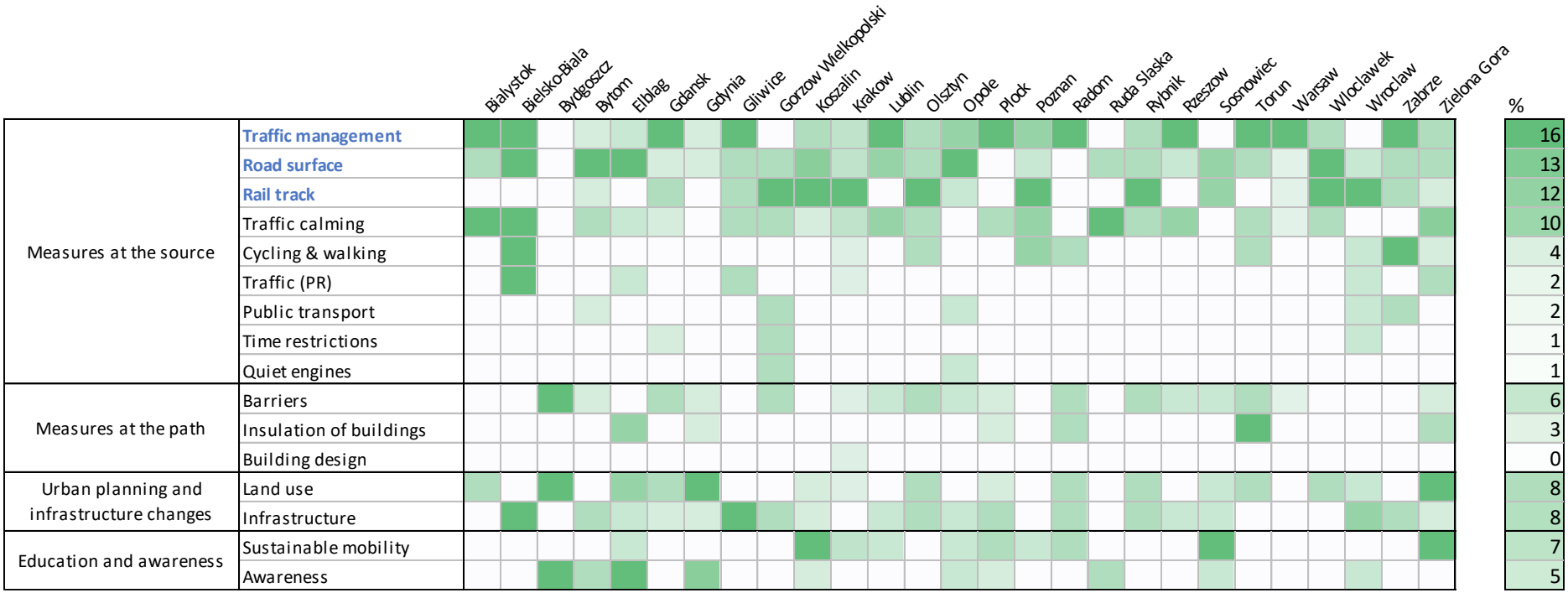
Major roads

		%
Measures at the source	**Road surface**	21
	Traffic calming	11
	Traffic management	4
	Time restrictions	1
Measures at the path	**Barriers**	18
	Insulation of buildings	6
Urban planning and infrastructure changes	**Land use**	15
	Infrastructure	10
Education and awareness	Sustainable mobility	7
	Awareness	6

Major rails

		%
Measures at the source	**Rail track**	58
Measures at the path	Insulation of buildings	5
Urban planning and infrastructure changes	**Land use**	26
Education and awareness	Sustainable mobility	5
	Awareness	5

Agglomerations



Portugal

Source	To be reported	Reported as a web form
Agglomerations	6	3
Major airports	2	2
Major roads	Yes	Incomplete
Major rails	Yes	No

Agglomerations

		Lisbon	Odivelas	Oeiras	%
Measures at the source	**Traffic calming**	■	■	■	19
	Road surface	■		■	13
	Traffic management	■			6
	Public transport	■			6
Measures at the path	Barriers	■			6
	Insulation of buildings	■			6
Urban planning and infrastructure changes	**Land use**	■		■	13
Other physical measures	Quiet areas		■		6
Education and awareness	**Awareness**		■	■	13
	Sustainable mobility			■	6
	Dissemination			■	6

Major airports

		Lisboa	Porto	%
Source intervention	**Traffic management**	■	■	33
	Time restrictions		■	17
Path interventions	Barriers	■		17
	Insulation of buildings	■		17
Education/ communication interventions	Dissemination	■		17

Major roads

		%
Measures at the source	Road surface	38
	Traffic calming	19
Measures at the path	Barriers	44

Spain

Source	To be reported	Reported as a web form
Agglomerations	61	6
Major airports	11	11
Major roads	Yes	Incomplete
Major rails	Yes	Incomplete

Agglomerations

		Alcobendas	Bilbao	Getafe	Lleida	Vigo	Leon	%
Measures at the source	Traffic management							12
	Cycling & walking							12
	Traffic calming							10
	Public transport							6
	Road surface							4
	Time restrictions							2
	Traffic (PR)							2
	Tyres							1
	Quiet engines							1
Measures at the path	Barriers							2
	Building design							1
	Insulation of buildings							1
Urban planning and infrastructure changes	Land use							7
	Infrastructure							2
Other physical measures	Quiet areas							8
	Green areas							1
Education and awareness	Promote sustainable mobili							12
	Awareness							8
	Dissemination							6

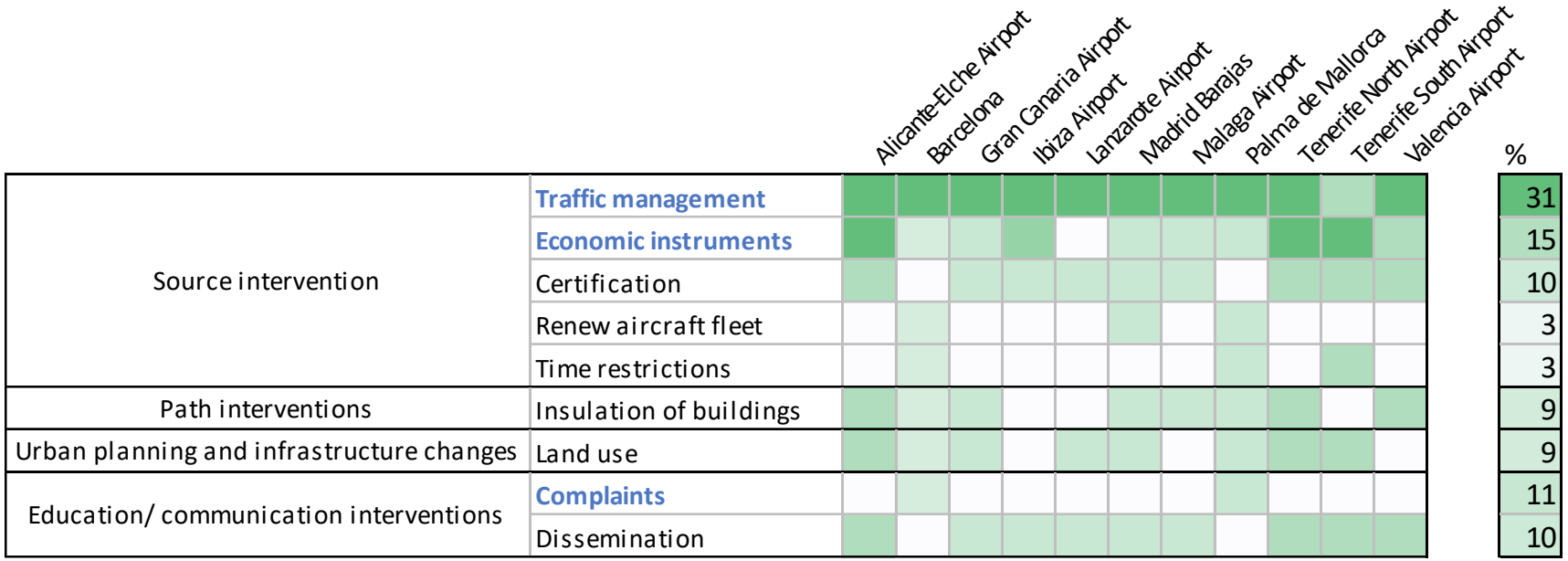
Major roads

		%
Measures at the source	Road surface	33
	Traffic management	11
	Traffic calming	11
Measures at the path	Barriers	33
Urban planning and infrastructure changes	Infrastructure	11

Major rails

		%
Measures at the path	Barriers	100

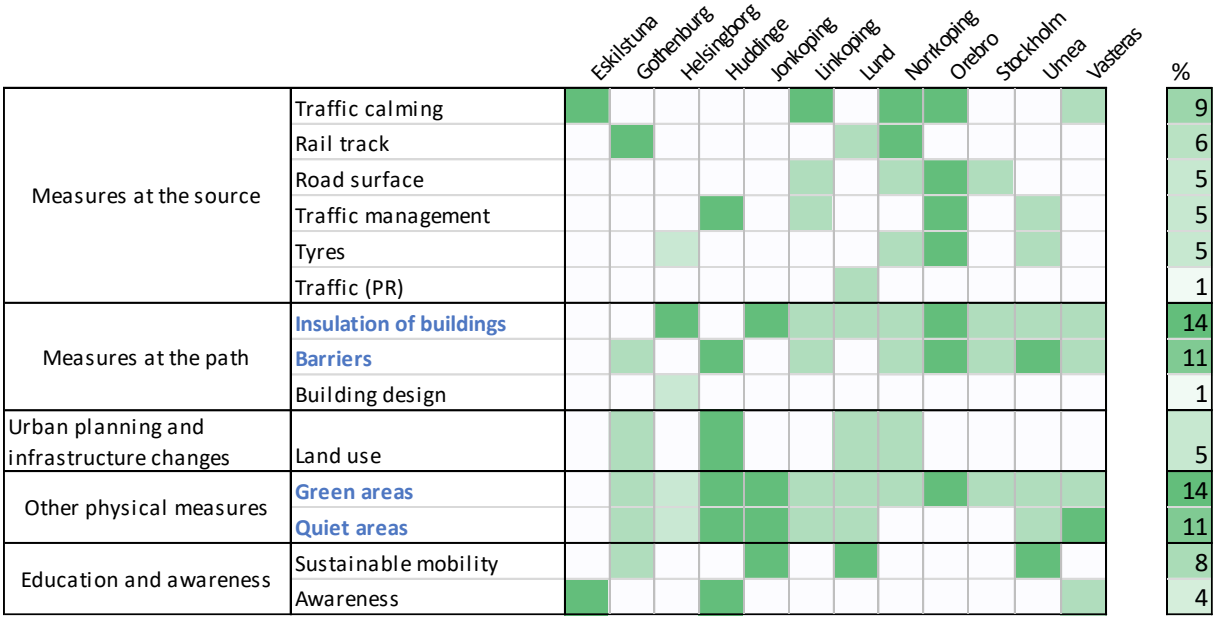
Major airports



Sweden

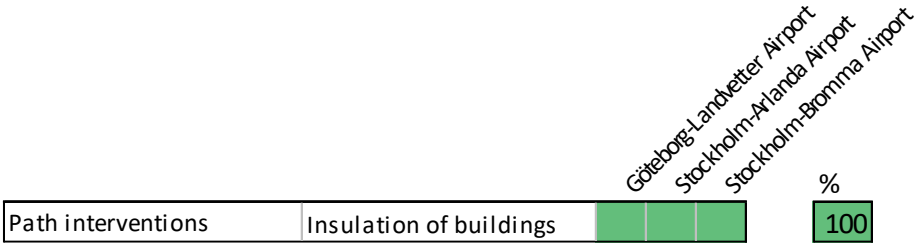
Source	To be reported	Reported as a web form
Agglomerations	15	12
Major airports	3	3
Major roads	Yes	Incomplete
Major rails	Yes	Incomplete

Agglomerations



		%
Measures at the source	Traffic calming	9
	Rail track	6
	Road surface	5
	Traffic management	5
	Tyres	5
	Traffic (PR)	1
Measures at the path	**Insulation of buildings**	14
	Barriers	11
	Building design	1
Urban planning and infrastructure changes	Land use	5
Other physical measures	**Green areas**	14
	Quiet areas	11
Education and awareness	Sustainable mobility	8
	Awareness	4

Major airports



		%
Path interventions	Insulation of buildings	100

Major roads

		%
Measures at the source	Road surface	20
Measures at the path	Barriers	40
	Insulation of buildings	40

Major rails

		%
Measures at the source	Rail track	60
Measures at the path	Insulation of buildings	40

United Kingdom

Source	To be reported	Reported as a web form
Agglomerations	73	68
Major airports	15	9
Major roads	Yes	Incomplete
Major rails	Yes	Incomplete

Agglomerations

The information provided does not include specific planned measures for agglomerations.

Major airports

Major roads

		%
Measures at the source	Road surface	40
Measures at the path	Barriers	20
	Insulation of buildings	20
Urban planning and infrastructure changes	Land use	20

Major rails

		%
Measures at the path	Barriers	50
	Insulation of buildings	50

European Topic Centre on Air pollution,
transport, noise and industrial pollution
c/o NILU – Norwegian Institute for Air Research
P.O. Box 100, NO-2027 Kjeller, Norway
Tel.: +47 63 89 80 00
Email: etc.atni@nilu.no
Web : https://www.eionet.europa.eu/etcs/etc-atni

The European Topic Centre on Air pollution, transport, noise and industrial pollution (ETC/ATNI) is a consortium of European institutes under a framework partnership contract to the European Environment Agency.

European Environment Agency
European Topic Centre on Air pollution,
transport, noise and industrial pollution