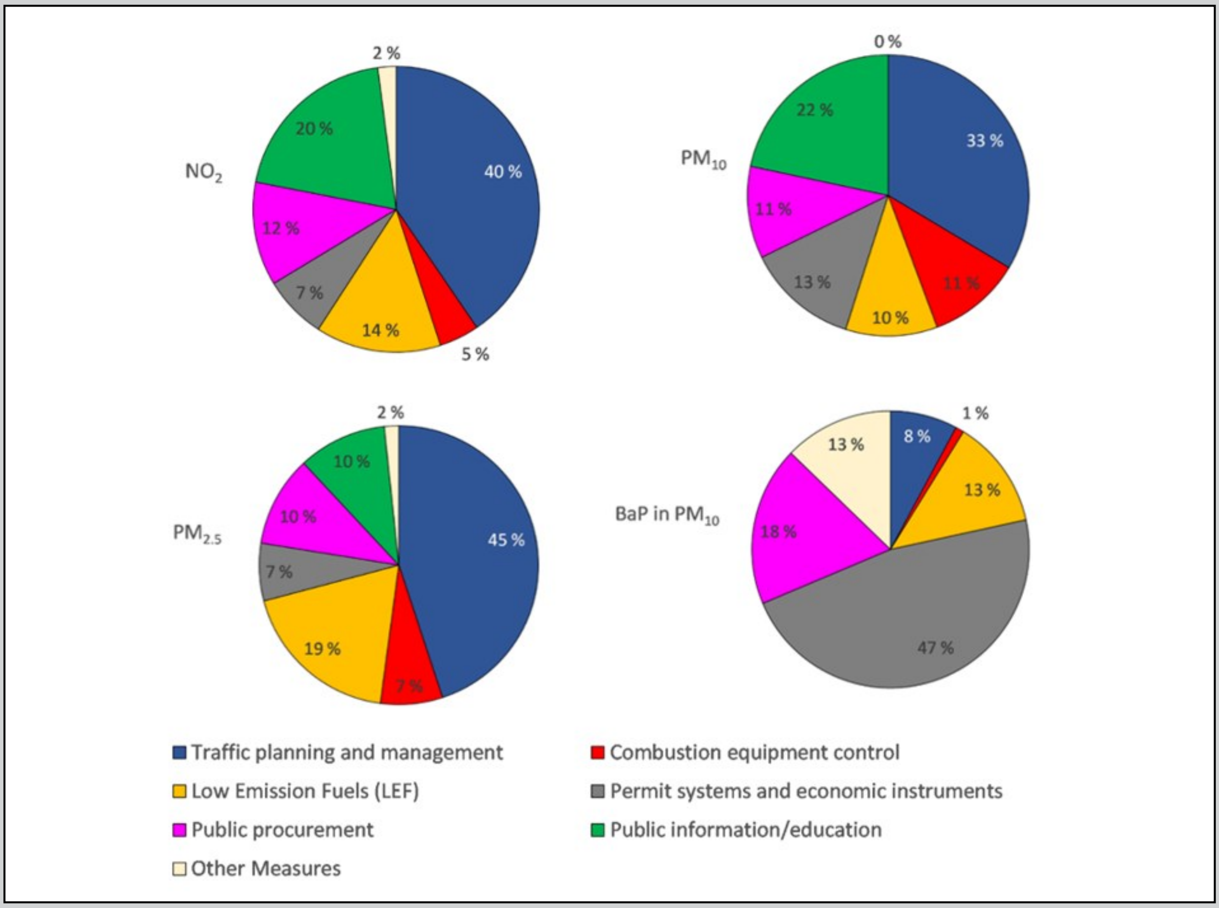
Eionet Report - ETC/ATNI 2020/9

Air Quality Plans and Measures

Analysis of data submitted from 2014 to 2020

December 2021



Authors:

Gabriela Sousa Santos (NILU), Tore Clemetsen (NILU), Torleif Weydahl (NILU), Cristina Guerreiro (NILU)

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
Layout: ETC/ATNI

Legal notice
The contents of this publication do not necessarily reflect the official opinions of the European Commission or other institutions of the European Union. Neither the European Environment Agency, the European Topic Centre on Air pollution, transport, noise and industrial pollution nor any person or company acting on behalf of the Agency or the Topic Centre is responsible for the use that may be made of the information contained in this report.

Copyright notice
© European Topic Centre on Air pollution, transport, noise and industrial pollution, 2021.

Reproduction is authorized, provided the source is acknowledged.
Information about the European Union is available on the Internet. It can be accessed through the Europa server (www.europa.eu).

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 analysis and assessments contained herein, unless otherwise indicated.

Author(s)
Gabriela Sousa Santos (NILU), Tore Clemetsen (NILU), Torleif Weydahl (NILU), Cristina Guerreiro (NILU)

ETC/ATNI c/o NILU
ISBN 978-82-93752-43-1

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

Preface

Under the Ambient Air Quality Directives (AAQD) (2004/107/EC and 2008/50/EC) and Implementing Provisions (2011/850/EU), EEA member countries report when required Air Quality Plans through the e-Reporting system, as follows:

- Information on air quality plans relating to declared zones (dataflow H)
- Information on air quality source apportionment (dataflow I)
- Information on scenarios for the attainment year (dataflow J)
- Information on measures to improve air quality (dataflow K).

There is a need to analyse these data reported to the EEA over several years. In addition to this report, the outcome of this analysis will be summarised in a briefing to publish on EEA's website in 2021.

In 2017 a preliminary analysis of this data has been done. The database for H-K dataflows has been further developed, allowing now a better link between the different dataflows and assessing more data with better quality. This analysis is based on the H-K data available in the new database.

Contents

Summary

The European Ambient Air Quality Directives (AAQD) have the overall objective to protect human health and the environment from ambient air pollution. This report provides an overview of the air quality plans and measures submitted between 2014 and 2020 by the individual countries for areas where the standards of air quality specified by the AAQD were not attained.

The European Ambient Air Quality Directives (AAQD) have the overall objective to protect human health and the environment as a whole from ambient air pollution. With this aim they set up a framework to monitor and assess ambient air quality, as a basis for defining measures to keep concentrations of specific pollutants below the air quality (AQ) standards (limits and/or target values). In case exceedances have been detected, the legislation requires measures are applied in order to bring the concentrations below the AQ standards as soon as possible and ensure avoidance of future exceedances in the short- and long-term. Moreover, citizens and vulnerable groups must be informed so that they can reduce their exposures.

In addition to the evaluations of the reported Air Quality Plans done by the European Commission for compliance checking, it is important to analyse the submitted data with the aim to provide information to the reporting Member countries that can be used to improve their air quality management practices. Previous studies in the framework of the Air Implementation Pilot (published in 2012 and 2013) made assessments of the measures and management practices but were not successful in defining the measures' effectiveness.

The Commission Implementation Decision 2011/850/EU ([1]) sets the framework for reporting AQ information and the data are reported in the European Environment Agency's e-reporting system. This report analyses the data reported in flows H (Air quality plans), I (Source apportionment), J (Scenario of the attainment year) and K (Measures), and additionally, their links to data flow G (Attainment of environmental objectives).

The EU member states are legally bound to provide the required information in case of exceedances of the air quality standards. This was also the case for United Kingdom until January 31, 2020 when this state exited the European Union and ended its membership to the EEA. Of the previous 33 countries (at the moment of writing consisting of EEA-32_2020 plus United Kingdom) , no reported data in dataflow H-K are available for Estonia, Greece, Hungary, Iceland, Ireland, Liechtenstein, Luxembourg, Malta, Switzerland, and Turkey (as of 06.11.2020).

Most countries focus their plans on traffic related pollutants NO_2 and/or PM_{10} (the only pollutants considered by Austria, Denmark, United Kingdom, Latvia, Netherlands, Portugal and Sweden), however in total, 22 pollutants are targeted. Czechia and Italy are the two countries that target most pollutants. More than half of air quality plan records (557 records) have status "implemented" and a significant number have status "under revision" (158) or "first year of implementation" (141). The rest of plans show status "in preparation" (40), "in formal adoption process (29), "ended with no foreseen revision" (18) or "under implementation" (one). This could indicate that while most plans were successful, a significant number required further attention. When interpreting these data, it should also be considered that the start of the attainment dates vary between pollutants (from 2005 for e.g. SO_2 to 2015 for $PM_{2.5}$), and that countries could also have applied for an extension.

An analysis of what are the reasons for exceedances (based on available data in dataflow I ([2])) shows Traffic as the main sector leading to exceedances in 64 % of records (and 100 % for Austria, Denmark, Finland, the Netherlands, Portugal, and United Kingdom, in line with the pollutants targeted), followed by Domestic heating (14 %, most prominent in Bulgaria, Poland, Romania, Slovenia and Slovakia). Local

([1]) https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32011D0850

([2]) Null data is ignored for the following percentages.

industry (10 %) is an important reported source in Belgium, but also important in a number of other countries (e.g., France, Poland, Spain). The category “Other” (8 %) is used in Bulgaria, Croatia, Italy, Poland, Spain, and Sweden; this category when given further information could comprise a variety of sources including meteorology, agricultural residue burning, harbour activity or shipping.

The majority of the exceedances occurred in urban areas (65 %) followed by suburban areas (21 %), while 14 % of the exceedances addressed in the plans occurred in rural areas. The air quality plans covering PM_{10} exceedances cover all area categories from rural to urban. NO_2 also covers all areas, however the expressive majority is in suburban and urban areas. For $PM_{2.5}$ exceedances the plans cover only suburban and urban areas. Ozone is targeted in rural-regional, rural-remote areas and urban areas, as the highest concentrations often occur in rural areas with important negative impacts on crops and forests and ozone standards for the protection of human health are also regularly exceeded in urban and suburban areas (EEA, 2020).

The estimated attainment date (reported in dataflow J) with the implementation of the reported measures, show that for 87 % of the plans compliance should have been attained by 2020.

Most measures target exceedances of NO_2 (62 %), PM_{10} (26 %) and $PM_{2.5}$ (10 %), and there are measures targeting exceedances of standards of BaP, Ni and Pb (all in PM_{10}) and SO_2. In one case the measure is relevant for C_6H_6.

Information about what measures are planned/implemented to achieve attainment is broadly in line with the reasons of exceedance. The main sectors that are targeted are transport (70%), commercial-residential (12 %) and industry (8 %). There are also measures in agriculture, shipping, and regarding off-road mobile machinery. An exceedance normally has several source contributors. The plan designers show the intention to act on these less important sources, even if not referred explicitly.

The most common measures adopted for NO_2, PM_{10}, BaP and $PM_{2.5}$ are in the category «Traffic planning and management» (39 % of the measures respecting these four pollutants), with more expression for NO_2 (40 % of all the measures for NO_2 exceedances), $PM_{2.5}$ (45 %), and PM_{10} (33 %). The next category is “Public information/education” (19 % of all measures for the four major pollutants in dataflow K) consisting of 22 % of the measures for PM_{10}, 20 % for NO_2 and 10 % for $PM_{2.5}$. The third most important category is the use of “Low emission fuels” (14 % of all measures), being the second most important category for measures targeting $PM_{2.5}$ exceedances (19 %). 11 % of all measures for NO_2, PM_{10}, BaP and $PM_{2.5}$ fall under the “Public procurement” category, and this category is the second most important for measures targeting BaP exceedances (18 %). 9 % of the measures for the major four are in the “Permit systems and economic instruments” category and this is the most important category for measures targeting BaP (47 %) and the third most important for PM_{10} measures (13 %). 6 % of measures targeting NO_2, PM_{10}, BaP and $PM_{2.5}$ belong to the “Combustion equipment control” category. Most countries use a wide variety of classification types, even if they have a high percentage of their measures’ “portfolio” in the “Traffic planning and management” category. This fits well with the countries’ assessment of the main reasons of the exceedances.

Even if the effectiveness of the plans is not directly linked to the number of reported measures, it is interesting to note that the countries with the highest number of exceedances also indicate the highest number of measures (e.g., Bulgaria, Germany, Spain, and United Kingdom). Exceptions are Italy reporting a high number of exceedances, but relatively low number of measures, and Czechia with low number of reported exceedances and a high number of reported measures. 12 % of the reported measures are not linked to an exceedance. It is possible to report measures regarding pollutants for which the EEA member countries are not obliged to report in the source apportionment dataflow (for example BaP). Other possible reason is that member countries are trying to reach the WHO guideline concentration levels which are lower than EU AQ standards.

The majority of measures (86 %) are managed at a local level, with the remaining being regional (11 %) and national (3 %). Bulgaria, Croatia, Latvia, Portugal and Slovakia declare that 100 % of their measures are administered at local level.

The reported data is mostly consistent and the type of measures seem appropriate to target the exceedances of the specific air pollutants and their main source sectors and reason of exceedance. Nevertheless, the reported data is not sufficient to assess the effectiveness of the plans and measures and the likelihood of attainment of the standards within the estimated attainment year.

Acknowledgements

This report is a result of ETC/ATNI task 1.1.2.5 from AP2020. The EEA task manager was Evrim Dogan Özturk. The EEA reviewers were Evrim Dogan Özturk, Alberto González Ortiz and Levente Molnar.

The data used in this report were obtained from the mandatory reporting of air quality plans and measures under the Ambient Air Quality Directives. The data for this report were downloaded in November 2020 and reflect the status of the reporting by EEA member countries at this point.

1 Introduction

The European Ambient Air Quality Directives (AAQD) ([3]) have the overall objective to protect human health and the environment as a whole from ambient air pollution. With this aim they set up a framework for Member States to monitor and assess ambient air quality, as a basis for defining measures to keep concentrations of specific pollutants below the air quality (AQ) standards (limits and/or target values). In case exceedances have been detected, Member States need to apply measures to bring the concentrations below the AQ standards as soon as possible and to avoid future exceedances, both in the short- and long-term. In addition, Member States have to take measures to inform the citizens/vulnerable groups so that they can reduce their exposure.

To achieve the EU AAQD objectives it is important to assess the measures and management practices implemented by Member States. Previous studies in the framework of the Air Implementation Pilot made such assessments, but were not successful in defining the measures' effectiveness (ETC/ACM 2012, 2013a, 2013b). They based their work on the assessment of trends in measured concentrations in AQ stations, on the AQ management information reported by Member States (through the questionnaire in 2004/461/EC), and also taking into account the *Time Extension Notifications* under the Article 22 of the 2008/50/EC Directive.

At the moment, the Commission Implementation Decision 2011/850/EU ([4]) sets the framework for reporting AQ information. This Decision has repealed previous frameworks and transferred the reporting under AAQD 2004/107/EC and 2008/50/EC from the earlier excel-based files to a web-based reporting system in which the information is introduced in a standardized and machine-readable form. This is supported by the EEA's e-reporting system in the EIONET Central Data Repository (CDR) ([5]), which is being populated by EEA member countries ([6]) with information since 2014. Further development by the European Environmental Agency (EEA) of viewers ([7]) to access this information has facilitated the analysis of this information.

The information required from the EEA member countries is listed in Annex II of 2011/850/EU in the following groupings (which are followed in CDR in the naming of each dataflow ([8])):

B – Zones and agglomerations

C – Assessment Regime

D - Assessment Methods

E - Primary validated assessment data and primary up-to-date assessment data

F - Generated aggregated data

G - Attainment of environmental objectives

H - Air quality plans

I – Source Apportionment

J – Scenario for the attainment year

K - Measures

([3]) The two European AAQD currently in force are: the 2004/107/EC that relates specifically to arsenic, cadmium, nickel, and polycyclic aromatic hydrocarbons (relative to the last item, benzo(a)pyrene acts as a marker for the carcinogenic risk of these compounds); and 2008/50/EC regulating ambient air concentrations of sulfur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter, lead, benzene, carbon monoxide, and ozone.
([4]) https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32011D0850
([5]) http://cdr.eionet.europa.eu/
([6]) EEA-32_2020 plus United Kingdom.
([7]) https://www.eea.europa.eu/themes/air/ (Accessed last on December 9, 2021).
([8]) A dataflow is the collection of XML files separated in the listed groupings.

The aim of the present document is to present and analyse the reported data on air quality plans (AQ plans), i.e., dataflows H-K. Therefore, we retrieved : dataflow H (AQ plans), dataflow I (Source apportionment), dataflow J (Scenarios for the attainment year with and without measures), and dataflow K (Measures). Moreover, for the previous analysis we needed information on the nature of the pollutant in exceedance and for acquiring it we also retrieved dataflow G (Attainment of environmental objectives).

In Section 2, we present an analysis of the data and in Section 3, we present conclusions. The presentation of the data analysis starts by introducing the reported AQ plans (dataflow H) and the European AQ standards. In Section 2.1 we analyse the reported data relative to the exceedances of the European AQ standards. We continue in Section 2.2 with the results of the model evaluations performed in order to assess future attainment, and in Section 2.3, we analyse the reported measures designed to eliminate the exceedances.

The analysis in this report was realized on a set of CSV files extracted from the XML files (Annex 1 contains information on number of files included and reasons for non-inclusion). Dataflows H-K were downloaded from the EEA portal, server SANDDAB, database Airquality_H2K_Dev on November 6, 2020. On January 2021, dataflow G was downloaded from the Central Data Repository(CDR) and linked to dataflows H-K for retrieving identification of the pollutant in exceedance.

2 Air Quality Plans submitted from 2014 to 2020

The detection of non-compliance with the AQ standards (exceedance situations) means that the EU Member States are not only required to take all necessary measures to achieve compliance, but also to report the AQ plans through their submission to the Commission. EEA member countries (which include EU Member States) submit the information regarding these AQ plans following the structure set with the Commission Implementing Decision 2011/850/EU for dataflow H-K. In this chapter we will analyse this reported data. For further information on the retrieval see Annex 1.

The most complete data flow is dataflow H (metadata on the AQ plans), and the least complete is dataflow I (Source apportionment). Number of records vary between the dataflows and data classes (from several hundreds to tens of thousands), as does the completeness of the individual reported data classes (see Annex 2). The dataflows should also be related to each other; however, such links are not always possible to make and when made can change the number of records. As a result, the statistics presented in this report can vary as their basis is not necessarily the same for theoretically comparable summaries. This basis depends on the ability to link the appropriate records and what is being linked. For example, for dataflow K without any link to other dataflow, the number of total measures is 19507. However, these are not unique type of measures for every countries as they may be introduce per administrative area. Then when dataflow K is linked to dataflow G (with pollutant identification) the number of measures diminishes, however again these are not unique measures as the same measure may be recorded for several pollutants. Other factor is data completeness (Annex 2). These practical issues complicate the data analysis and can result in ambiguous results. In order, to define the basis, we introduced tables with absolute numbers along the analysis.

In Table 2.1, we show the countries that have reported AQ plans in dataflow H, the number of AQ plans identifiers, pollutants covered and the ranges of dates for the reported first exceedance and for the plans official adoption dates. Cyprus has no record in dataflow H, however, Cyprus will appear further on as it registered five source apportionments in dataflow I. Czechia and Italy are the countries which work on the most diversified list of pollutants, whereas Austria, Denmark, United Kingdom, Latvia, Netherlands, Portugal and Sweden only consider NO_2 and/or PM_{10}, which shows a focus on traffic related exceedances.

Figure 2.1 (the legend is explained in Table 2.2) shows the status of AQ plans in each country at submission, i.e., whether they were under preparation, adoption, implementation, revision, etc. The vast majority of the AQ plans (557 records) were already implemented. However, there was a significant number of plans that were under revision, which may mean that the measures had been implemented, but were not successful or sufficient.

Table 2.1: Reported Air Quality Plans (dataflow H), their adoption dates, covered pollutants and year of first exceedance of AQ standards

	Country	Number of AQ plans identifiers	Pollutants covered ([a])	First exceedance	Adoption dates
1	AT (Austria)	3	NO_2, PM_{10}	2005	2014,2016
2	BE (Belgium)	7	NO_2, PM_{10}, Pb (aer)	2005-2017	2014-2017
3	BG (Bulgaria)	91	SO_2, NO_2, PM_{10},$PM_{2.5}$, Cd (in PM_{10}), BaP (in PM_{10})	2007,2009-2013, 2016, 2017	2007,2010-2013, 2016, 2017
4	CZ (Czechia)	42	SO_2, NO_2, PM_{10}, $PM_{2.5}$, Cd (aer), As (aer), C_6H_6, As (prec), BaP (prec)	2005, 2013	2016
5	DE (Germany)	501	NO_2, PM_{10}, O_3, CO, C_6H_6, BaP (prec)	1997, 2000, 2002-2010, 2012, 2013, 2015-2017	2004,2006-2020
6	DK (Denmark)	1	NO_2	2010	2015
7	ES (Spain)	56	SO_2, NO_2, PM_{10}, $PM_{2.5}$, O_3, CO, C_6H_6, BaP (in PM_{10}), BaP (in $PM_{2.5}$), NH_3	1997, 2005, 2006, 2009-2012, 2014, 2015, 2017	2006,2007, 2010, 2012-2019
8	FI (Finland)	6	NO_2, BaP (in PM_{10}), As (in PM_{10})	2006, 2015	2016
9	FR (France)	78	SO_2, NO_2, PM_{10}, $PM_{2.5}$, O_3, CO, C_6H_6, Pb (in PM_{10}), Cd (in PM_{10}), Ni (in PM_{10}), As (in PM_{10}), BaP (in PM_{10}),	1999, 2002, 2005-2008, 2010, 2011, 2015	2006, 2012-2016, 2018, 2019
10	GB (United Kingdom) ([b])	2	NO_2	2013, 2015	2015, 2017
11	HR (Croatia)	5	NO_2, PM_{10}, $PM_{2.5}$, O_3, BaP (in PM_{10})	2013, 2016, 2017	2015, 2016, 2018
12	IT (Italy)	35	SO_2, NO_2, NO_X (as NO_2), PM_{10}, $PM_{2.5}$, O_3, CO, C_6H_6, Pb (in PM_{10}), Cd (in PM_{10}), Ni (in PM_{10}), As (in PM_{10}), BaP (in PM_{10}), Ni (aer), NH_3, T-VOC	2001, 2002, 2005, 2011-2013, 2015	2000, 2006-2018
13	LT (Lithuania)	3	PM_{10}, BaP (in PM_{10})	2013	2014, 2015
14	LV (Latvia)	7	NO_2, PM_{10}	2005	2011, 2014, 2016
15	NL (Netherlands)	1	NO_2	2015	2018
16	NO (Norway)	15	SO_2, NO_2, PM_{10}, $PM_{2.5}$	2005, 2009, 2010, 2012, 2016	2005, 2010, 2013-2018
17	PL (Poland)	33	SO_2, NO_2, PM_{10}, $PM_{2.5}$, O_3, C_6H_6, As (in $PM_{2.5}$), BaP (prec)	2012-2015	2013-2017

	Country	Number of AQ plans identifiers	Pollutants covered ([a])	First exceedance	Adoption dates
18	PT (Portugal)	14	NO_2, PM_{10}	2001, 2013-2015	2009, 2015
19	RO (Romania)	18	NO_2, PM_{10}, C_6H_6, $PM_{2.5}$	2006, 2007, 2017	2018
20	SE (Sweden)	5	NO_2, PM_{10}	1997, 2002, 2010, 2011	2015, 2018, 2019
21	SI (Slovenia)	12	PM_{10}	2002, 2003, 2010	2013, 2014, 2017
22	SK (Slovakia)	16	NO_2, PM_{10}, $PM_{2.5}$, O_3, BaP (in PM_{10}), $PM_{2.5}$, O_3	2003-2005	2013, 2016

Notes: ([a]) As (aer) – Arsenic (aerosol) ; As (prec) – Arsenic (precipitation) ; As (in PM_{10}) – Arsenic in PM_{10} (aerosol) ; BaP (prec) – Benzo(a)pyrene (precipitation) ; BaP (in PM_{10}) – Benzo(a)pyrene in PM_{10} (aerosol); BaP (in $PM_{2.5}$) – Benzo(a)pyrene in $PM_{2.5}$ (aerosol) ; Cd (aer) – Cadmium (aerosol) ; Cd (in PM_{10}) – Cadmium in PM_{10} (aerosol) ; C_6H_6 – Benzene (air) ; CO – Carbon monoxide (air) ; NH_3 – Ammonia (air) ; Ni (aer) – Nickel (aerosol) ; Ni (in PM_{10}) – Nickel in PM_{10} (aerosol) ; NO_2 – Nitrogen dioxide (air) ; NO_X (as NO_2) – Nitrogen oxides (air) ; O_3 – Ozone (air) ; Pb (aer)– Lead (aerosol) ; Pb (in PM_{10}) – Lead in PM_{10} (aerosol); $PM_{2.5}$ – Particulate matter < 2.5µm (aerosol) ; PM_{10} – Particulate matter < 10µm (aerosol); SO_2 – Sulphur dioxide (air) ; T-VOC – Total volatile organic compounds (air).

([b]) We use the original notation in the database for United Kingdom: GB.

The majority of the AQ plans aim at achieving compliance with AQ standards for the protection of health (Table 2.3) and, therefore, report health as the protection target. Some AQ plans include compliance with AQ standards for the protection of vegetation (Table 2.4) : three AQ plans in Spain regarding pollutants ozone and ammonia ; four AQ plans in France for ozone, and two AQ plans in Italy for nitrogen oxides.

Figure 2.1: Status of the AQ plans at reporting, per country: top figure shows all countries and bottom figure is a zoom without Germany (DE) (See Table 2.2 for more information on legend)

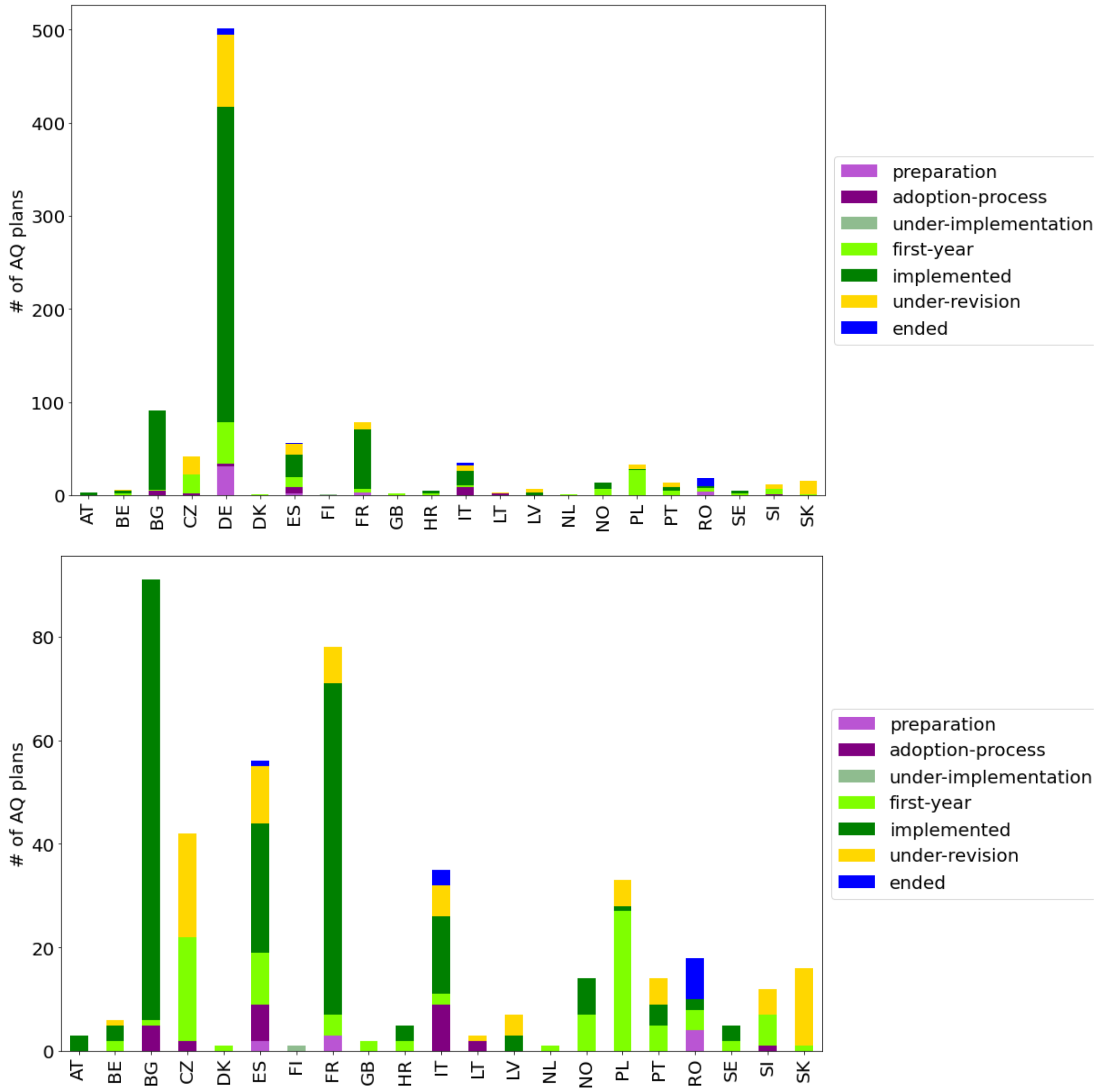


Table 2.2: Air Quality Plans Status code ([a]).Of the 951 records (unique identifiers), 944 provide information on status

Notation	Further information	Number of AQ plans records	Percentage
Implemented		557	59
under-revision		158	17
first-year	First year of implementation, adopted during reported year	141	15
preparation	In preparation	40	4
adoption-process	In formal adoption process	29	3
ended	Ended, no revision foreseen	18	2
under-implementation	Minor modifications of the adopted plan may occur and do not need to be reported through the full information on AQ plan	1	
	Total	944	

Note: ([a]) https://dd.eionet.europa.eu/vocabulary/aq/statusaqplan.

The air quality plans should be made available to the Commission no later than 2 years after the end of the calendar year in which the first exceedance was observed (2011/850/EU). However, in Table 2.1 between the dates in the column for the “First exceedance” and the column “Adoption dates”, we have to take into consideration when the AAQD directives 2004/107/EC and 2008/50/EC attainment dates for each pollutant started to be applicable (see Table 2.3). For example, for NO_2 the applicable dates for the limit values started in 2010, with the possibility of extension to 2015. For PM_{10} these dates were 2005 and 2011, respectively.

Table 2.3: Air Quality Directives standards (limits, target values, exposure concentration obligations) and the start of the attainment dates for the protection of health (2008/50/EC and 2004/107/EC)

Pollutant	Averaging period	Limit value (LV)	Target value (TV)	Exposure concentration obligation (ECO)	Start attainment year
SO_2	Hour	350 µg/m³			2005
	Day	125 µg/m³			2005
NO_2	Hour	200 µg/m³			2010 ([a])
	Year	40 µg/m³			2010 ([a])
NO_X					
PM_{10}	Day	50 µg/m³			2005 ([b])
	Year	40 µg/m³			2005 ([b])
$PM_{2.5}$	Year	25 µg/m³ 20 µg/m³ (indicative)		20 µg/m³	2015-LV 2020-ECO and indicative LV
Pb	Year		0.5 ng/m³		2005
C_6H_6	Year	5 µg/m³			2010 ([a])
CO	Maximum daily 8-hour mean	10 mg/m³			2005
O_3	Maximum daily 8-hour mean (averaged over 3 years)		120 µg/m³		2010
As	Year		6 ng/m³		2013
Cd	Year		5 ng/m³		2013
Ni	Year		20 ng/m³		2013
BaP	Year		1 ng/m³		2013

Notes: ([a]) Possible for EU Member States to apply for extension to 2015.
([b]) Possible for EU Member States to apply for extension to 2011.

Table 2.4: Air Quality Directive 2008/50/EC standards for the protection of vegetation

Pollutant	Averaging period	Legal nature	Concentration level
O_3	AOT40 ([a]) accumulated over May to July and averaged over 5 years	Target value	18 000 µg/m³ hours
		Long-term objective	6 000 µg/m³ hours
NO_x	Year	Vegetation critical level	30 µg/m³
SO_2	Winter (October 1 to March 31)	Vegetation critical level	20 µg/m³
	Year	Vegetation critical level	20 µg/m³

Note: ([a]) AOT40 is an indication of accumulated O_3 exposure, expressed in µg/m³·hours, over a threshold of 40 parts per billion (ppb). It is the sum of the differences between hourly concentrations > 80 µg/m³ (40 ppb) and 80 µg/m³ accumulated over all hourly values measured between 08.00 and 20.00 (Central European Time).

2.1 Exceedances

The vast majority (95 %) of the identified exceedances refer to exceedances of NO_2 and PM_{10} AQ standards, as shown in Table 2.5.

Table 2.5: Number of exceedances in dataflow I per recorded pollutant

Notation	Number of exceedances	Percentage
NO_2	428	63
PM_{10}	215	32
$PM_{2.5}$	10	1
O_3	9	1
BaP (in PM_{10})	7	1
Ni (in PM_{10})	5	1
Pb (in PM_{10})	2	0
Cd (in PM_{10})	1	0
SO_2	1	0
C_6H_6	1	0
	679	

The member countries have to assess and report the main reasons that have led to the exceedances of AQ standards. This is reported in dataflow I – Source Apportionment – for each exceedance situation. The member countries can choose the main exceedance reason from a standard list of notations as shown in Table 2.6. This table shows the exceedance reasons from the most (top) to the least frequently reported (bottom). The four last options were not reported. In Figure 2.2, we show the percentual selection by each country for all its source apportionment (exceedances) records. For Czechia there is no information introduced in the class "Exceedance Reasons".

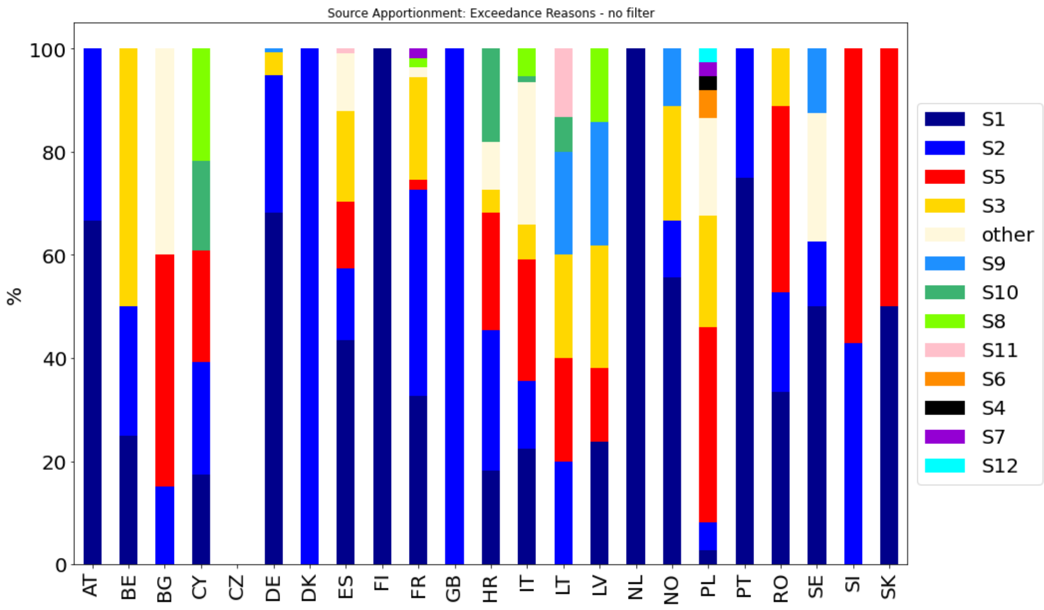
Table 2.6: Exceedance reasons. List of notations, definitions ([a]) and reported numbers

Notation	Definition	Number of exceedances	Percentages
S1	Heavily trafficked urban centre	222	34
S2	Proximity to a major road	198	30
S5	Domestic heating	91	14
S3	Local industry including power production	64	10
Other	Other, please specify	51	8
S9	Winter sanding of roads	11	2

Notation	Definition	Number of exceedances	Percentages
S10	Transport of air pollution originating from sources outside the Member State	8	1
S8	Natural source(s) or natural event(s)	7	1
S11	Local petrol station	3	0
S6	Accidental emission from industrial source	2	0
S4	Quarrying or mining activities	1	0
S7	Accidental emission from non-industrial source	1	0
S12	Parking facility	1	0
S13	Benzene storage	0	0
S16	Favourable meteorological conditions for ozone formation	0	0
S17	Emissions due to public works and construction in the vicinity	0	0
S18	Use of studded tyres	0	0
	Total	660	

Note: ([a]) Base URL for the vocabulary definition is https://dd.eionet.europa.eu/vocabulary/aq/exceedancereason/

Figure 2.2: Exceedance reasons reported by each country (relative percentage)



Sixty-seven percent of entries in dataflow I provide information about Exceedance reason. A large proportion of the reported exceedance reasons (out of 660 reported records) are related to traffic (34 % are S1-Heavily trafficked urban centre - and 30 % are S2 - Proximity to a major road). For some countries, traffic is the only main reason reported, as it is the case for Austria, Denmark, Finland, Netherlands, Portugal, and United Kingdom. This comprises a small number of source apportionments reported by each country. A notable exception is the United Kingdom which reported 78 source apportionments (all S2), which come from two AQ plans of national scope focusing on road emissions and NO_2 for the reference years 2013 and 2015 (the latter AQ plan is an update of the AQ plan for the reference year 2013). Germany has 156 source apportionments reported relating to AQ plans adopted from 2004 to 2020 (Table 2.1), 144 of these source apportionments are related to traffic. The large majority of the traffic related exceedances of AQ standards are related to NO_2 and PM_{10} (see Figure 2.3 and Figure 2.4).

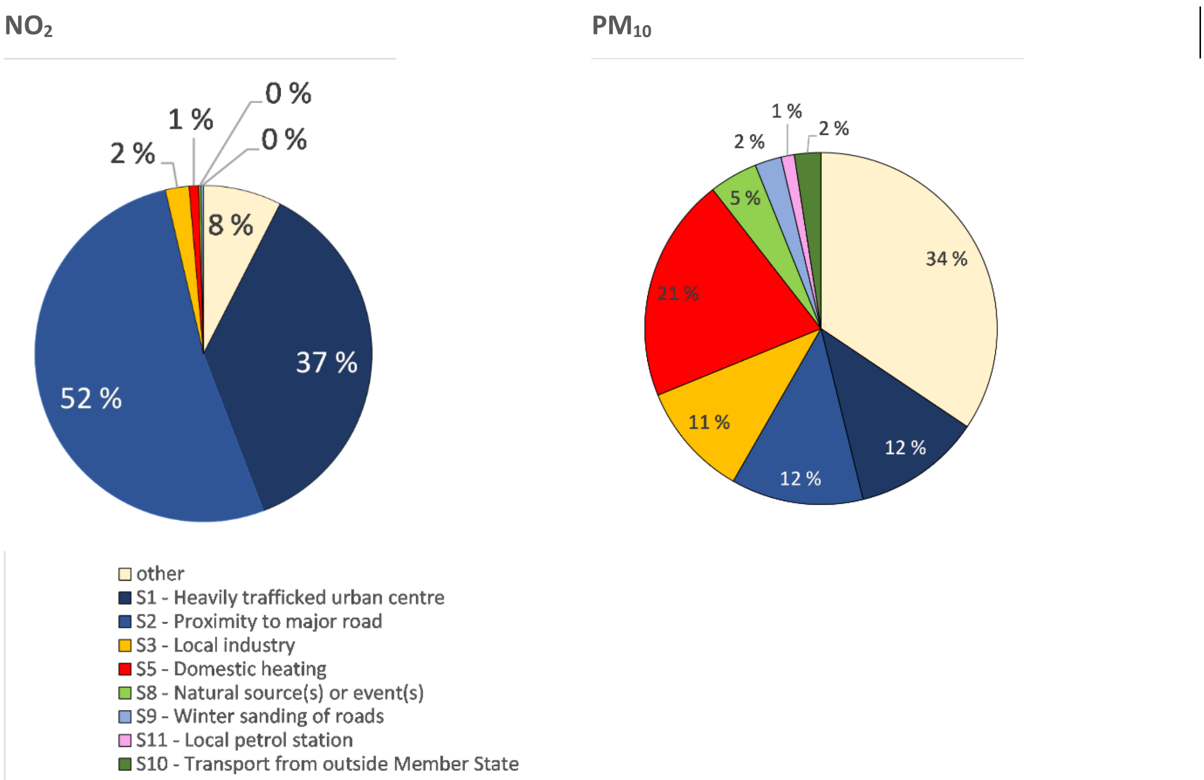
The third most frequently reported reason for exceedance is domestic heating with 14 % of the total entries; 82% of these cases are exceedances of PM_{10} AQ standards (other pollutants have low number of occurrences). The countries that report most often domestic heating (S5) as the main exceedance reason are Italy (18), Poland (14), Spain (14), Romania (12) and Slovenia (12).

Local industry (S3) is reported as the main reason for 10 % of the exceedances, with the most of these exceedances being of PM_{10} AQ standards (Figure 2.4). In terms of countries, these cases are reported by Spain (19), Poland (8), Germany (7) and France (7).

Regarding the exceedance reason « other», further information declared a mixture of significant sources. Other reasons reported and not included in the list in Table 2.6 were meteorological reasons (for exceedances of PM_{10} (24) and $PM_{2.5}$ (7)), burning of agricultural residues (11 exceedances of PM_{10}) and harbour activity or shipping (for exceedances of PM_{10} (12), NO_2 (5), and ozone (3)).

The relative numbers of records for exceedance reasons for NO_2 and PM_{10} is shown in Figure 2.3. It shows the prevalence of traffic sources for NO_2, whereas PM_{10} has a wider variety of sources, most importantly besides traffic, as already referred, is domestic heating and local industry.

Figure 2.3: Number of exceedance reasons (%) for nitrogen dioxide (NO_2) and PM_{10}.



Relative to the reported area where the exceedances occur, it is worth mentioning that 65 % of the records state that the exceedances were in an urban setting, 21 % suburban, and the remaining rural.

In Figure 2.4 we show for four of the most frequent recorded pollutants in dataflow I the main reason for the exceedance and area of occurrence. Nitrogen dioxide is mainly emitted by traffic and traffic densities are highest in urban and suburban areas. On the other hand, PM_{10} has a larger variety of sources, but like NO_2, its exceedances often occur in populated areas, i.e., urban and suburban areas, with higher human activity and emissions. The few ozone exceedances in dataflow I were reported by Italy. Ozone is a secondary pollutant (meaning it is not emitted directly by any emission source) formed in the atmosphere from complex chemical reactions, due to emissions of precursor gases such as NO_x and Volatile Organic Compounds (VOC). In contrast to other pollutants, O_3 levels are generally highest at rural locations. This is because at short distances from NO_x sources, e.g. at urban and traffic stations, O_3 is depleted through the titration reaction by the freshly emitted NO. Nevertheless, high O_3 concentrations may occur in urban stations, due to the O_3 formation that occurs at times in large urban areas during episodes of high solar radiation and temperatures.

In Figure 2.5 and

Figure 2.6, we present exceedances levels and numbers for when the reporters have defined the existence of the exceedance and have entered a reference year (year for which the exceedance was assessed) in dataflow I (based on linking the dataflow I to dataflow G). We present the maximum values for the same year and country, which means that we show the level of the highest exceedances.

For the same source apportionment record there is the data class “exceedance level” and data class “exceedance number”. Most countries’ reporters interpret exceedance level as the annual concentration value above the limit (40 $\mu g/m^3$ both for NO_2 and PM_{10} – Table 2.3) (Figure 2.5 and

Figure 2.6 – top) and as exceedance number the number of occurrences above the hourly limit value for NO_2 (200 $\mu g/m^3$) or the daily limit value for PM_{10} (50 $\mu g/m^3$) (Figure 2.5 and

Figure 2.6 – bottom). The countries that appear without values in one graph for one pollutant have the correspondent value in the counterpart graph. This means that in the respective exceedance situation only one of the averaging periods is in breach.

Figure 2.4: Number of reported area classifications (in dataflow I) versus exceedance reasons for nitrogen dioxide (NO_2), particulate matter (PM_{10} and $PM_{2.5}$) and ozone (O_3)

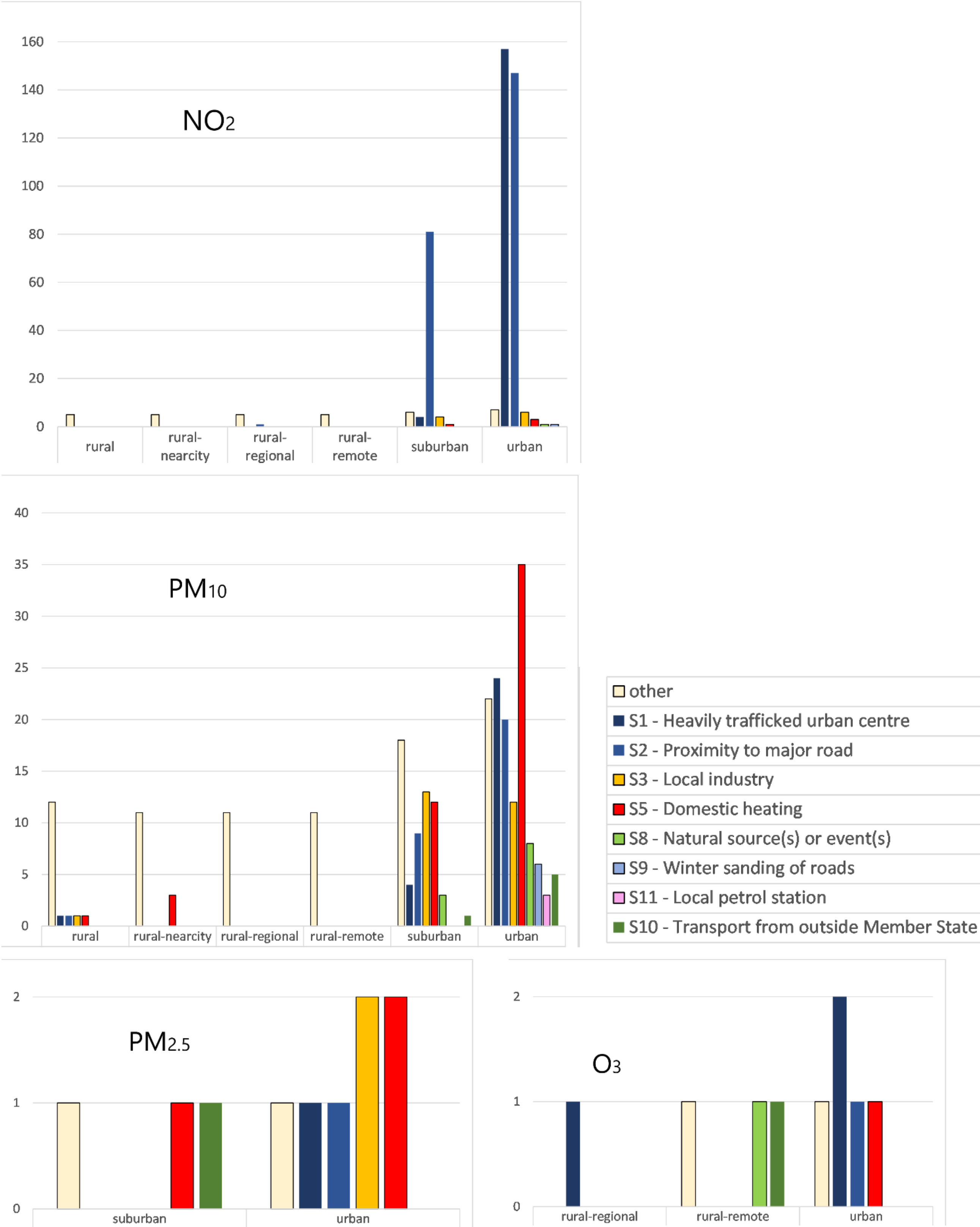
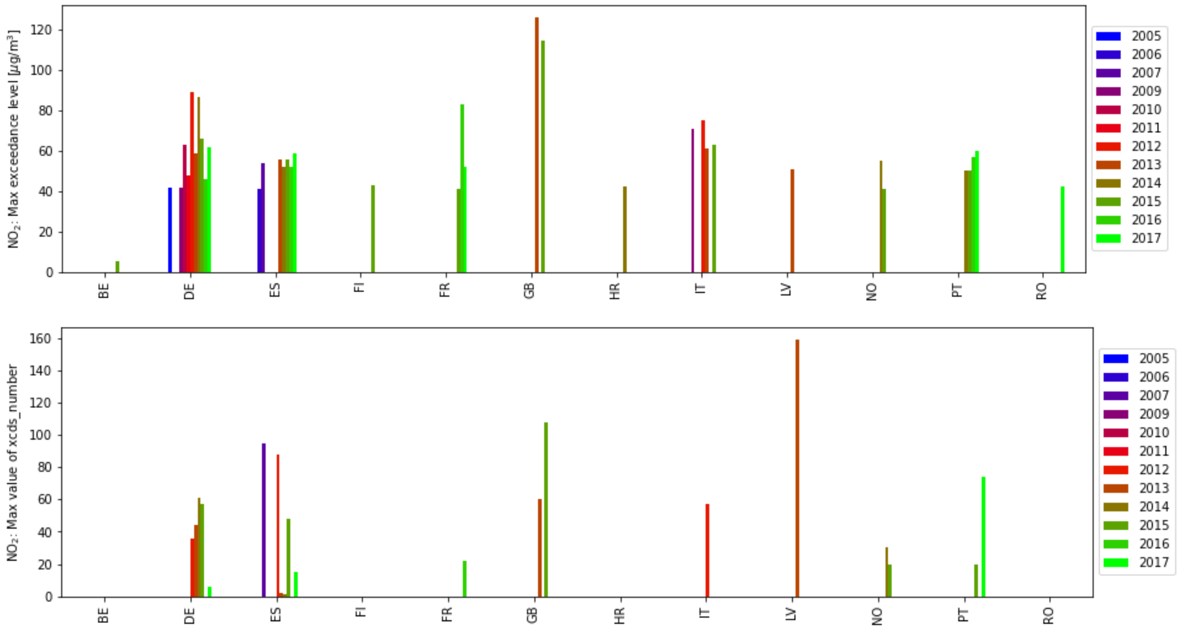
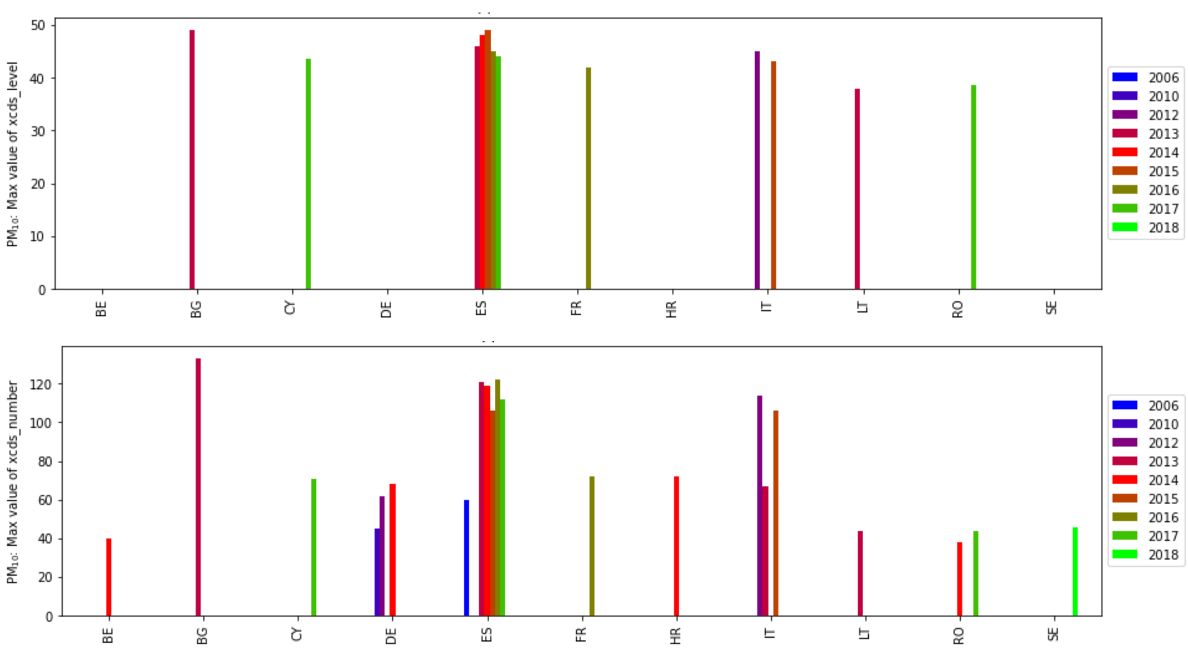


Figure 2.5: Exceedances relative to NO_2 per country. Top: Maxima of the exceedance values reported per reference year ([a]) for the annual limit value (unit is µg.m^{-3}). Bottom: Maxima of the number of exceedances of the hourly limit value of 200 µg.m^{-3} reported per reference year



Note: ([a]) In dataflow I, reference year is the one for which the exceedance was assessed.

Figure 2.6: Exceedances relative to PM_{10} per country. Top: Maxima of the exceedance values reported per reference year ([a]) for the annual limit value (unit is µg.m^{-3}). Bottom: Maxima of the number of exceedances of the daily limit value of 50 µg.m^{-3} reported per reference year



Note: ([a]) In dataflow I, reference year is the one for which the exceedance was assessed.

Figure 2.5 (top) shows that the highest exceedances of the NO_2 annual AQ standard were reported by France, Germany, Italy, and United Kingdom. However, Germany and Italy have their highest breaches before the reference year of 2013, whereas United Kingdom reported a maximum exceedance of NO_2 annual mean of 115 µg/m^3 in the reference year 2015 and France of 79 µg/m^3 in 2016. For non-compliance of the hourly NO_2 AQ standard (less than 18 hourly NO2 mean concentrations above 200 µg/m^3 - Figure 2.5 bottom), the highest breaches are in Latvia, Portugal, Spain, and United Kingdom. Latvia and Spain reported the highest breaches before 2013, whereas Portugal reported it (maximum number of 74) for the reference year 2017, and the United Kingdom (maximum number of 108) for 2015.

For PM_{10} (Figure 2.6 top), the non-compliance of its annual AQ standard is in the range of 40-50 µg/m^3 and the non-compliance of its daily PM_{10} AQ standard (less than 35 daily PM_{10} mean concentrations above 50 µg/m^3 - Figure 2.6 bottom) is in the more spread range of 35-130. Most of these reported exceedances happened before reference year 2015. The most recent exceedances were reported for reference years 2017 and 2018. For 2017 by Cyprus, Spain (112 times daily PM_{10} means above 50 µg/m^3), and Romania. For 2018, Sweden reported 46 PM_{10} daily concentrations above 50 µg/m^3. Cyprus reporters note high natural sources contribution in their PM_{10} exceedances (Sahara sand and sea salt spray). Figure 2.5 and Figure 2.6 show that the exceedances of the NO_2 and PM_{10} standards persist in several countries in Europe, despite implemented AQ plans and measures. Nevertheless, the assessment of trends of NO_2 and PM_{10} concentrations in Europe show decreases in most countries, indicating that the policies and measures implemented over the last decade have led to improvements (EEA, 2020).

Other reported information regarding the exceedances includes the exposed population and exposed area to concentrations in exceedance of the AQ standards, as well as the length of road along which the concentrations are breaching the AQ standards. Exposed population is the metric with more records in this exposure section. It is likely that some exceedance situations are better described by road length than area exposed (and vice-versa) and, thus, it is understandable that there are less records in these data classes. In Figure 2.7 and Figure 2.8, we show the sum per year and per country of the previous information, for NO_2 and PM_{10}, respectively. As before, no values for a given country indicates that they have selected exceedance as « existing », the pollutant is identified and the value for the exposure class is 0. The maximum values for exposed population for NO_2 and PM_{10} occur in Italy in the reference year of 2012. These are from the same AQ plan for the region of Lombardia, which has a timetable ending in 2020. It would be interesting to know the methodology for calculating the exposed population: if they count the population in the domain (which is probably what happened in the study for the Lombardia region considering the magnitude of the exposure reported) or if the values refer to a more sophisticated methodology. The information on exposure is likely not useful to identify improvements over the years, because this information probably does not concern the same domains and probably the methodologies to calculate these exposure were not the same. An assessment of exposures was done by the EEA (2020), based on reported measurement data and modelling and it shows that air pollution continues to have significant impacts on the health of the European population, particularly in urban areas, due to exposure to PM_{10} and NO_2 over the last decade.

Figure 2.7: Relative to the NO_2 exceedances: Sum of the Exposed population (number of inhabitants), sum of the exposed area (km^2), and sum of the length of road exceeding the Air Quality standards (km) per reference year for the exceedances. Y-scale is logarithmic

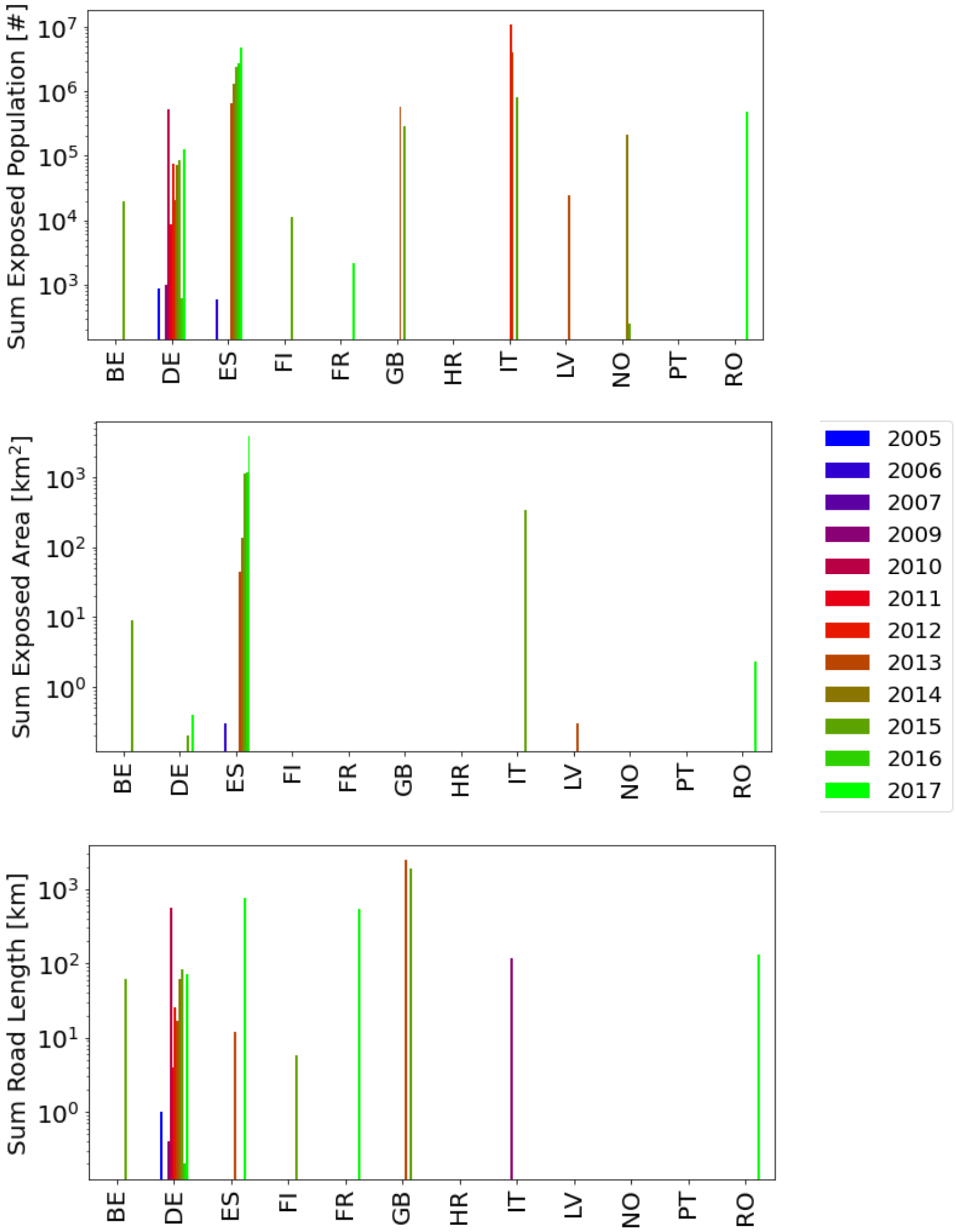
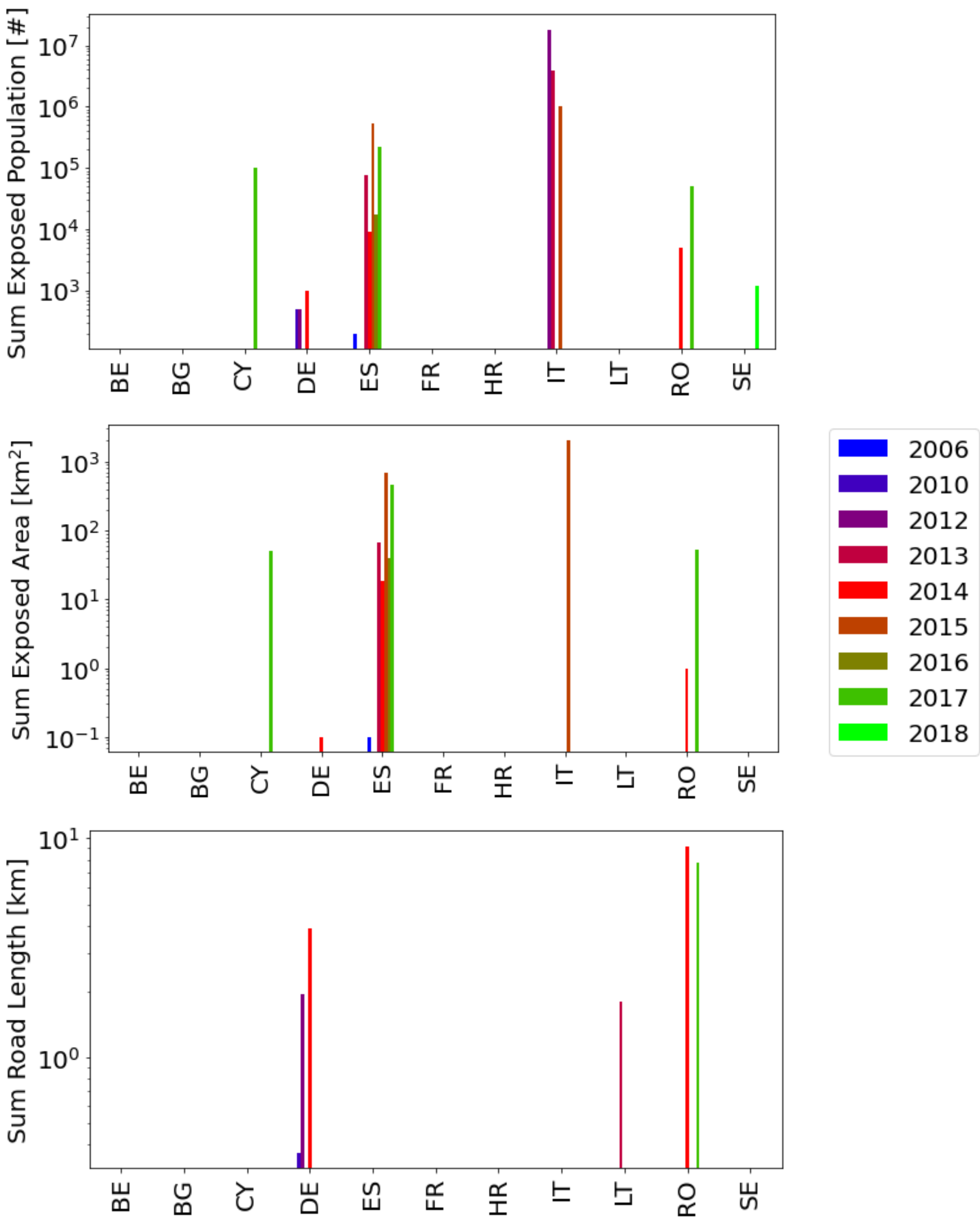


Figure 2.8: Relative to the PM_{10} exceedances: Sum of the Exposed population (number of inhabitants), sum of the exposed area (km^2), and sum of the length of road exceeding the Air Quality standards (km) per reference year for the exceedances. Y-scale is logarithmic



2.2 Evaluation of attainment

The reporting obligations on AQ plans include information on the estimated air quality situation in two scenarios in the future, both based on a business as usual development assumption. In the *base scenario* there are no further policies and measures, whereas the *projection scenario* include the effects of the proposed plans and measures' implementation. This is reported in Dataflow J (evaluation). The core information in dataflow J is the date by when the environmental standards will be met and the evidence that this is achievable with the measures presented: the attainment date.

Figure 2.9 shows the reported reference year (year for which the projection starts) and corresponding attainment year. It is expected that the reference year is earlier than the attainment year and, thus, in the Figure all points should be above the black diagonal line. The majority of the points below the black diagonal line regard Poland's entries (48) and one from Germany. Thirty nine of the evaluations (from Germany and Bulgaria) consider that the attainment will be achieved within the year (points on line). According to the reported evaluations in dataflow J, attainment should have been achieved in 2020 for 87 % of the exceedances.

Figure 2.9: Reference year (year from which projection starts) versus attainment year in dataflow J. Size of bubbles proportional to the frequency of the pairing

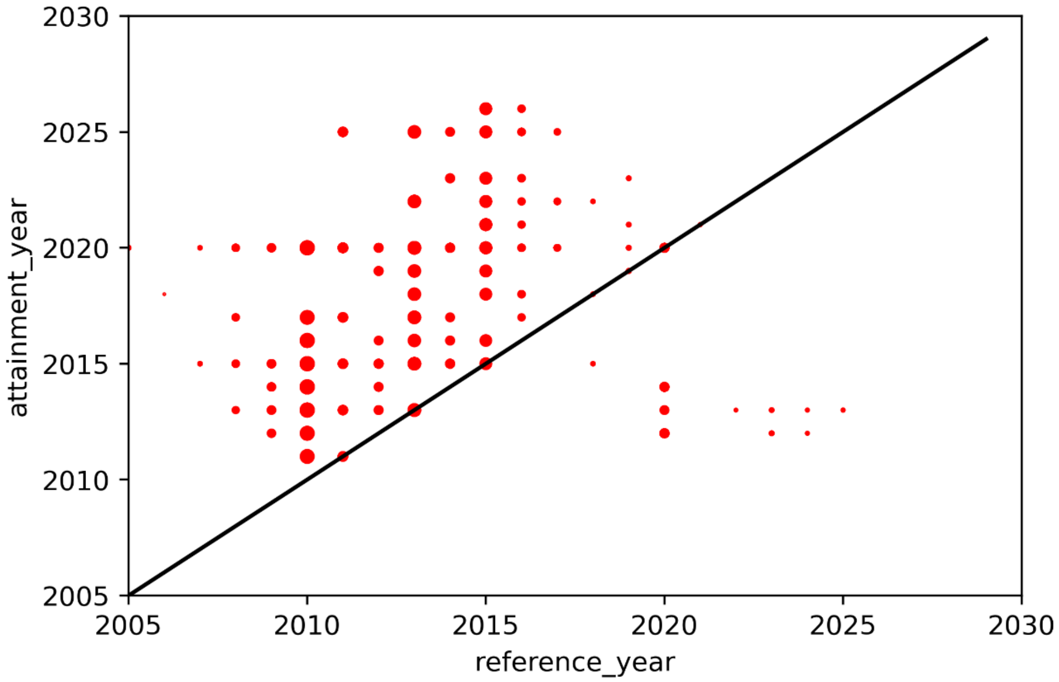


Figure 2.10 shows the 264 available pairs of reported NO_2 annual means ([9]) for the « Base concentration » and the « Projection concentration », that is, expected concentration without and with measures, respectively. For these, 145 show a reduction in "Projection concentrations" with the implementation of the planned measures (dark bars are lower than respective light bars), while, surprisingly, for 62 cases it shows an increase in "Projection concentration" compared to the "Base concentration" (dark bars higher than light bars). In addition, for 57 cases both the Base and Projection concentrations are lower than the limit value of 40 µg/m^3. Similar pairs of data values for PM_{10} exist only for 28 records, 17 for the annual means and 11 for number of days in a calendar year above 50 µg/m^3 (Figure 2.11). We can see that of these 28 records, 17 are not above the respective AQ standards in the « Base scenario », that is, above 40 µg/m^3 on the left of Figure 2.11 and above 35 days in a calendar year on the right. For the remaining records, attainment is not accomplished or the « Projection concentration » is exactly the AQ limit value.

([9]) There are only six records for number of hours above 200 µg/m^3.

Figure 2.10: NO_2 annual means ($\mu g/m^3$) for the base case (orange bars) and correspondent projection concentrations (dark bars)

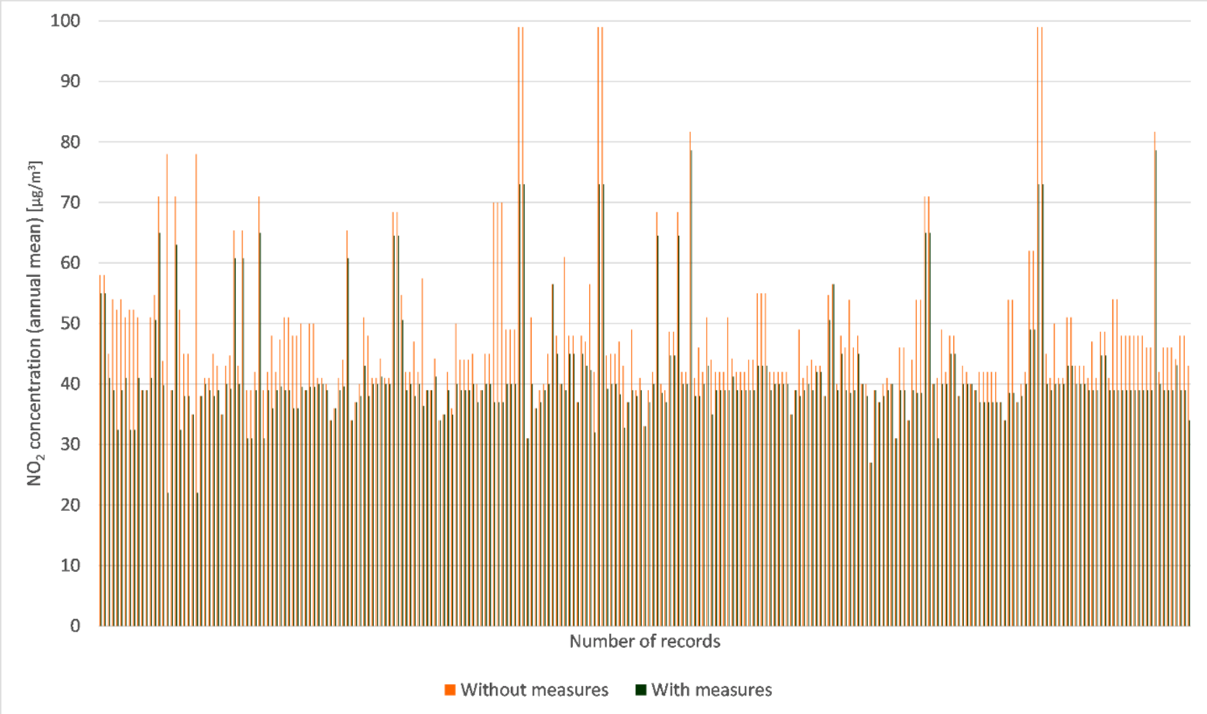
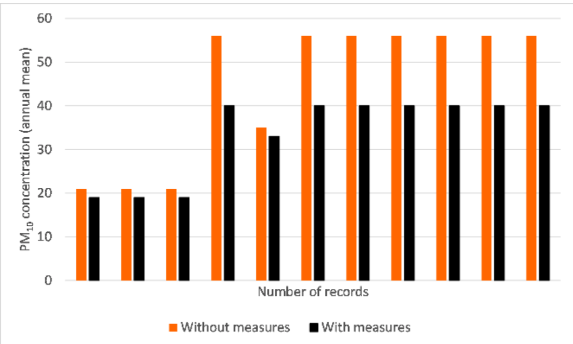
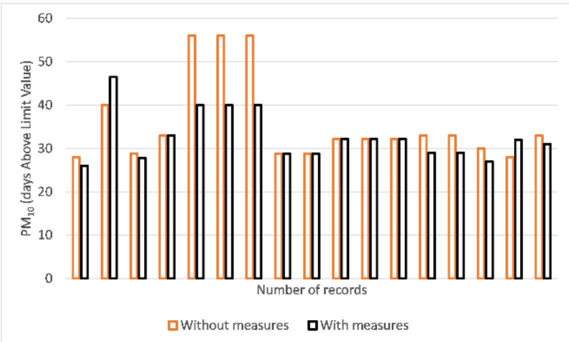


Figure 2.11: PM_{10} annual means ($\mu g/m^3$) (left plot) and PM_{10} number of days in a calendar year above 50 $\mu g/m^3$ for the base case (orange bars) and correspondent projection concentrations (dark bars)



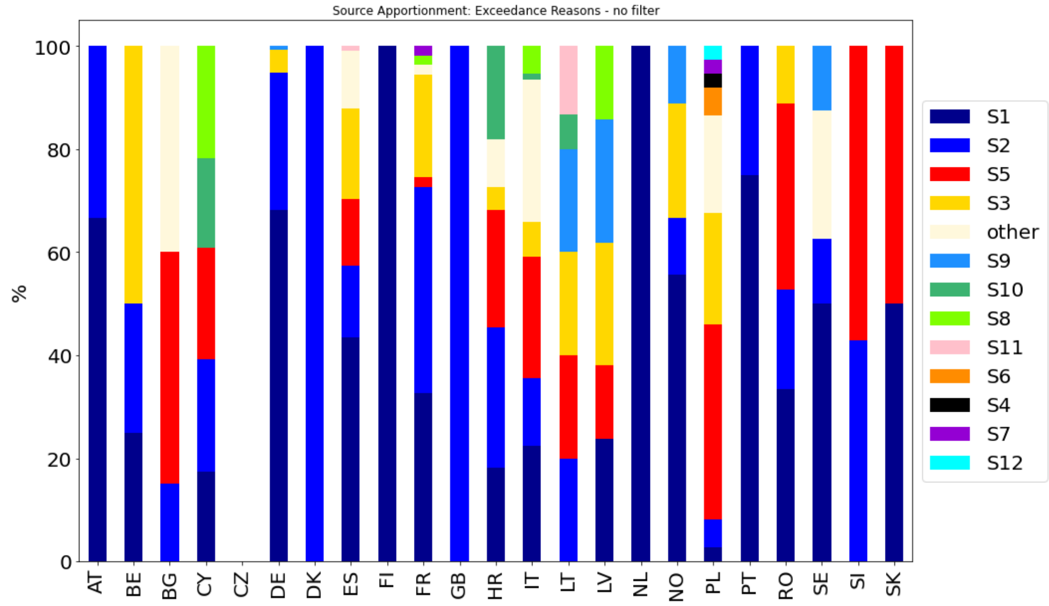


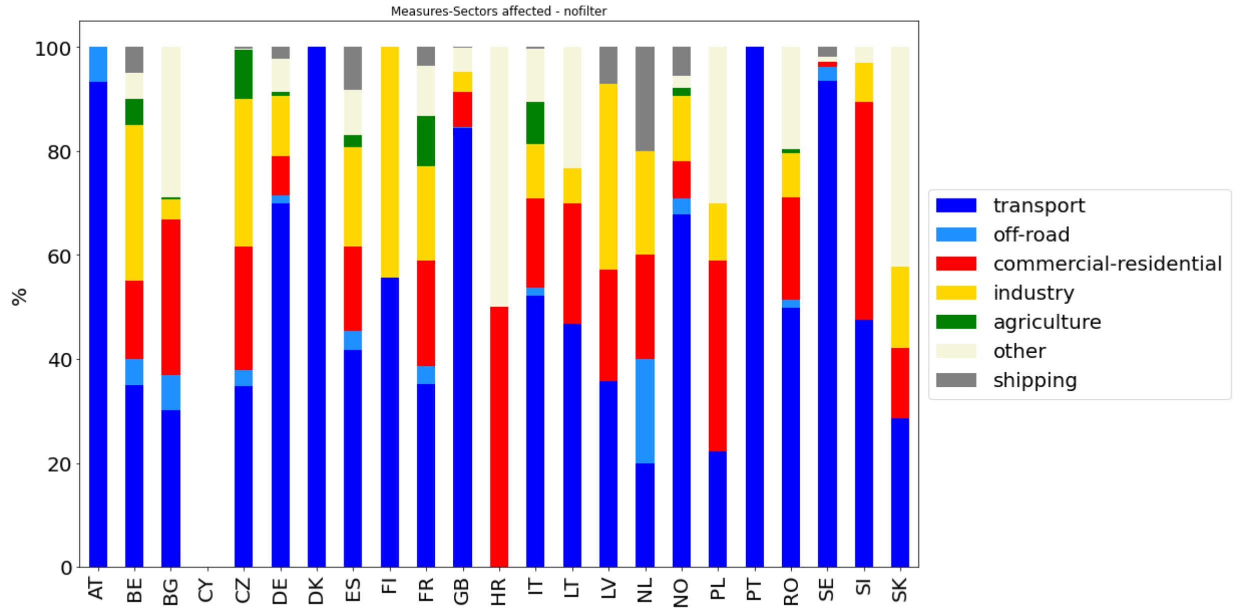
2.3 Analysis of measures to achieve compliance with air quality standards

In Figure 2.12, we show the relative percentage of the exceedance reasons per country (top) and the relative percentage of the sectors affected by the measures that the countries designed in order to eliminate these exceedances (bottom). We note again that for Cyprus there is only information in dataflow I – Source Apportionment and for Czechia there are no entries for exceedance reasons.

In general, the sectors affected reflect the exceedance reasons: 70 % of the measures are in Transport and 66 % of the exceedance reasons are related to traffic; 12 % are in commercial-residential sectors against 14 % of exceedance reasons being domestic heating; 8 % in industry sector versus 10 % industry related exceedance reasons. There are also measures in the sectors of agriculture and shipping, which are often the entries in *other* exceedance reasons. An exceedance normally has several source contributors. The plan designers show the intention to act on these less important sources, even if not referred explicitly.

Figure 2.12: Exceedance reasons (top) and sectors affected by the measures (bottom) per country (in relative percentage) (see definition for the legend of top figure in Table 2.6)





Note: Blues are for transport/traffic related categories; red denotes residential-commercial categories; yellow is relative to industry categories.

Table 2.7 presents detailed reported information on the type of measures. The measures are organized in six categories: Traffic planning and management, Combustion equipment control (stationary and mobile), Low emission fuels (stationary and mobile), Permit systems and economic instruments, Public procurement, and Public information/education. There are 33 types of measures classifications that can be chosen, however apparently, they are not sufficient as 16 % of measures have been defined as

"Other measures". The three types with more inserted measures are in the Traffic planning and management category: "traffic-shift", "traffic-public", and "traffic-other".

Table 2.7: Reported information on classification of measures ([a]), and number of measures per category

Notation	Category	Definition	Number of measures	Percentages
traffic-LEZ	Traffic planning and management	Low Emission Zones	309	1
traffic-diffpark	Traffic planning and management	Differentiation of parking fees	212	1
traffic-managepark	Traffic planning and management	Management of parking places	397	2
traffic-speed	Traffic planning and management	Effective reduction of speed limits and control	341	2
traffic-congestion	Traffic planning and management	Congestion pricing zones	88	0
traffic-freight	Traffic planning and management	Freight transport	599	3
traffic-other	Traffic planning and management	Other	2901	13
traffic-landuse	Traffic planning and management	Land use planning to ensure sustainable transport facilities	221	1
traffic-shift	Traffic planning and management	Encouragement of shift of transport modes	3393	15
traffic-slow	Traffic planning and management	Slow modes (e.g. expansion of bicycle and pedestrian infrastructure)	646	3
traffic-public	Traffic planning and management	Effective improvement of public transport	1535	7
emissioncontrol	Combustion equipment control	Emission control equipment for small and medium sized stationary combustion sources/replacement of combustion sources	414	2
retrofitting	Combustion equipment control	Retrofitting emission control equipment to vehicles	147	1
LEF-other	Low emission fuels for small, medium and large scale stationary sources and in mobile sources	Other	1259	6
LEF-regulations	Low emission fuels for small, medium and large scale stationary sources and in mobile sources	Regulations for fuel quality	62	0

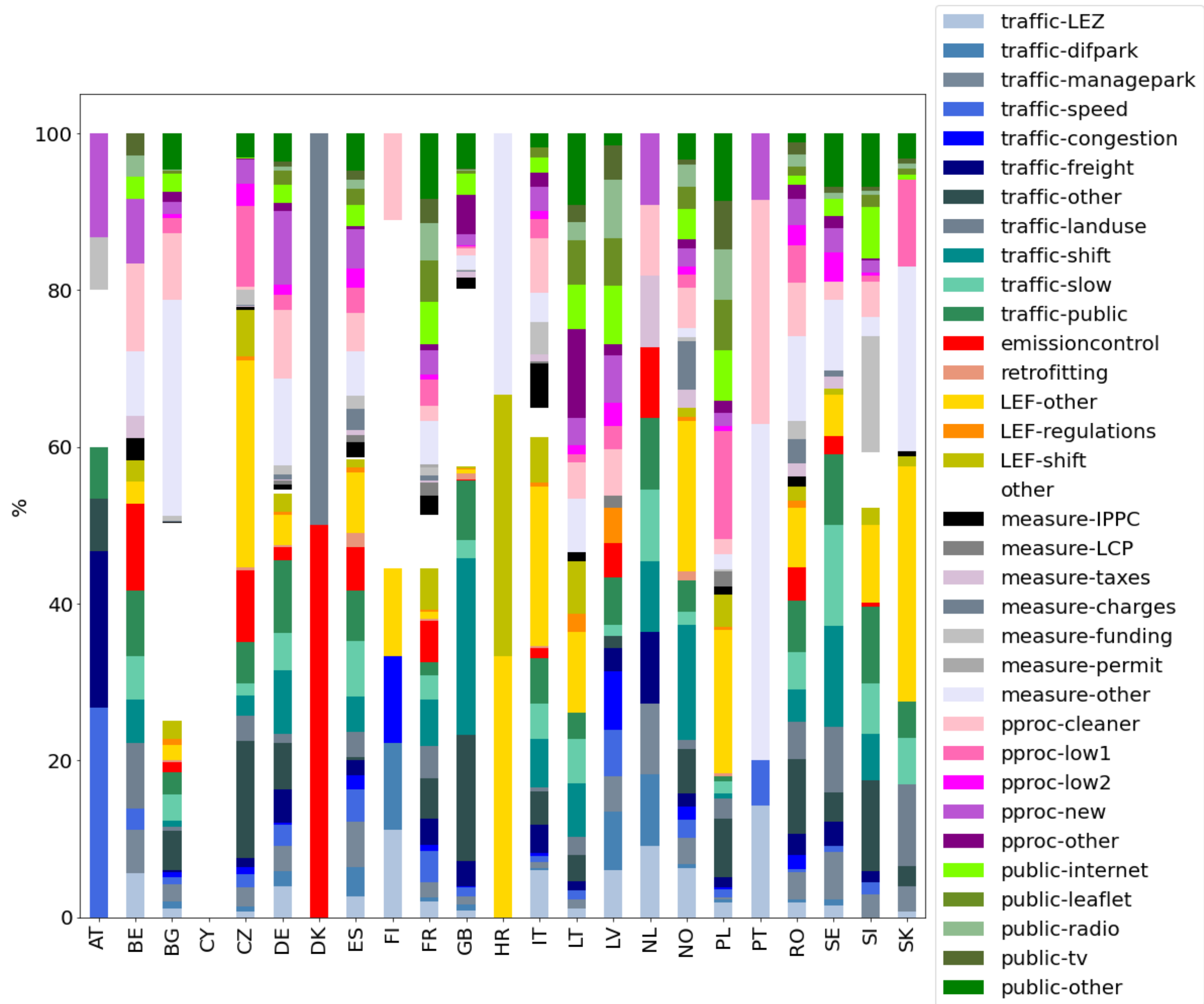
Notation	Category	Definition	Number of measures	Percentages
LEF-shift	Low emission fuels for small, medium and large scale stationary sources and in mobile sources	Shift to installations using low emission fuels	365	2
other		Other measure	3465	15
measure-IPPC	Permit systems and economic instruments	IPPC permits beyond BAT	279	1
measure-LCP	Permit systems and economic instruments	LCP permits and national plans beyond BAT	32	0
measure-taxes	Permit systems and economic instruments	Introduction/increase of environment taxes	130	1
measure-charges	Permit systems and economic instruments	Introduction/increase of environment charges	79	0
measure-funding	Permit systems and economic instruments	Introduction/increase of environmental funding	193	1
measure-permit	Permit systems and economic instruments	Tradable permit system	3	0
measure-other	Permit systems and economic instruments	Other measures	1070	5
pproc-cleaner	Public procurement	Cleaner vehicle transport services	581	3
pproc-low1	Public procurement	Low emission stationary combustion sources	520	2
pproc-low2	Public procurement	Low emission fuels for stationary and mobile sources	172	1
pproc-new	Public procurement	New vehicles, including low emission vehicles	575	2
pproc-other	Public procurement	Other	752	3
public-internet	Public information/education	Internet	544	2
public-leaflet	Public information/education	Leaflets	184	1
public-radio	Public information/education	Radio	97	0
public-tv	Public information/education	Television	71	0
public-other	Public information/education	Other	983	4
		Total	22619	

Note: ([a]) https://dd.eionet.europa.eu/vocabularyconcept/aq/measureclassification/

In Figure 2.13, we can see the types of measures in relative terms per country. Most countries have a wide variety of classification types and most countries have a high percentage of their "portfolio" in the "Traffic planning and management" category. This is especially the case for Austria, United Kingdom, the Netherlands, and Sweden, which have around 60 % of their measures in that category. This fits well with their assessment that the main reason of their exceedances is related to road transport emissions. Portugal and Finland declare all of their exceedance reasons being related with traffic (Figure 2.12 – top), but in the case of Portugal, they put more of their total effort in achieving a cleaner and newer vehicle fleet. This may be, because even if not declared as exceedance reasons by Finland, industrial sources are important as shown in the sectors affected by the measures (Figure 2.12 – bottom).

There is a large proportion of measures undefined (« Other measures » in Table 2.7) and United Kingdom for its absolute numbers deserves a mention in defining 2993 measures as "Other measures".

Figure 2.13: Measures classification in percentage for each country (see more information on measure classifications in Table 2.7)



Note: Colours in the figure are sequential and in the same order as the legend, but reverse: bottom-up whereas the legend is top to bottom. Note also that blues are for "Traffic planning and management"; yellows and reds are for "Combustion equipment control" and "Low emission fuels"; greys are "Permit systems and economic instruments"; pinks are "Public procurement"; greens are "Public information/education".

In Table 2.8 we show the number of exceedances reported by the countries ([10]) and the number of individual measures. In general, the majority of measures are managed locally (86 %), with the remaining being regional (11 %) and national (3 %). Bulgaria, Croatia, Latvia, Portugal and Slovakia declare that 100 % of their measures are administered at local level. The United Kingdom (GB) has introduced a large number of measures as the measures are recorded per council ([11]). United Kingdom reports around 80 % of its measures at local administrative level and the remaining on national level.

Table 2.8: Number of exceedances versus number of measures

Country	Number of exceedances	Number of measures
AT	3	15
BE	10	12
BG	103	1259
CZ	22	1551
DE	140	1403
DK	1	2
ES	66	342
FI	1	9
FR	23	179
GB	78	13222
HR	7	2
IT	79	334
LT	3	22
LV	4	5
NL	1	1
NO	16	112
PL	16	199
PT	13	35
RO	29	204
SE	4	105
SI	12	354

([10]) Defined as the records with exceedances set as true: « xcds »=True, even if no number was presented for the exceedance level or number.
([11]) For UK local governance system see e.g., https://www.politics.co.uk/reference/local-government-structure/

Country	Number of exceedances	Number of measures
SK	2	140
	Total	19507

Normally, the countries with the highest number of exceedances also have the highest number of measures (e.g., Bulgaria, Germany, United Kingdom, and Spain). Exceptions are Italy reporting a high number of exceedances, but relatively low number of measures; and Czechia with low number of reported exceedances and a high number of reported measures. Also worth of note is that 12 % of the measures reported are not linked to an exceedance. It is possible to report measures regarding pollutants for which the EU Member States are not obliged to report in the source apportionment dataflow (for example BaP). Other possible reason is that EEA member countries are trying to reach the WHO guideline concentration levels. The World Health Organization guidelines are lower than EU AQ standards[12].

In the following, we do the analysis for the pollutants with more measures records (in dataflow K): NO_2, PM_{10}, BaP (in PM_{10}), and $PM_{2.5}$ (Table 2.9).

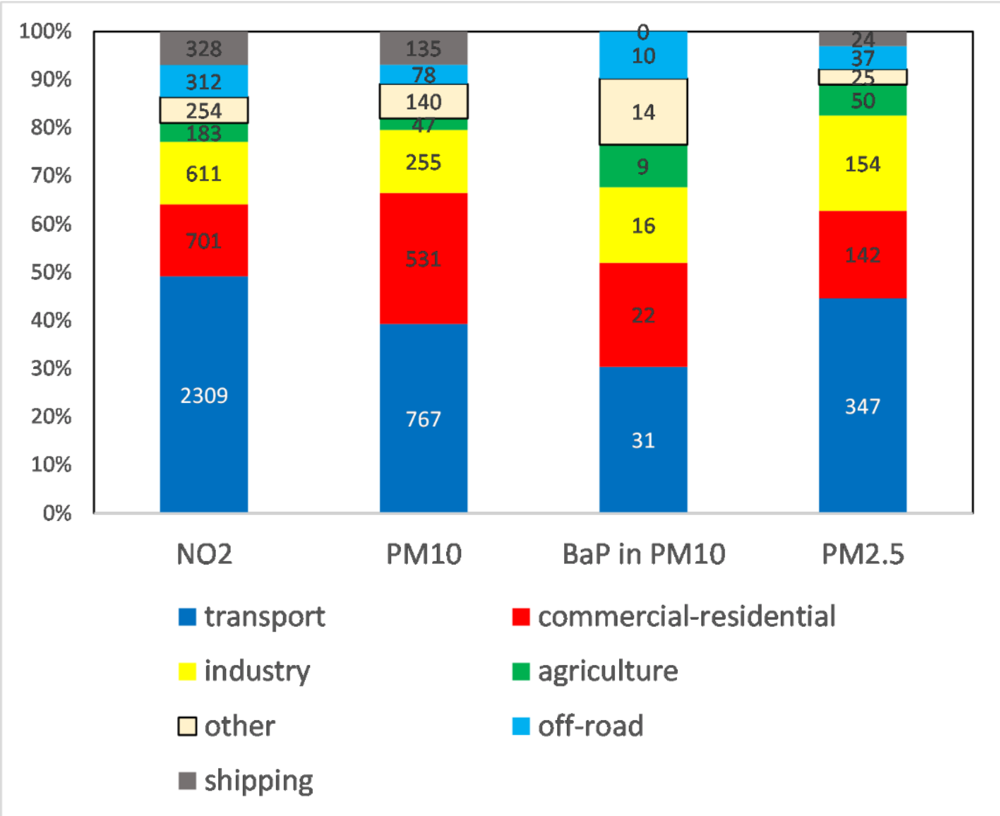
Table 2.9: Number of measures (dataflow K) per pollutant

Notation	Number of measures	Percentage
NO_2	4698	62
PM_{10}	1953	26
$PM_{2.5}$	779	10
O_3	-	-
BaP (in PM_{10})	102	1
Ni (in PM_{10})	14	0
Pb (in PM_{10})	3	0
Cd (in PM_{10})	-	-
SO_2	40	1
C_6H_6	1	0
	7590	

[12] Very recently the WHO updated their global air quality guidelines (AQG). Several of their updated AQG levels are even lower than the ones EEA member countries would have been considering. https://apps.who.int/iris/handle/10665/345329, Last accessed December 9, 2021.

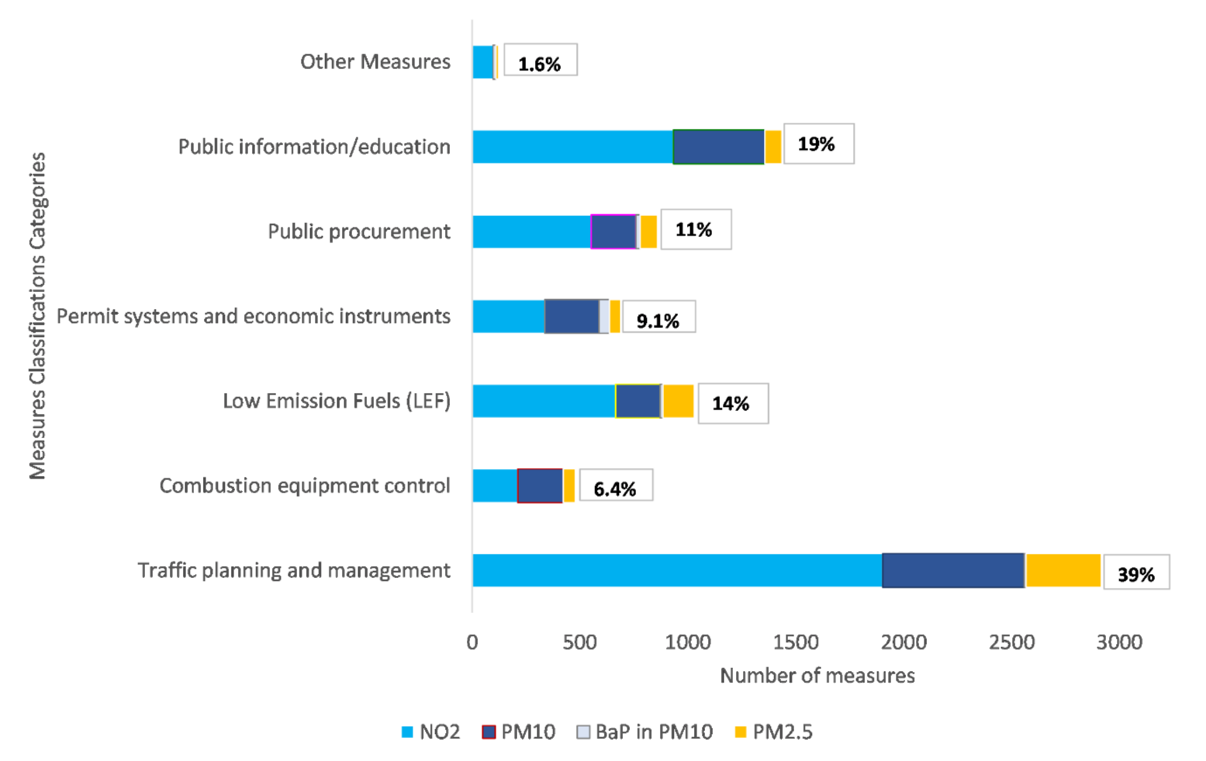
Figure 2.14 shows the sectors affected and respective number of reported measures for NO_2, PM_{10}, BaP, and $PM_{2.5}$. Most measures affect transport (relevant for all four pollutants). Regarding measures classification (Figure 2.15) «Traffic planning and management» is the category with most reported measures (39 %). It is especially relevant for NO_2, PM_{10} and $PM_{2.5}$, for which this category represents 40 %, 33 % and 45 % of all reported measures. Regarding the most reported types of traffic related measures (Figure 2.16), public transport improvement ("traffic-public") is a popular measure for all four pollutants. Other frequently reported measures include the management of parking spaces ("traffic-managepark"), the limitation of vehicles speed, the creation of LEZ (Low Emission Zones), and transport modal shifts ("traffic-shift" and "traffic-slow"). The differentiation of parking fees is preferred in NO_2 related action. In relative terms, a big proportion of measures on transport for $PM_{2.5}$ and BaP are not provided (« other » labels). Some of these traffic labelled measures also affect the commercial-residential sector, e.g., the measures denoted as traffic-LEZ, traffic-speed, and traffic-managepark.

Figure 2.14: Sectors affected by the measures (% and number of measures) for the pollutants with more submitted data in dataflow K



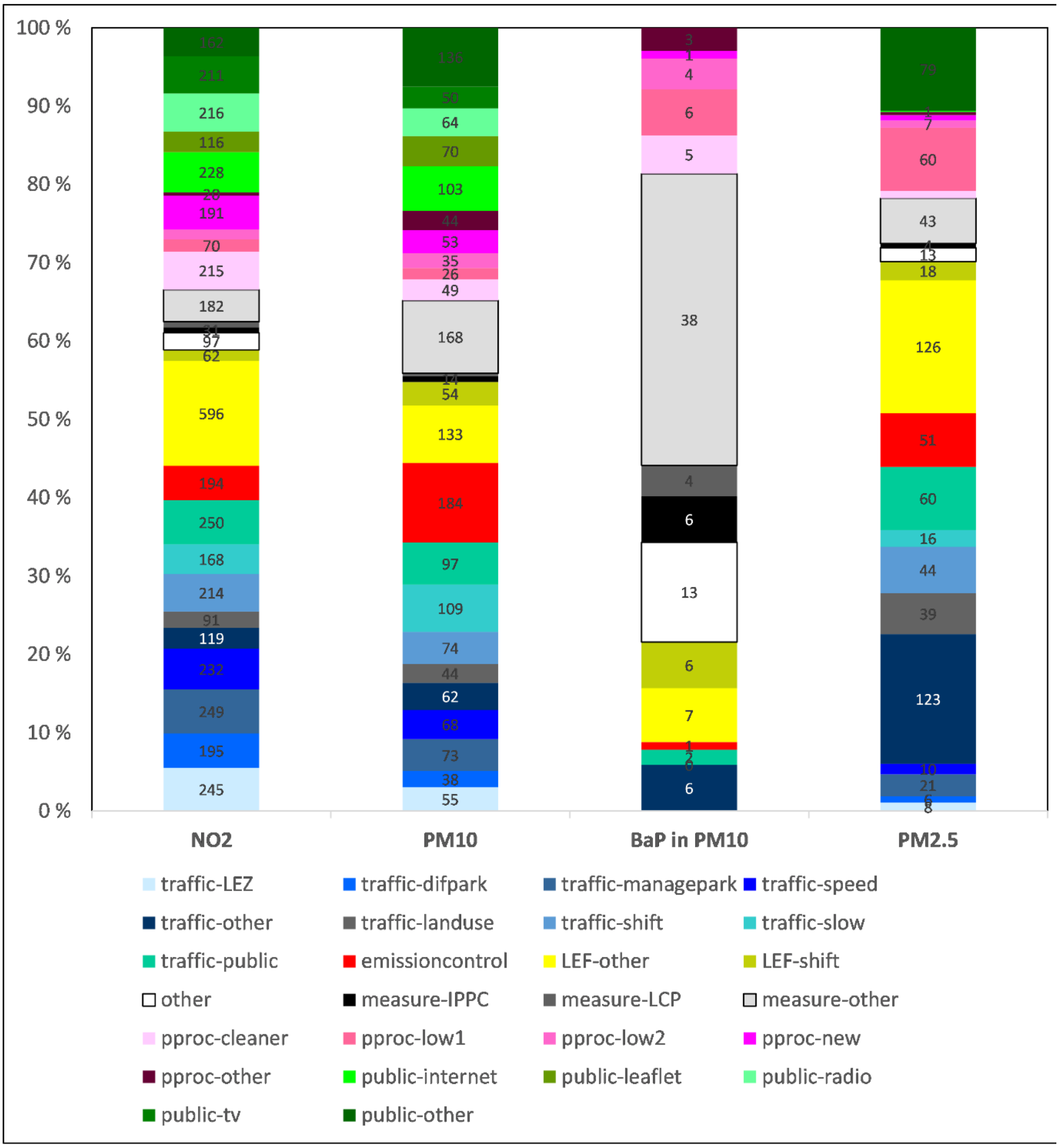
The second most affected sector is the commercial-residential for NO_2, PM_{10} and BaP, while industry is the second most affected sector for $PM_{2.5}$. The most frequently reported types of measures for the commercial-residential sector are within the categories « Low Emission Fuels » and «Public information/education ». The « Low Emission Fuels » category is important for all pollutants and « Public education/information » is especially important for NO_2 and PM_{10} (it is circa 20 % of their measures - Figure 2.17 ; the media chosen for this category is very varied as we can see in Figure 2.16 in green colors).

Figure 2.15: Measures categories for NO_2, PM_{10}, BaP, and $PM_{2.5}$.



The category « Public procurement » is important for all pollutants (pink colors in Figure 2.16), with especial relevance for action on low emission stationary combustion sources ("pproc-low1") in measures targeting NO_2 and $PM_{2.5}$. For PM_{10} and BaP, « Permit systems and economic instruments » is important, however, most measures are not defined (measures-other). For BaP this category is 47 % of its measures (Figure 2.17).

Figure 2.16: Measures classification (% and number of measures) per pollutant: NO_2, PM_{10}, $PM_{2.5}$, and BaP

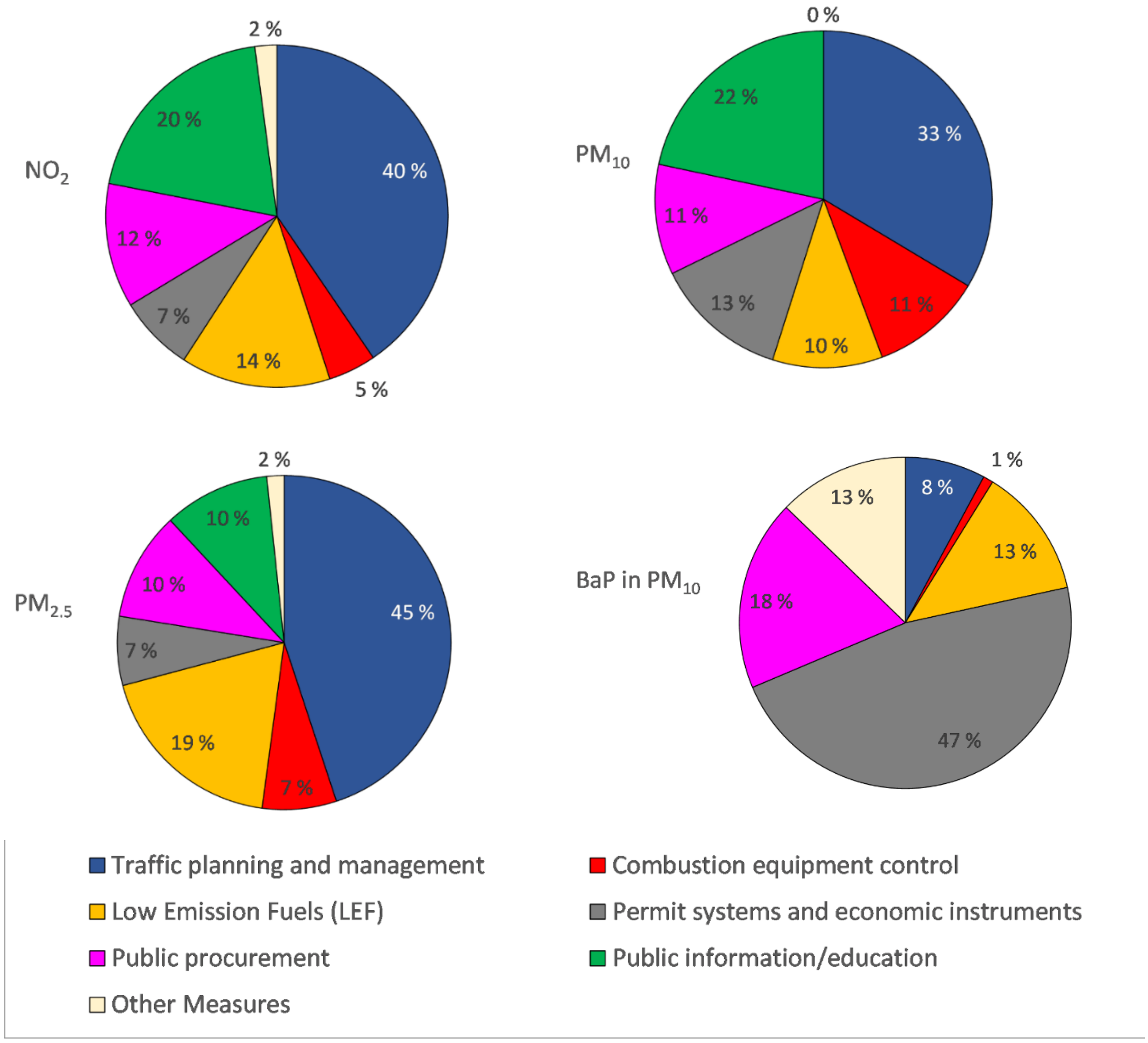


Notes: For this plot around 6 % of the less reported classifications was not included for NO_2, PM_{10}, and $PM_{2.5}$. Blues are for "Traffic planning and management"; red is "Combustion equipment control"; yellows are "Low emission fuels"; greys are "Permit systems and economic instruments"; pinks are "Public procurement"; greens are "Public information/education".

For exceedances of NO_2 and particles ([13]) standards related to Industrial emissions, the reported measures focus on controlling the combustion equipment ("emissioncontrol") and implementing « Low emission Fuels » ("LEF-other"). Even for this sector, public education and information is reported frequently for PM_{10} and NO_2.

([13]) particles = $PM_{2.5}$ and PM_{10}.

Figure 2.17: Measures classification categories fractions for each of the pollutants NO_2, PM_{10}, BaP, and $PM_{2.5}$



In agriculture, EEA member countries focus most often on "Low Emission Fuels" (NO_2 and $PM_{2.5}$) and secondly on « Publication information/education » (NO_2 and particles). As in previous sectors, measures targeting PM_{10} and BaP are classified as "Permit systems and economic instruments".

In terms of spatial scale for the implementation of the 7532 measures reported for these four main pollutants, 36 % are at local scale, 36 % at agglomeration or zone level, 22 % at town level (as part of a zone), and 5 % at national level (code list in Table 2.10).

Figure 2.18, we see the spread of the spatial scale per pollutant and per administrative level of management (Table 2.11). As we can see, most measures are being managed at the local and regional level. This is true for all the sectors affected by the measures (Figure 2.19). Local management especially implies local scale for NO_2 and $PM_{2.5}$, but also town scale is very important for PM_{10} and BaP.

Town scale measures for NO_2 are relatively important for the sectors of industry, shipping and off-road mobile machinery, whereas for PM_{10} it is for transport and commercial-residential (not shown). For NO_2, these two sectors are mostly affected by measures at local and aggregated level.

Table 2.10: Code list for the spatial scale of measures ([a])

Notation	Further information		Number of measures with pollutants identification	Percentage
national			363	5
town	Town as part of a zone		1696	22
zone_agg	Zone/agglomeration		2723	36
local			2750	36
		Total	7532	

Note: ([a]) https://dd.eionet.europa.eu/vocabulary/aq/spatialscale

Table 2.11: Code list for the administrative level of measures ([a])

Notation	Number of measures with pollutants identification	Percentage
national	481	6
regional	2957	39
local	4094	54
Total	7532	

Note: ([a]) https://dd.eionet.europa.eu/vocabulary/aq/administrativelevel.

Figure 2.18: Spatial scale and administrative level in which the measures are managed for the pollutants (clockwise): NO_2, PM_{10}, BaP in PM_{10} and $PM_{2.5}$. Code lists are in Tables 2.10 and 2.11

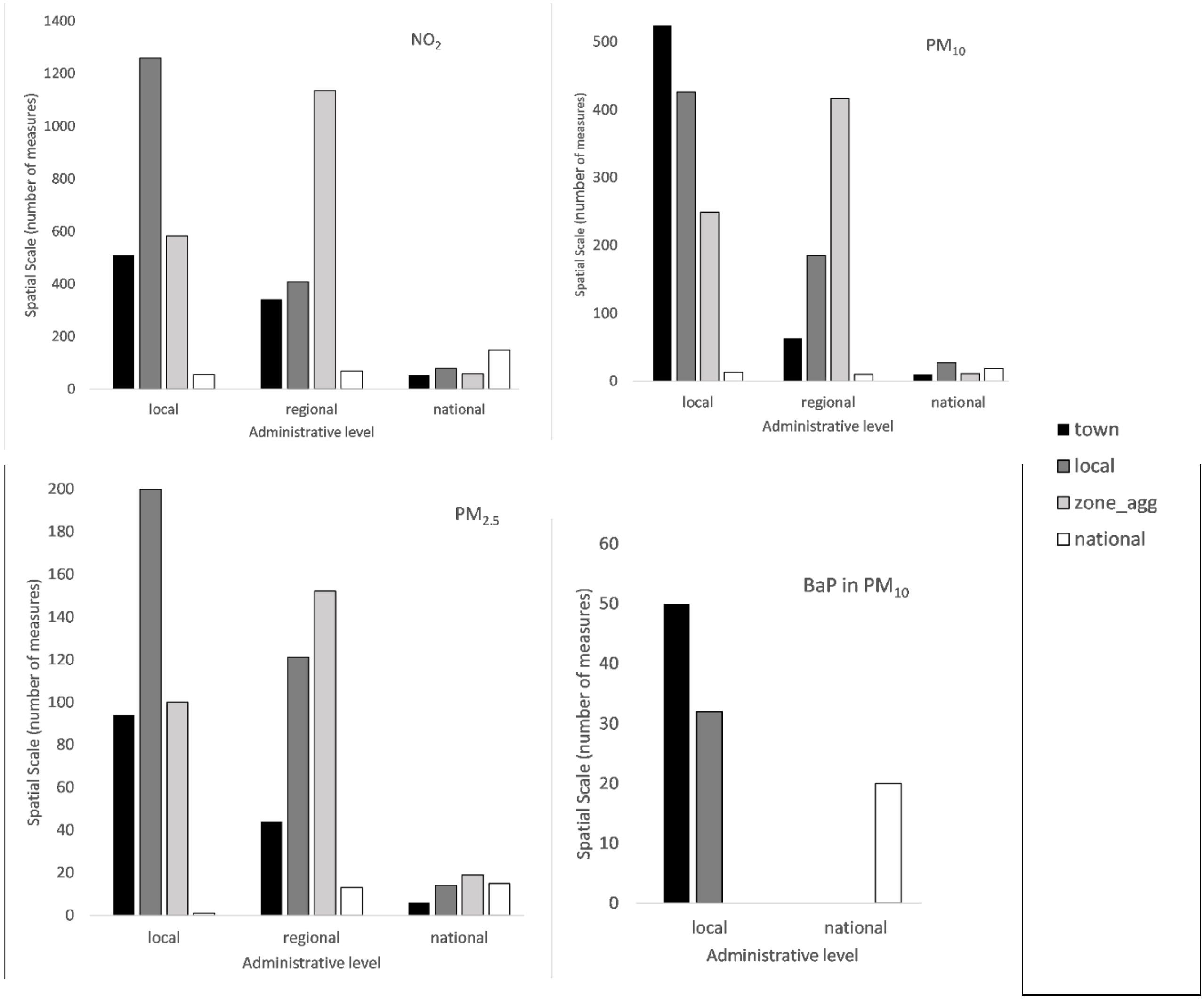
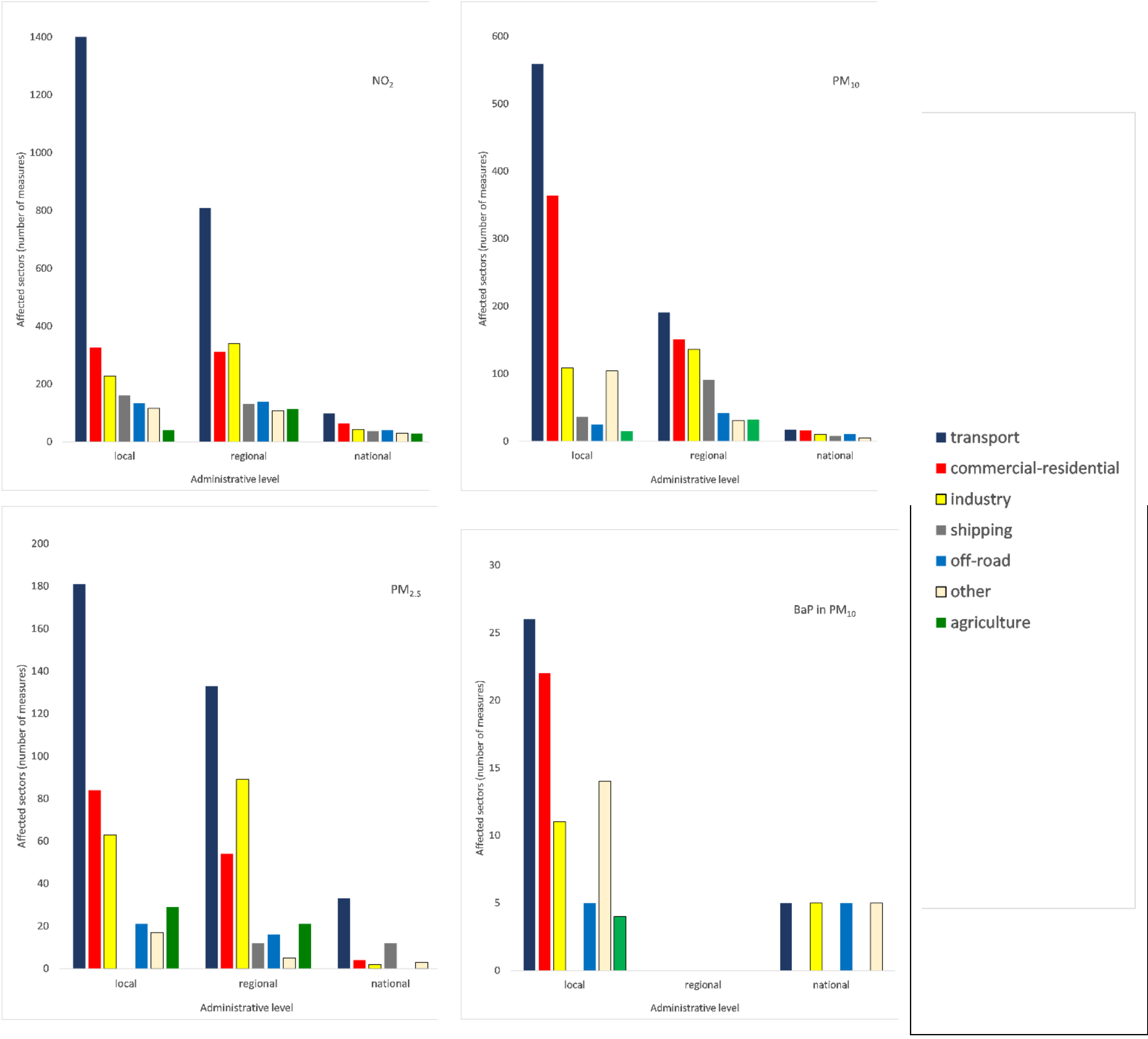


Figure 2.19: Sectors affected by the measures and administrative level in which the measures are managed for the pollutants (clockwise): NO_2, PM_{10}, BaP in PM_{10}, and $PM_{2.5}$.



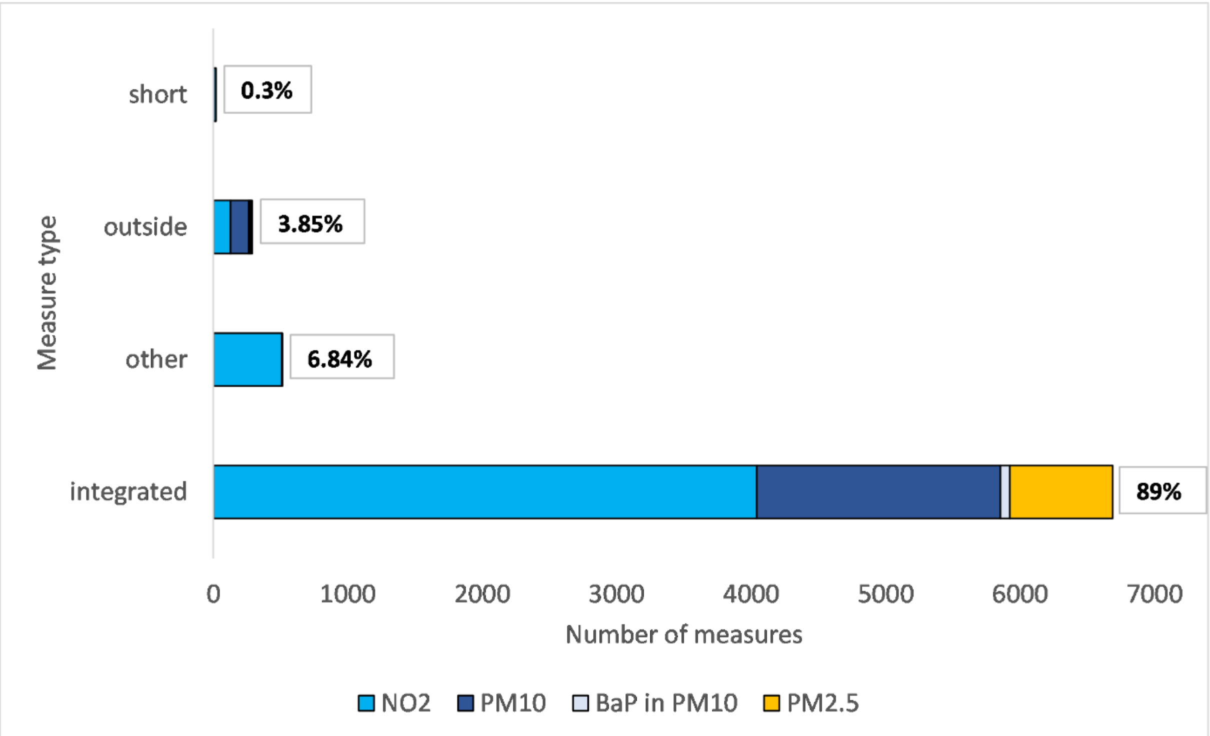
Relative to the type of measures (Table 2.12) we see that most measures reported are « integrated » (89 %) (Figure 2.20). An integrated measure means that it is included in an AQ plan. Measures outside of Air quality or Short term Action Plans constitute around 4 % of the total. Close to 7 % of the measures type is not determined (reported as "other"). None of the analysed reported measures related to pollutants NO_2, PM_{10}, BaP, and $PM_{2.5}$ were managed in coordination with other EEA member countries or aimed to the protection of sensitive groups.

Table 2.12: Code list for measures types ([a])

Notation	**Further information**	**Number of measures with pollutants identification**	**Percentage**
coordinated	Coordinated measure with other Member States	0	0
sensitive	Measure geared at the protection of sensitive groups	0	0
short	Short-term measure	20	0
outside	Measure outside of Air quality or Short term Action Plan	289	4
other	Other	514	7
integrated	Measure integrated in Air Quality Plan	6689	89
	Total	7512	

Note: ([a]) https://dd.eionet.europa.eu/vocabulary/aq/measuretype.

Figure 2.20: Measures type (%) per pollutants NO_2, PM_{10}, BaP, and $PM_{2.5}$. (Code list in Table 2.12)



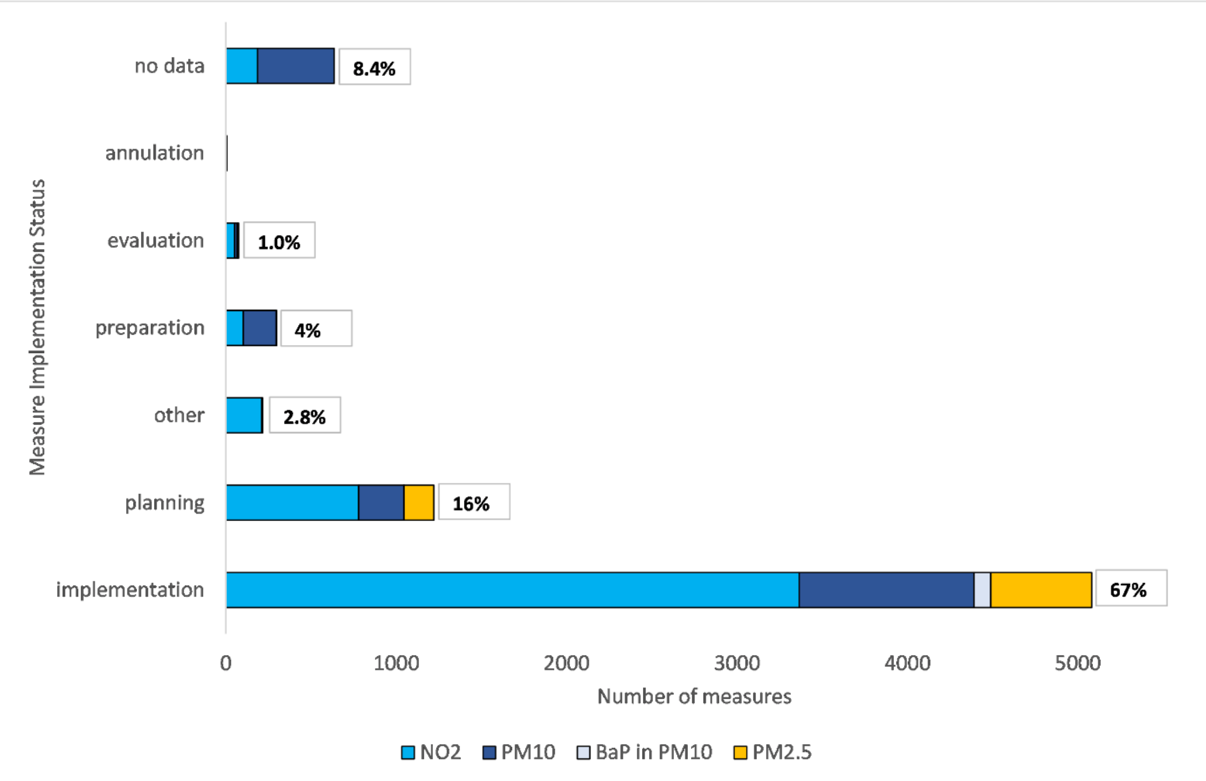
In terms of implementation status (Table 2.13 and Figure 2.21), 67 % of the measures for NO_2, PM_{10}, BaP, and $PM_{2.5}$ exceedances were under implementation at the reporting time. There is a relevant number of reported measures without a implementation status (11 %) and 16 % were in the planning stage.

Table 2.13: Code list for measures implementation status ([a])

Notation	Number of measures with pollutants identification	Percentage
annulation	5	0
evaluation	76	1
preparation	299	4
other	215	3
planning	1221	18
implementation	5081	74
Total	6897	

Note: ([a]) https://dd.eionet.europa.eu/vocabulary/aq/measureimplementationstatus.

Figure 2.21: Measures implementation status (%) per pollutant NO_2, PM_{10}, BaP, and $PM_{2.5}$. (Code list in Table 2.12)



In terms of the measures duration (time scale), 62 % of the measures are expected to last more than one year (long term) (Table 2.14). However, there seems to be some inconsistencies between the measures time scale and their reported « planned start date » and « planned end date » (Figure 2.22). For example, for NO_2 and $PM_{2.5}$, more measures are expected to last more than one year when the data provider reported the specific dates than when inserting the respective notation from Table 2.14. It is expectable for the reporters to have less information on very specific dates than a general knowledge on duration, however for $PM_{2.5}$ that is not the case.

Table 2.14: Code list for measures time scale ([a])

Notation	Further information	Number of measures with pollutants identification	Percentage
long	long term (more than 1 year)	4656	62
medium	medium term (1 year)	970	13
short	short term (less than 1 year)	1349	18
unknown	unknown timescale	557	7
	Total	7532	

Note: ([a]) https://dd.eionet.europa.eu/vocabulary/aq/timescale.

In Figure 2.22, to the right, we can see for each pollutant the distribution of time durations of the measures considering « planned start date » and « planned end date ». The first column regards the unknown duration measures, the second column are the short and medium measures and the following black columns are the distribution of the measures that last years. We can see that the most frequent are measures lasting 5-6 and 8-9 years.

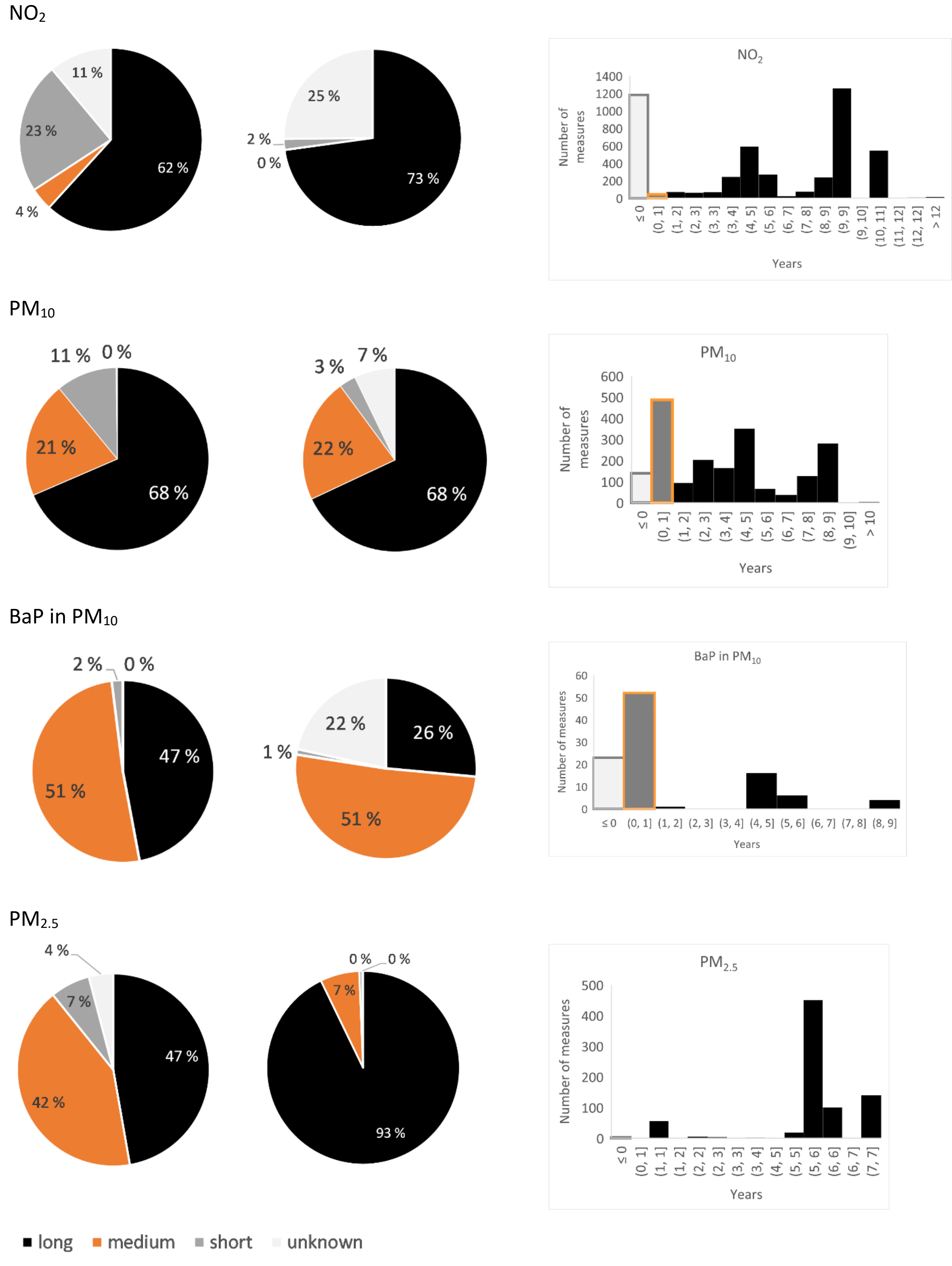
2.4 Outcome of the plans and measures for compliance achievement

There is one mandatory data class in dataflow K that could, in principle, be used to assess the estimated outcomes of the reported AQ plans and measures in terms of achievement of compliance with the AQ standards: Reduction in annual emissions due to the applied measure(s). However, the coverage of this data class is very low with only 3 % of the measures having this information. In addition, there is no requested information on the pollutant(s) to which the reported changes in emissions refer. The air pollutants in exceedance are not always primarily emitted, as e.g., particulate matter, NO_2 and O_3. They may be formed in the atmosphere due to chemical reactions of its emitted percursors (EEA, 2020). This means that for every reported reduction in emissions it is necessary to report the correspondent pollutant.

The current data in the system does not allow an assessment of the expected impact of the AQ plan and measures on emissions nor on ambient air concentrations (completeness of these data classes is lower than 4 % - see Annex 2 for available data) of the target pollutants. Thus, it is not possible to assess whether an AQ plan is likely to ensure compliance by the reported date.

Figure 2.22: Measures implementation time scale per targeted pollutant (NO_2, PM_{10}, BaP in PM_{10}, and $PM_{2.5}$)

Based on Code List on Table 2.14	Based on Planned Start Date and End Date	Distribution of the measures according to their planned duration



3 Conclusions

The European Air Quality Directive (2008/50/EC) sets the obligation of developing and implementing Air Quality Plans with measures to improve air quality in those zones and agglomerations where ambient air concentrations exceed the EU standards, and to maintain it where it is good. This document provides a first analysis of the Air Quality Plans submitted officially in the period 2014 to 2020 by EEA member countries ([14]) through the European Environment Agency (EEA) e-reporting system following the framework (2011/850/EU) for dataflows H (plans), I (source apportionment), J (scenario evaluation) and K (measures). Measures to improve air quality have been developed and implemented throughout Europe since 1996 and form a core element in the management of air quality.

In the period 2014 – 2020, 23 member countries submitted at least one air quality plan. Most countries focus their plans on traffic related pollutants NO_2 and/or PM_{10} (the only pollutants considered by Austria, Denmark, United Kingdom, Latvia, Netherlands, Portugal, Sweden, and Slovenia), however in total, 22 pollutants are targeted. Czechia and Italy are the two countries that target most pollutants. More than half of air quality plan records (557 records) have status "implemented" and a significant number have status "under revision" (158) or "first year of implementation" (141). The rest of recorded plans show status "in preparation" (40), "in formal adoption process (29), "ended with no foreseen revision" (18) or "under implementation" (one). This could indicate that while most plans were successful, a significant number required further attention. When interpreting these data, it should also be considered that the start of the attainment dates vary between pollutants (from 2005 for e.g. SO_2 to 2015 for e.g. $PM_{2.5}$), and that countries could also have applied for an extension.

Most reported exceedances identified per pollutant are for NO_2 (63 %), and for PM_{10} (32 %), the remaining five per-cent is for $PM_{2.5}$, ozone, nickel (in PM_{10}), lead (in PM_{10}), cadmium (in PM_{10}), SO_2 and benzene (in descending order).

An analysis of what are the reasons for exceedances (based on available data in dataflow I ([15])) shows traffic as the main sector leading to exceedances in 64 % of records (and 100% for Austria, Denmark, Finland, the Netherlands , United Kingdom, and Portugal, in line with the pollutants targeted), followed by domestic heating (14 %, most prominent in Bulgaria, Poland, Romania, Slovenia and Slovakia). Local industry (10 %) is an important reported source in Belgium, but also important in a number of other countries (e.g., Spain, France, , Poland). The category "Other" (8%) is used in Bulgaria, Spain, Croatia, Italy, Poland and Sweden; this category when further information is given could comprise a variety of sources including meteorology, agricultural residue burning, harbour activity or shipping.

The large majority of the exceedances occurred in urban areas (65 %) followed by suburban areas (21 %), while 14% of the exceedances addressed in the plans occurred in rural areas. The air quality plans covering PM_{10} exceedances cover all area categories from rural to urban. NO_2 also covers all areas, however the expressive majority is in suburban and urban areas. For $PM_{2.5}$ exceedances the plans cover only suburban and urban areas. Ozone is targeted in rural-regional, rural-remote areas and urban areas, as the highest concentrations often occur in rural areas with important negative impacts on crops and forests and ozone standards for the protection of human health are also regularly exceeded in urban and suburban areas (EEA, 2020).

The estimated attainment date (reported in dataflow J) with the implementation of the reported measures, show that for 87 % of the plans compliance should have been attained by 2020.

([14]) EEA-32_2020 plus United Kingdom.

([15]) Null data is ignored for the following percentages.

Most measures target exceedances of NO_2 (62 %), PM_{10} (26 %) and $PM_{2.5}$ (10 %), and there are measures targeting exceedances of standards of BaP, Ni and Pb (all in PM_{10}) and SO_2. In one case the measure is relevant for C_6H_6.

Information about what measures are planned/implemented to achieve attainment is broadly in line with the reasons of exceedance. The main sectors that are targeted are transport (70%), commercial-residential (12 %) and industry (8 %). There are also measures in agriculture, shipping, and regarding off-road mobile machinery. An exceedance normally has several source contributors. The plan designers show the intention to act on these less important sources, even if not referred explicitly.

The most common measures adopted for NO_2, PM_{10}, BaP and $PM_{2.5}$ are in the category «Traffic planning and management» (39 % of the measures respecting these four pollutants), with more expression for NO_2 (40 % of all the measures for NO_2 exceedances), $PM_{2.5}$ (45 %), and PM_{10} (33 %). The next category is "Public information/education" (19 % of all measures for the four major pollutants) consisting of 22 % of the measures for PM_{10}, 20 % for NO2 and 10 % for PM2.5. The third most important category is the use of "Low emission fuels" (14 % of all measures for major pollutants), being the second most important category for measures targeting $PM_{2.5}$ exceedances (19 %). 11 % of all measures for NO_2, PM_{10}, BaP and $PM_{2.5}$ fall under the "Public procurement" category, and this category is the second most important for measures targeting BaP exceedances (18 %). 9 % of the measures for the major four are in the "Permit systems and economic instruments" category and this is the most important category for measures targeting BaP (47 %) and the third most important for PM_{10} measures (13 %). 6 % of measures targeting NO_2, PM_{10}, BaP and $PM_{2.5}$ belong to the "Combustion equipment control" category. Most countries use a wide variety of classification types, even if they have a high percentage of their measures' "portfolio" in the "Traffic planning and management" category. This fits well with the countries' assessment of the main reasons of the exceedances.

Even if the effectiveness of the plans is not directly linked to the number of reported measures, it is interesting to note that the countries with the highest number of exceedances also indicate the highest number of measures (e.g., Bulgaria, Germany, United Kingdom, and Spain). Exceptions are Italy reporting a high number of exceedances, but relatively low number of measures, and Czechia with low number of reported exceedances and a high number of reported measures. 12 % of the reported measures are not linked to an exceedance. It is possible to report measures regarding pollutants for which EU Member States are not obliged to report in the source apportionment dataflow (for example BaP). Other possible reason is that EEA member countries are trying to reach the WHO guideline concentration levels which are lower than EU AQ standards.

The majority of all measures (86 %) are managed at a local level, with the remaining being regional (11 %) and national (3 %). Bulgaria, Croatia, Latvia, Portugal and Slovakia declare that 100 % of their measures are administered at local level.

The measures target the relevant emission sectors for the pollutants, and again, the information is mostly consistent across data flows. Perhaps of note is that the relatively few measures that target the agriculture sector focus on «Low emission fuels » and « Public information/Education ». Measures targeting BaP are focused in "Permit systems and economic instruments".

The reported data is mostly consistent and the type of measures seem appropriate to target the exceedances of the specific air pollutants and their main source sectors and reason of exceedance. Nevertheless, the reported data is not sufficient to assess the effectiveness of the plans and measures and the likelihood of attainment of the standards within the estimated attainment year.

4 References

EEA, 2020, *Air quality in Europe — 2020 report*, EEA Report No 09/2020, European Environment Agency (https://www.eea.europa.eu/publications/air-quality-in-europe-2020-report)

EEA, 2019, *Air quality in Europe – 2019 report*, EEA Report No 10/2019, European Environment Agency (https://www.eea.europa.eu/publications/air-quality-in-europe-2019)

ETC/ACM, 2012, Progressing to cleaner air —evaluating non-attainment areas, ETC/ACM Technical paper 2012/10.

ETC/ACM, 2013a, *Air Implementation Pilot —Workshop on measures*, ETC/ACM Technical paper 2013/5.

ETC/ACM, 2013b, *Air Implementation Pilot —Management practices* (update 2013), ETC/ACM Technical paper 2013/7.

ETC/ACM, Jaume Targa, Tony Bush, Barbara Magagna and Lorena Banyuls. August 2017, *USER GUIDE TO XML & DATA MODEL FOR AIR QUALITY PLANS (H-K)*.

EU, 2004, Directive 2004/107/EC of the European Parliament and of the Council of 15 December 2004 relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air (OJ L 23, 26.1.2005, p. 3-16) (https://eur-lex.europa.eu/eli/dir/2004/107/oj)

EU, 2008, Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe (OJ L 152, 11.6.2008, p. 1-44)

EU, 2011, Commission Implementing Decision No 2011/850/EU of 12 December 2011 laying down rules for Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council as regards the reciprocal exchange of information and reporting on ambient air quality (OJ L 335, 17.12.2011, p. 86-106)

Annex 1
Import status of XML files in dataflows H-K considered in the present report

After the process of importing the XML files to the European Environment Agency (EEA) database Airquality_H2K_Dev and further quality control (dbo scheme, i.e. checking appropriate datatypes and making all possible links) we had 4862 XML files. 71 XML files failed to be imported (due to the datatypes inserted being wrong) and 1323 XML files were skipped, because corresponding files with newer content replaced these.

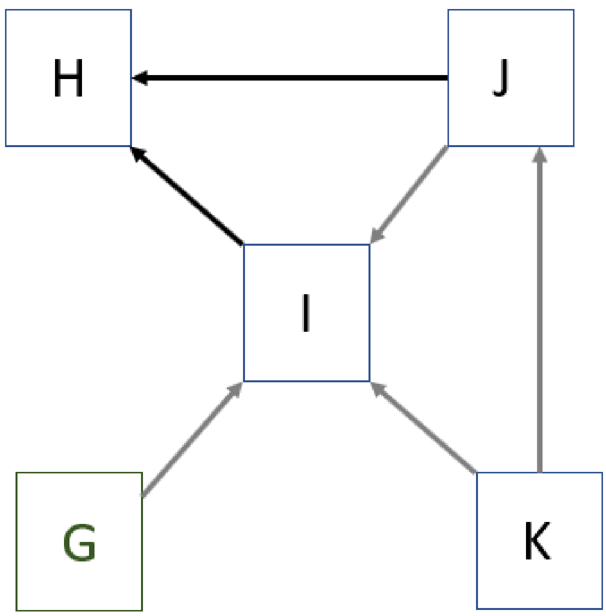
Annex 2
Overview of available data

The data is reported in XML files per country via the EIONET CDR system ([16]). The XML files for dataflows H to K were imported into the European Environment Agency (EEA) database Airquality_H2K_Dev using the dedicated H-K import application ([17]). All data is imported into the database, including metadata such as, for example, history of imports and versions (this is the so-called raw scheme). In a further set of rules in the database, restrictions are imposed, which means checking appropriate datatypes and making all possible links (the so-called dbo scheme). At this point, the data is stored in various CSV file sheets and each record (each row) in each dataflow contains a primary identifier.

When links are possible, secondary identifiers are also created (for example in dataflow I linked to dataflow H, the CSV file sheets will contain primary identifiers for I records and secondary identifiers for H records). The relationships between the dataflows are shown in Figure A2.1. Dataflow I (Source apportionment) has a direct connection to all other dataflows analysed in this report. Dataflow H (AQ Plans) has direct connection to I (Source apportionment) and J (Evaluation). Thus, to have information in K (Measures) on the AQ plans we will need to use more than one link, be it through J or I. The links are created between records that have the exact same content in the data classes that refer to the country, to the reporting year and to the "localid". The "localid" is a data class created automatically when the reporting of an AQ plan is done through the Plans and Programmes e-Reporting System (PaPeRS), but it is supposed to be changed by the data provider and taken care of during the lifecycle of the AQ plan and its data.

The data is extracted from databases H-K and G to CSV files using specific SQL queries. In the CSV files, each row is one record with one primary identifier. Each column is one class of data or metadata. The single piece of information characterized by one record and one class is a data value.

Figure A2.1: Relations between the analysed dataflows



([16]) https://cdr.eionet.europa.eu/
([17]) This application was developed at NILU (Norwegian Institute for Air Research) for doing the referred task especially for dataflow H-K.

In Table A2.1, we present for the AQ plans identifiers, how many exist as primary in dataflow H and as secondary in the other dataflows of H-K after linking. The AQ plans identifiers do not point to a unique AQ plan, but to a unique record. For example, the 14 AQ plans identifiers for Portugal point to two AQ plans. This happens, because the expected recording of each AQ plan with a unique localid is not preserved by the reporters. This allows for the data connected to one AQ plan to be updated at a later time. Changes are registered in a boolean class called “Change” and then a class for “Change description”.

Table A2.1: Existing identifiers for Air Quality Plans, in each dataflow, per country

	Country	Number of AQ plans identifiers in DataFlow H (AQ plans)	Number of AQ plans identifiers in DataFlow I (Source Apportionment)	Number of AQ plans identifiers in DataFlow J (Evaluation)	Number of AQ plans identifiers in Dataflow K (Measures)
1	AT (Austria)	3	3	3	2
2	BE (Belgium)	7	5	4	4
3	BG (Bulgaria)	91	83	91	83
4	CY (Cyprus)	-	5 ([a])	-	-
5	CZ (Czechia)	42	22	22	22
6	DE (Germany)	501	134	109	56
7	DK (Denmark)	1	1	1	1
8	ES (Spain)	56	46	49	45
9	FI (Finland)	6	1	1	1
10	FR (France)	78	15	11	13
11	GB (United Kingdom)	2	2	2	2
12	HR (Croatia)	5	0	0	0
13	IT (Italy)	35	17	9	0
14	LT (Lithuania)	3	3	3	3
15	LV (Latvia)	7	4	4	4
16	NL (Netherlands)	1	1	1	1
17	NO (Norway)	15	11	6	6
18	PL (Poland)	33	33	31	33
19	PT (Portugal)	14	6	-	4
20	RO (Romania)	18	17	6	15
21	SE (Sweden)	5	5	5	5
22	SI (Slovenia)	12	5	-	5
23	SK (Slovakia)	16	1	-	1
	TOTAL	951	420	358	306

([a]) Count of Source Apportionment primary identifiers.

EEA member countries which have no reported data in dataflow H-K are: Estonia, Greece, Hungary, Iceland, Ireland, Liechtenstein, Luxembourg, Malta, Switzerland, and Turkey.

For Cyprus it was not possible to create AQ plans identifiers, primary or secondary, and there is no data inserted in other dataflows (« - « in Table A2.1), except for the Source Apportionment. No data is also the case of Portugal, Slovenia, and Slovakia in dataflow J (Evaluation). In other cases, there is a wealth of data in the respective dataflow, but there is no connection to H (« 0 » - indicated as zero in Table A2.1): this is the case for Italy in dataflow K (measures), and overall for Croatia.

In the following subsections we will show the completeness of the data classes in the CSV files produced at NILU for dataflow H-K. This accounting is performed for data classes reported as numerical values, dates, and coded lists (that is, there is a standard code list). Also we do accounting for the dates listed in Commission Implementation Decision 2011/850/EU.

In Table A2.2, we show good completeness of data for dataflow H, which is the most complete in H-K. The field with less data values is “Adoption date”, but this does not have to be a miss, because the AQ plan may be in preparation or in the adoption stage at the time of record. The number of data values in “Pollutants covered” is higher than the AQ plans records, because it is usual for an AQ plan to cover more than one pollutant. We shaded in grey the fields that can have multiple choices. In this way, we make clear why a field may have much larger amount of data values than the other classes in the same dataflow, but be less complete. This means that primary identifiers are missing. This is made more visible in Table A2.3 for availability of data in the source apportionment of the exceedance situations.

We also denote the “voluntary” classes as defined in « User Guide to XML & Data Model for Air Quality Plans (H-K) » with an asterisk. As is shown, the data completeness in dataflow I is low, especially for the generality of the data classes with source apportionment information, that is, the contribution of different sources to the exceedances. The classes more complete are the ones relative to the year for which the exceedance is assessed (86 % of the source apportionment identifiers), the contribution of the regional background total to the exceedance (81 %) and the classification of the area (91 %) in urban, suburban, rural. Apparently, it is not easy for the EEA member countries to accomplish the level of detailed source apportionment requested in the legislation.

Table A2.2: Completeness of data classes in Dataflow H (AQ plans). Shaded grey are classes that allow multiple choices per plan

Classes	# data values	Completeness (%)	Classes	# data values	Completeness (%)
Adoption date	734	83	Status (code)	944	99.6
Timetable	944	99.5	Pollutants covered (code)	1874	100
Reference year of first exceedance	947	99.8	Protection target (code)	1872	100

*Table A2.3: Completeness of data classes in Dataflow I (Source Apportionment). *Voluntary class. Ꭓ Conditional to their actual existence or existence in other location of the database. Shaded grey are classes that can have multiple choices per source apportionment*

Class	# data values	Completeness (%)	Class	# data values	Completeness (%)
Reference year ([a])	632	86	Lcl_inc: traffic	331	45
Reg_bkg: total ([b])	589	81	Lcl_inc: industry ([e])	92	13
Reg_bkg: ms ([c])	235	32	Lcl_inc: agriculture	22	3
Reg_bkg: transboundary	143	20	Lcl_inc: commercial and residential	132	18
Reg_bkg: natural	33	4	Lcl_inc: shipping	15	2
Reg_bkg: other	250	34	Lcl_inc: off-road mobile machinery	43	6
Urb_bkg: total ([d])	512	70	Lcl_inc: natural	9	1
Urb_bkg: traffic	356	49	Lcl_inc: transboundary	6	0.8
Urb_bkg: industry ([e])	317	43	Lcl_inc: other	140	19
Urb_bkg: agriculture	38	5	Exceedance level Ꭓ	418	57
Urb_bkg: commercial and residential	344	47	Exceedance number Ꭓ	194	26
Urb_bkg: shipping	75	10	Adjustment type Ꭓ	201	27
Urb_bkg: off-road mobile machinery	139	19	Exceedance area surface Ꭓ	127	17
Urb_bkg: natural	33	4	Road length Ꭓ	248	34
Urb_bkg: transboundary	16	2	Exposed population Ꭓ	299	41
Urb_bkg: other	346	47	Exposed areaᎢ	120	16
Lcl_inc: total ([f])	438	60	Area classification (code)	931	91
			Exceedances reasons* (code)	714	67

([a]) Year for which exceedance has been assessed.
([b]) Reg_bkg=Regional background.
([c]) ms = from within Member State.
([d]) Urb_bkg = Urban background.
([e]) Includes heat and power production.
(f) Lcl_inc = Local increment.

Dataflow J completeness is presented in Table A2.4. The intention of this dataflow is to assure that the measures planned will be successful in eliminating the exceedance situation(s). As we have seen previously, four member countries have inserted no data in dataflow J. For the other member countries, the completeness is good for the mandatory classes (dates and emissions information), bad for concentration information and mediocre for exceedance information. This probably points to numerical modelling limitations.

*Table A2.4: Completeness of data classes in Dataflow J (Evaluation). *Voluntary class*

Classes	# data values	Completeness (%)	Classes	# data values	Completeness (%)
Reference year ([a])	567	100	Attainment year	567	100
Baseline emissions	524	92.4	Projection emissions	503	88.7
Baseline concentrations*	306	54	Projection concentrations*	313	55.2
Baseline exceedances*	74	13.0	Projection exceedances*	63	11.1

([a]) Year from which projection starts

Table A2.5 shows the number of data values and completeness relative to the measures. The number of data values is much larger in this dataflow than the others showing the wealth of measures being implemented. The classes that characterize the measures have very good availability of data, however the classes that evaluate the effect of the measures (be it economically or on pollution) have very poor coverage. It is understandable that an evaluation of the impact of a specific measure on concentrations is not available. The same low completeness is also understandable for information that implies that the measure has ended like final cost, implementation actual end date, and emissions reduction. However, low completeness also exists for the actual start date of the measures, which should be available for the 65 % of the measures reported as in implementation.

*Table A2.5: Completeness of data classes in Dataflow K (Measures). *Voluntary class. Ӽ Conditional to their actual existence. Shaded grey are classes that can have multiple choices per measure*

Classes	# data values	Completeness (%)	Classes	# data values	Completeness (%)
Measure type (code)	19503	~100	Implementation planned start date	19034	97.6
Measure classification (code)	22619	100	Implementation planned end date	19094	97.9
Measure timescale (code)	19491	99.9	Implementation actual start date	757	3.88
Administration level (code)	20976	100	Implementation actual end date	640	3.28
Affected sectors (code)	20993	~100	Date when measure is expected to take full effect	2762	14.2
Spatial scale (code)	21180	100	Emissions reduction	638	3.27
Estimated cost	1195	6.13	Emissions units	701	3.59
Final cost*	89	0.46	Expected impact on concentrations	456	2.34
Currency Ӽ	1949	9.99	Expected impact on exceedances	128	0.66
Implementation status*	18616	95.4			

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