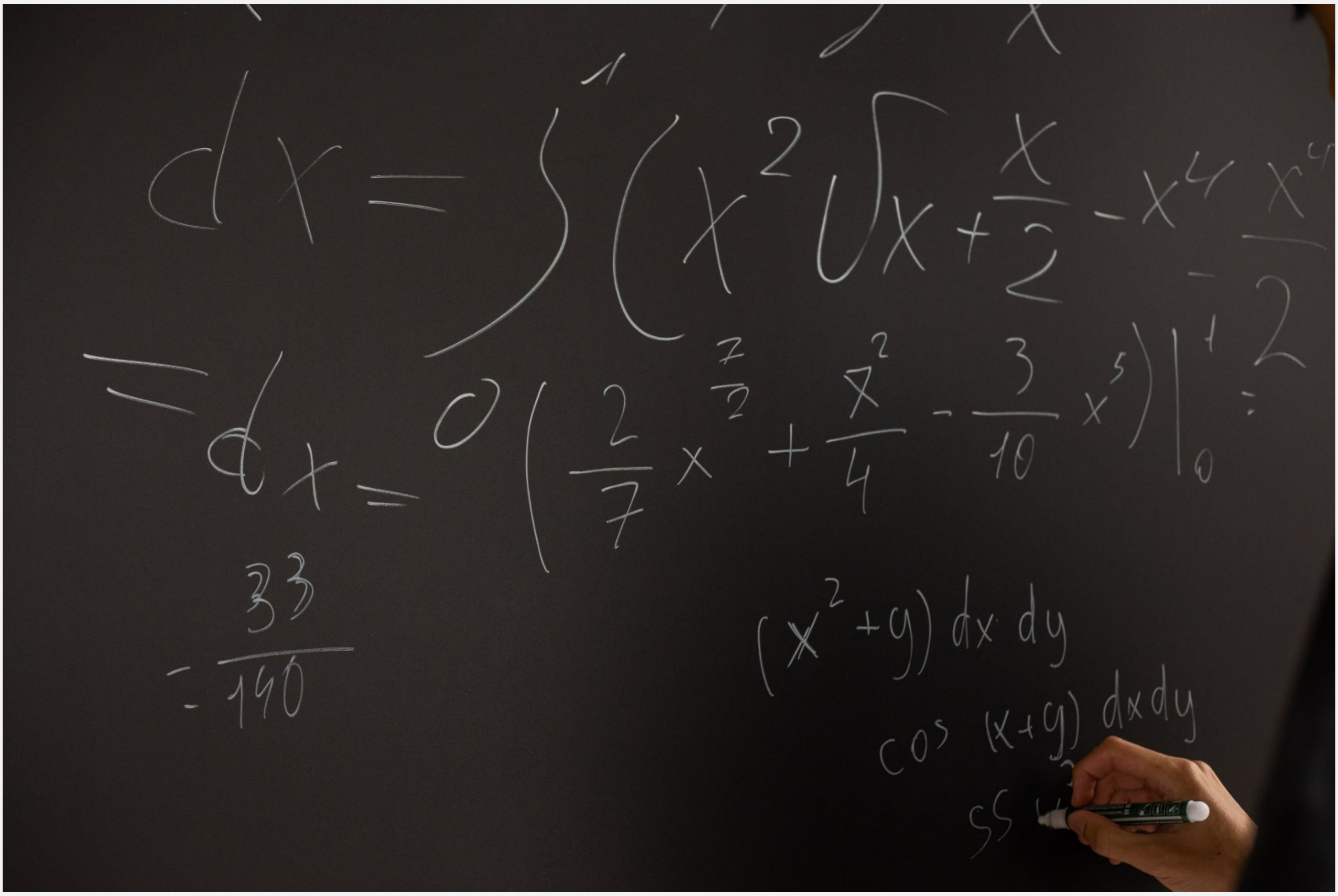
ETC HE Report 2023/10

Development of a 2017 baseline to monitor noise under the zero pollution objectives

Methodological document



Authors:
Núria Blanes (UAB), Jaume Fons (UAB), Matthias Hintzsche (UBA), Maria José Ramos (UAB), Miquel Sáinz (UAB), Roger Milego (UAB), Eulalia Peris (EEA)

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European Topic Centre on
Human Health and the Environment (ETC HE)
https://www.eionet.europa.eu/etcs/etc-he

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Summary

The aim of this work is to produce an updated 2017 dataset representing the number of people exposed to noise from road, rail, aircraft and industries that is comparable to 2022 reference year, both inside and outside Environmental Noise Directive's (END) urban agglomerations in order to provide support to the EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil'. The commitment is to reduce by 2030 the share of people chronically disturbed by noise from transport by 30 % compared to 2017.

Reported data in 2017 cannot be used to monitor the noise objective under the zero pollution action plan. From 2019 countries cannot longer use their national calculation methods and have to change their calculation method to CNOSSOS-EU and adapt the method in which population and receiver points are distributed across the façade of the buildings. Therefore, the exposure data from 2017 needs to be made comparable to 2022, 2027 and subsequent reporting years.

It is envisaged a lot of variability across countries depending on how the national method compares with CNOSSOS-EU. For some countries the number of people exposed will increase and for some others the number of people exposed will decrease, due to the change of the calculation method but also due to how the population is attributed to the exposed buildings and façades.

Therefore, due to the changes in the calculation methodology of strategic noise maps, and in order to assess progress towards the zero pollution ambition, the aim of this report is to present a methodology for making countries' 2017 exposure data comparable to the newly reported exposure data.

The strategic noise maps reported for the year 2022 as well as other data on traffic, related noise factors per END noise sources, and changes in the population will be used to extrapolate back the number of people exposed to noise in 2017 in terms of Lden and Lnight. Missing exposure data from countries for the year 2022, will be gap-filled with methods described also in this report.

All noise sources follow the same workflow, which is based on the change in the population exposure due to demographic factors, transport data, and noise abatement measures of relevance between the 2017-2022 period.

1 Introduction

Reducing environmental noise is a key objective under the zero-pollution ambition of the European Commission (EC, 2021). Specifically, the commitment is to reduce by 2030 the share of people chronically disturbed by noise from transport by 30 % compared to 2017. In order to provide support to the EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil', the EEA will need to continuously monitor the progress toward the Zero-Pollution objectives, in order to provide the European Commission with periodic reports monitoring and assessing the zero-pollution objectives.

To monitor the noise objective under the zero pollution action plan, future reporting years (i.e. 2022 and 2027) will need to be assessed against the 2017 exposure baseline. However, from 2019 countries cannot longer use their national calculation methods and have to change their calculation method to CNOSSOS-EU (EC, 2015). This will result in non-comparable data between strategic noise maps reported in 2017 and the following reporting years. Therefore, the exposure data from 2017 needs to be made comparable to 2022, 2027 and subsequent reporting years. In addition to CNOSSOS-EU, the directive also updated the method in which population and receiving points are distributed across the façade of the buildings.

Currently, there is a lot of variability across countries and the differences between years will depend on how the national method compares with CNOSSOS-EU. For some countries the number of people exposed will increase and for some others the number of people exposed will decrease, due to the change of the calculation method but also due to how the population is attributed to the exposed buildings and façades.

Due to the changes in the calculation methodology of strategic noise maps, and in order to assess progress towards the zero pollution ambition, the aim of this report is to present a methodology for making countries' 2017 exposure data comparable to the newly reported exposure data.

The strategic noise maps reported for the year 2022 as well as other data on traffic, related noise factors per Environmental Noise Directive (END) noise sources, and changes in the population will be used to extrapolate back the number of people exposed to noise in 2017 in terms of Lden and Lnight. Missing exposure data from countries for the year 2022, will be gap-filled with methods described in section 3 of this report.

2 Objective

The aim of this work is to produce an updated 2017 dataset representing the number of people exposed to noise from road, rail, aircraft and industries that is comparable to 2022 reference year, both inside and outside Environmental Noise Directive's urban agglomerations (EC, 2002)

Two different processes are being presented in this methodological document:

- Methodology to gap fill exposure data for 2022 reference year based on 2022 reported data (see section 3);
- Methodology to estimate a new 2017 exposure baseline for the different END noise sources, based on reported and gap filled dataset from 2022 (see section 4).

3 Methodology to gap fill exposure data for 2022 reference year

3.1 Overview

The previous methodology for gap filling exposure data to the different END noise sources (ETC/ATNI, 2021), reviewed in 2020, is no longer valid since one of the premises was to use data reported in the previous period if data was missing.

Due to the changes in the calculation methodology of strategic noise maps from 2022 onwards i.e. CNOSSOS-EU, change in the distribution of measurement points and people in the most exposed façade, there is a need to define a new calculation method for estimating missing data.

In the following sections, the gap-filling method that will be implemented when exposure data of a specific country and source is missing is presented. The method is based on European averages, country averages and regressions using 2022 reported exposure data. This method will be reviewed and updated with new deliveries from 2022.

3.2 Input data

To estimate the missing exposure data for 2022 reference year, the following data is used as input datasets:

- countries that have delivered technically accepted DF4_8 (strategic noise maps) data for 2022 reference year in Reportnet 3;
- countries that have delivered DF1_5 (noise sources) data for 2020 reference year in Reportnet 3 or Reportnet 2 (if data has not been submitted in Reportnet 3);
- for the countries that have not delivered information on the noise sources corresponding to the 4th reporting cycle (2020 – 2025), reported data corresponding to 2015 reference year will be used to gap fill the exposure data for the complete EEA coverage.

General specifications in relation to the four noise sources to be gap filled with 2022 data:

- Agglomerations:
    - Countries declaring «No» in declaration of noise sources in Reportnet 3 will not be gap filled.
    - Countries declaring «-1» in DF1_5 2020 in Reportnet 2 will not be gap filled.
    - The list of agglomerations to be considered for the reporting cycle 2020-2025 will be elaborated with the reported agglomerations in Reportnet 3 or Reportnet 2 for 2020 reference year. For those countries with no data reported in 2020, agglomerations submitted in 2015 are used to have a complete EEA coverage for agglomerations to be included in the gap filling exercise (a consultation issued in August 2023 was issued to countries to confirm the agglomerations to be included). The list of agglomerations included can be found in Annex 1.
    - Applicable sources inside each agglomeration will be specified based 1) on the attribute applicableSource reported in Reportnet 3 DF1_5 Dataflow for agglomerations or 2) based on information submitted in 2017 strategic noise maps or 3) based on specific responses from countries (consultation issued in August 2023). The applicable sources that will be considered per each agglomeration and therefore, gap filled if data is not provided, can be found in Annex 1.

- Major roads:
  - Countries declaring «No» in Declaration of noise sources in Reportnet 3 will not be gap filled.
  - Countries declaring «-1» in DF1_5 2020 in Reportnet 2 will not be gap filled.
  - Countries indicating «-1» both in DF1_5 noise sources in 2015 reference year or in DF4_8 strategic noise maps in 2017 will not be gap filled.
  - Countries not reporting information on road segments' length will not be gap filled.

- Major railways:
  - Countries declaring «No» in Declaration of noise sources in Reportnet 3 will not be gap filled.
  - Countries declaring «-1» in DF1_5 2020 in Reportnet 2 will not be gap filled.
  - Countries indicating «-1» both in DF1_5 noise sources in 2015 reference year or in DF4_8 strategic noise maps in 2017 will not be gap filled.
  - Countries not reporting information on railways segments' length will not be gap filled.

- Major airports:
  - Countries declaring «No» in Declaration of noise sources in Reportnet 3 will not be gap filled.
  - Countries declaring «-1» in DF1_5 2020 in Reportnet 2 will not be gap filled.
  - Countries indicating «-1» both in DF1_5 noise sources in 2015 reference year or in DF4_8 strategic noise maps in 2017 will not be gap filled.

3.3 Gap filling methodology per noise source

Table 3.1 describes the gap filling methodology that will be followed per each END noise source.

Table 3.1 Gap filling methodology that will be implemented per each noise source

<table>
<tr><th colspan="2">Noise source</th><th>Gap filling process</th></tr>
<tr><td rowspan="2">Agglomeration</td><td>Road noise</td><td>- Discard outliers. Outliers have been computed based on the interquartile range (difference between the 3rd and 1st quartiles).
- Correlation between total number of inhabitants & total number of people exposed >= 55 dB Lden to agglomerationRoad (available data reported and technically accepted) (*).
- Mean percentage distribution of exposed people between the 5 noise bands (available data delivered) versus the total number of people exposed (exclude agglomerations with all noise bands equal to 0).
- Apply the correlation and the percentage distribution to missing agglomerations based on total population.
- The same process will be applied for Lnight estimations.

(*) Correlations will only be checked when reported exposure data for 2022 reference year will be downloaded from Reportnet 3. In case no correlation is found, the European average of percentage of the total population exposed >=55 dB Lden will be used. Depending on the available number of agglomerations and countries reporting 2022 exposure data it will be evaluated if the resulting regression can be applied.</td></tr>
<tr><td>Rail noise / aircraft noise / industrial noise</td><td>- Discard outliers. Outliers have been computed based on the interquartile range (difference between the 3rd and 1st quartiles).
- Calculate European average of the percentage of the total population exposed >= 55 dB Lden.
- Mean percentage distribution of exposed people between the 5 noise bands (available data delivered) versus the total number of people exposed (exclude agglomerations with all noise bands equal to 0).
- Apply the European average and the percentage distribution to missing agglomerations based on total population.
- The same process will be applied for Lnight estimations.

Only agglomerations with the corresponding noise source inside their boundary will be gap filled.</td></tr>
<tr><td colspan="2">Major roads / Major railways</td><td>- Countries that will be included in the regression calculation will be those ones that reported exposure data covering 95 % or more of the expected minimum LAU areas.
- Calculate the regression between total number of people exposed outside agglomerations >=55 dB Lden and total length reported at country level outside agglomerations (to calculate the regression, only countries considered complete will be included in the calculation): see section 3.3.1 for more details.
- Mean percentage distribution of exposed people between the 5 noise bands (available data delivered) versus the total number of people exposed.</td></tr>
</table>

Noise source	Gap filling process
	○ In this case, incomplete countries will be taken into consideration: the mean percentage distribution is using all data provided and the calculation is based on the sum of the total number of people exposed. - Apply the correlation at country level based on length reported and the mean percentage distribution per noise bands. - Apply the correlation and the mean percentage distribution to missing length in countries considered not completely covered (based on the percentage of kilometres from DF1_5 and calculated as covered by noise contour maps outside agglomerations) and sum the result of the gap filling estimations with the reported exposure data (partial gap filling). - The same process will be applied for Lnight estimations.

Major airports	- Calculation of the average relative change of total population exposed >= 55dB Lden between the current reporting period (2022) and the previous reporting cycle (2017): it is assumed an homogeneous change for all major airports and for all bands. The same calculation will be done for Lnight estimations
	  - In the case of major airports, 2017 reported exposure data will be used to gap fill 2022 exposure data by 1) calculating the average relative change using all airports where data is available in both reporting periods and 2) applying the average relative change calculated to missing airports in 2022 using as input data the 2017 reported or gap filled exposure data.
	  - The mean average relative change calculated with reported data will be applied to major airports that have not delivered exposure data in 2022 using reported or gap filled 2017 exposure data.
	  - In the case of a new major airport reported (not existing in 2017 dataset), the correlation between number of movements and population exposed considering all data reported will be applied.

In addition to the steps described above, we identified some exceptional cases where the population exposed to noise was zero for all the noise bands in 2017 and therefore these cases will be kept at zero population exposed in the gap filled dataset of 2022. The reason for this is that, if there were zero people exposed to a source in 2017, it is unlikely that there will be a number of people exposed to that source similar to the averages extracted. These cases were identified in some agglomerations for railways, airports and industry sources and also to some major airports. The list of entities that will be taken into consideration is detailed in Annex 5.

3.3.1 Length for major roads and major railways outside agglomerations to calculate the regression between exposed people and total number of kilometers per country

In the case of major roads and major railways, when length is reported as specified in DF1_5, the kilometres reported should cover the whole road or rail infrastructure with more than 3 million vehicles per year and more than 30.000 train passages per year respectively.

In this case, when reporting noise sources in DF1_5, there is no distinction between kilometres of the infrastructure inside the END agglomerations and outside the END agglomerations, while when reporting strategic noise maps and the number of people that is exposed to major roads and major railways, the END distinguishes between population exposed outside agglomerations and population exposed including agglomerations.

The gap filling process only aims to calculate the number of people exposed outside agglomerations. Therefore, the following process has been followed to estimate the kilometres of the infrastructure outside END agglomerations and inside END agglomerations.

- Overlay the polygons of the END agglomerations and the segments of the major roads/major railways as provided in DF1_5.
- Calculate the percentage of length located inside and outside agglomerations.
- Apply the calculated percentage to the length reported (per country) to obtain the estimated length of major roads or major railways outside agglomerations.
    - If a country has not reported agglomeration polygons, the mean percentage of length located inside and outside agglomerations calculated above will be applied to the length reported to obtain the estimated length of major roads or major railways outside agglomerations.

The estimated length outside agglomerations per country that will be used to calculate regressions with the number of people exposed can be found in Annex 2 for major roads and in Annex 3 for major railways.

4 Methodology to estimate the 2017 population exposure baseline

4.1 Overview

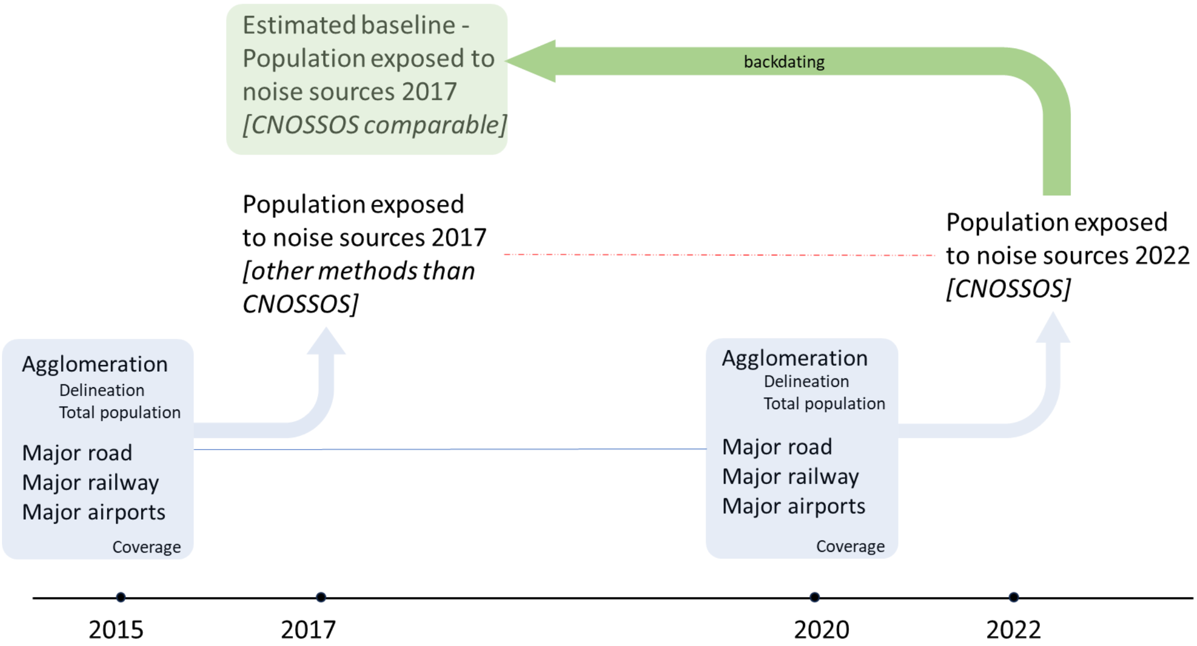
Because of the adoption of a Common NOise aSSessment methOdS (CNOSSOS-EU; EC, 2015) for all noise sources, data reported in 2022 is not comparable with strategic noise maps corresponding to 2017, which were developed using national methods. The evaluation of the progress towards Zero Pollution Action Plan 2030 requires a 2017 baseline. Therefore, there is a need to estimate a new 2017 exposure baseline that would be comparable with 2022 exposure data and future reporting years.

Figure 4.1 provides an overview of the data reported in two consecutive reporting periods for noise sources (DF1_5) and strategic noise maps (DF4_8) (2015-2017 and 2020-2022), highlighting the methodological change for modelling the population exposed. This change was due to the adoption of the CNOSSOS-EU, effective in the reporting of 2022.

This method change results in a lack of comparability between the number of persons exposed to noise in 2017 and 2022. Therefore, two options have been considered:

- Use the existing knowledge on the equivalences between national methods and CNOSSOS to transform the data reported in 2017. This approach is problematic since no review covers all the used national methods, and only fragmented information is available.
- Backdate data reported in 2022 considering the main factors that can influence a change in the population exposed to noise between 2017 and 2022. This approach takes into consideration relevant population and transport changes between the two years as well as a set of measures from the study on projections of health impacts from transportation noise (ETC/HE, 2022).

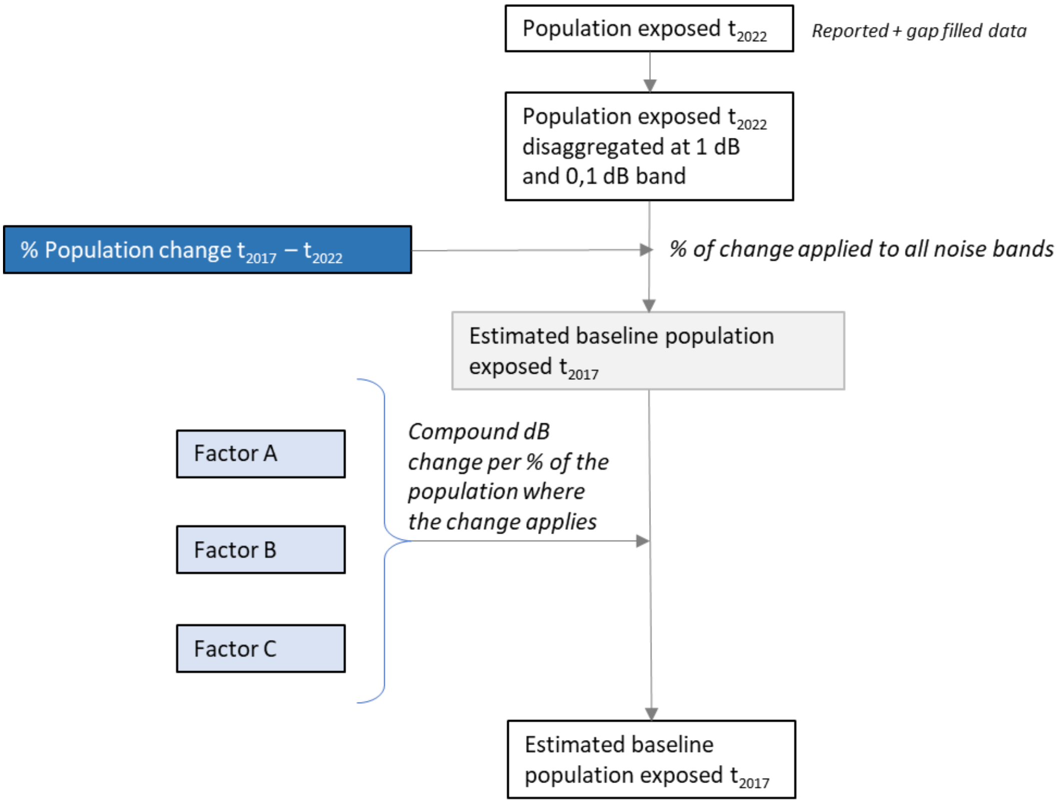
Figure 4.1 Overview of two reporting periods for noise sources and strategic noise maps, data reported, differences in methodologies for noise assessment, and proposed approach to estimate 2017 baseline (in green)



4.2 General workflow

All the noise sources follow the same workflow, as described in Figure 4.2, and are based on the change in the population exposure due to demographic factors, transport data, and noise abatement measures of relevance between the 2017-2022 period. The trends for the period 2017-2022 developed in ETC/HE, 2022 are reversed to derive the estimated baseline from the exposure data from 2022 reference year (see section 3).

Figure 4.2 General workflow to estimate 2017 baseline for a specific noise source. Demographic changes (in dark blue), transport projections and related noise factors (in light blue) contribute to the change of the exposed population to a specific noise source between 2022 and 2017. Boxes in grey refer to intermediate calculations



Below is a summary of the main steps involved in the calculation of the estimated exposure 2017 new baseline:

1. Select the population exposed at t_{2022}.:

The population exposed at t_{2022} is the information that is used as the input data to calculate the estimated population exposure in 2017.

This information is the reported exposure information as provided by the Member States under the Environmental Noise Directive requirements corresponding to strategic noise maps (DF4_8) from 2022 reference year. There are significant delays in reporting of strategic noise maps of 2022 by countries, resulting in gaps in the dataset. Therefore, a gap-filling is performed to complete any missing information and ensure a full assessment of environmental noise in Europe for 2022 reference year. Detailed information on the gap-filling methodology is provided in section 3.

2. Disaggregate the population at a 1 dB noise band (one decimal precision):

The population exposed to different noise sources and indicators are reported per 5 dB noise intervals following the END requirements. The various factors that modify noise exposure result in a change of dB units or lower. Therefore, the 5 dB intervals must be disaggregated at the decimal level (one decimal precision) to integrate these changes. Lowering the noise bands at which the exposed people is calculated following the END requirements are also estimated, covering a potential increase of the number of people exposed.

The methodology is described in ETC/HE, 2023.

3. Apply the demographic changes:

We assume homogenous population change both inside agglomerations and outside agglomerations (see details in sections 4.4.1 and 4.5.1 respectively). Therefore, the ratio of population change is applied to the people exposed to all noise bands.

When estimating population exposed to major roads and major railways, the change on road and rail network between 2015 and 2020 is also included as a factor (see sections 4.5.2. and 4.5.3).

4. Calculate the dB change from the different factors:

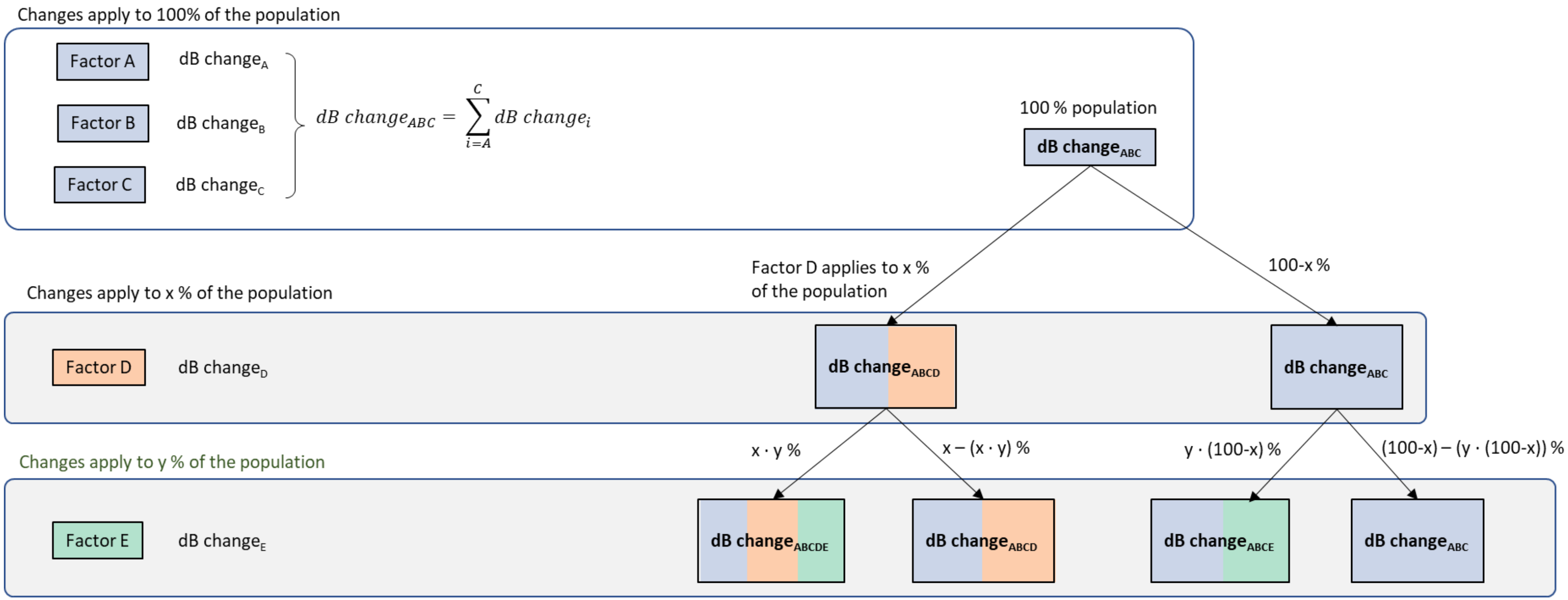
Each factor (light blue boxes in Figure 4.2) needs to be translated into a dB change to estimate the final distribution of the estimated new baseline for 2017 exposure data. Details are provided per noise source in subsequent sections. Unless specifically mentioned, the resulting dB change for a specific factor is applied to all noise bands.

5. Integrate all dB changes:

Some factors apply to the entire population, and others only apply to a limited share. For instance, the noise reduction of the regulation sound level of motor vehicles is applied to the entire population, whilst the noise reduction of sound barriers is only applied to those people exposed to major roads.

Figure 4.3 provides an overview of the approach to integrate the dB change of all factors under a specific noise source. It is considered that all the elements interact. Therefore, all the combinations resulting from different percentages are identified. Existing groups from a previous step are further divided according to the percentage of the factor under consideration. In the last step, the final groups with different percentages are obtained, each with a specific result of dB change. The subindexes in the figure reflect the factors included in each aggregated dB change.

Figure 4.3 Process to aggregate the dB change of different factors for a specific noise source. The figure provides an example with five elements (A to E). Three factors apply to the entire population (A, B, C), and two other factors only apply to a fraction of the total population exposed (D, x %; and E, y %)



4.3 Input data

The data used to generate the estimated 2017 exposure baseline is listed as follows:

Data flow	Reference year(s)	Parameter	Use
DF1_5	2015, 2020	Inhabitants of the agglomeration (Annex 1)	Calculation of demographic change (2020-2015)
		List of agglomerations (Annex 1)	New agglomerations reported in 2020 will be discarded for the 2017 baseline estimation
		Applicable sources inside agglomerations (Annex 1)	Discard agglomerations if a specific noise source is not applicable for an agglomeration for the estimation of the 2017 exposure baseline
		Length of major roads outside agglomerations (Annex 2)	Change in length of major roads (2020-2015)
		List of countries reporting major roads (Annex 2)	A country declaring major roads in 2020 for the first time will be discarded for the 2017 baseline estimation.
		Length of major rails outside agglomerations (Annex 3)	Change in length of major rails (2020-2015)
		List of countries reporting major railways (Annex 3)	A country declaring major railways in 2020 for the first time will be discarded for the 2017 baseline estimation.
		List of major airports (Annex 4)	New major airports reported in 2020 will be discarded for the 2017 baseline estimation
DF4_8	2022	Reported and gap filled exposure data for agglomeration road, agglomeration rail, agglomeration air and agglomeration industry	Input data for the calculations of the 2017 baseline estimation
		Reported and gap filled exposure data for major roads and major railways outside agglomerations	Input data for the calculations of the 2017 baseline estimation
	2022	Reported exposure data for major airports outside agglomerations	Input data for the calculations of the 2017 baseline estimation

4.4 Noise sources inside agglomerations

4.4.1 Common factor: A. Demographic changes

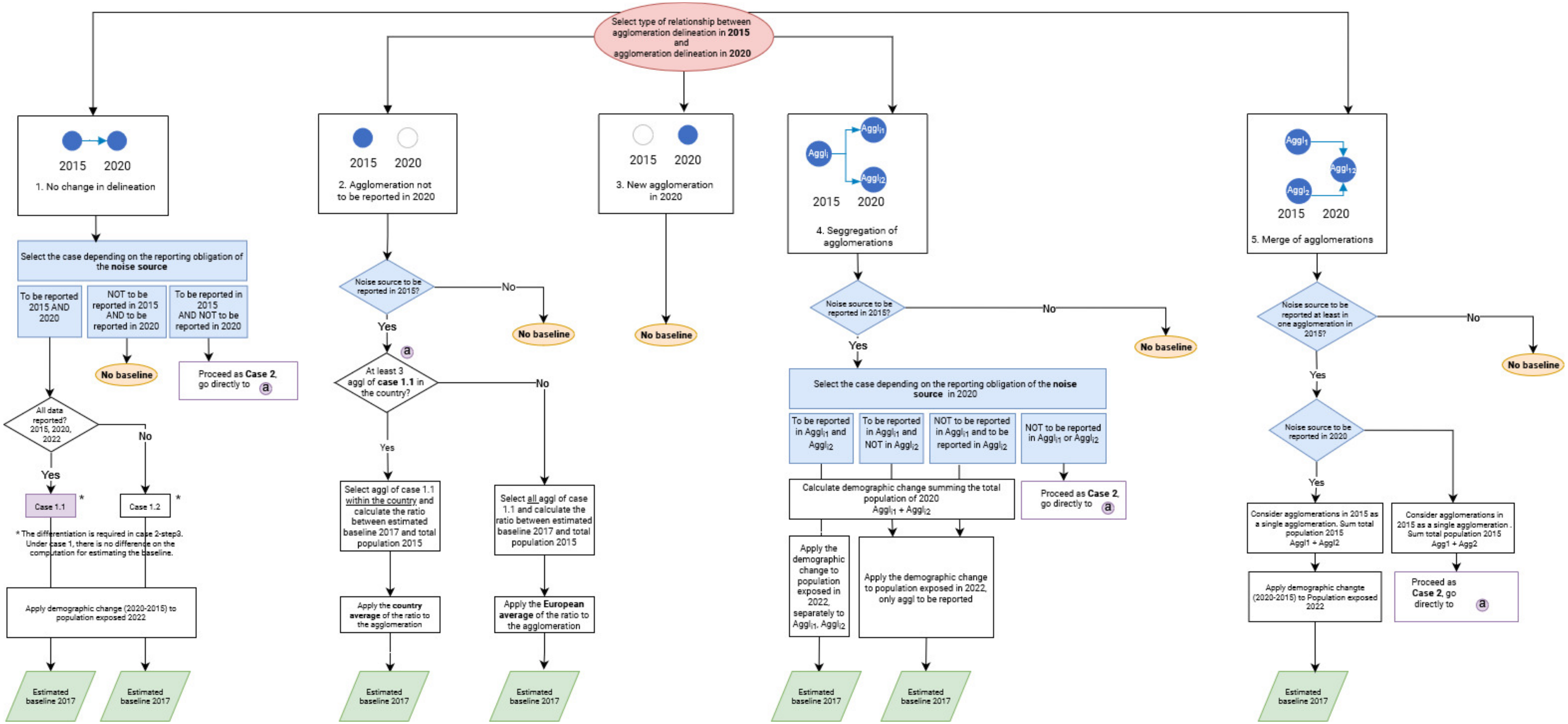
Calculating demographic changes (2020-2015) is the first step in calculating the baseline for 2017 (Figure 4.2). The approach is common for all noise sources inside agglomerations, and we assume homogenous population change across all dB ranges. Therefore, the ratio of population change is applied to the population exposed to all noise bands in 2022.

Three elements are considered, which explain all the possible cases to be addressed:

- Coverage of agglomerations in 2015 and 2020. The first step of Figure 4.4 depicts all possible cases:
    - Case 1 is the most common case when the agglomeration fulfils the END requirements with data available for 2015 and 2020, and no significant changes in the delineation are reported.
    - Case 2. Demographic changes between 2015 and 2020 may result in a population decrease for a particular agglomeration. If the outcome is that the agglomeration has less than 100 000 inhabitants in 2020, then the agglomeration is outside the END scope and does not have to be reported. In that case, the 2017 baseline is estimated, but no data will be reported in 2020/2022.
    - Case 3. It is the opposite of case 2. The agglomeration is outside the END scope in 2015, but due to a demographic increase, it has to be reported in 2020. In that case, the 2017 baseline will not be calculated. However, the agglomeration will be reported from 2020 onwards.
    - Case 4. An agglomeration may be disaggregated into two agglomerations in 2020 because of the country's administrative reasons or other organisational settings. In that case, the estimated 2017 baseline will consider the two agglomerations separately as reported in 2020.
    - Case 5. Two agglomerations in 2015 merged in 2020 because of the country's administrative reasons or other organisational settings. In that case, the baseline will join the two agglomerations in a single one to ensure coherence with 2020 and further reporting.
- A second element is fulfilling the END requirements to report a specific noise source inside the agglomeration. For example, any airport may not affect an agglomeration; therefore, this noise source does not have to be reported. The inclusion of this element in the workflow is highlighted in blue in Figure 4.4. Generally, a particular noise source must be reported in subsequent reporting phases. However, a noise source may change its reporting obligation between subsequent periods in a few agglomerations. In that case, the following rule will be applied:
    - If the noise source has to be reported in 2015, the baseline is estimated.
    - If the noise source does not have to be reported in 2015, the baseline is not estimated, and the data will indicate that that noise source was not required to be reported under the END requirements in 2015.
- A third component relates to the source of the data: data reported by Member States or data gap-filled. This differentiation is needed in the final steps of case 2, where the national and European averages are required. The averages are calculated only with reported data.

When an agglomeration is not required by the END in 2015, or the noise source in the agglomeration is not applicable, no baseline is estimated.

Figure 4.4 Workflow for calculating the demographic change 2022-2015 and its application to people exposed in 2022 (first step for the estimation of the 2017 baseline -see Figure 4.2)



A detailed description of each case presented in Figure 4.4 is shown below:

Case 1 – Agglomeration unchanged

Data input:
Total population 2015 in agglomeration (reported)
Total population 2020 in agglomeration (reported)
Number of people exposed to noise reported and/or gap-filled in 2022
Overview:
Demographic change between 2015 and 2020 is calculated per agglomeration and applied to the corresponding population exposed in the agglomeration in 2022.

Figure 4.5 Overview of agglomerations for case 1 (left) and calculation of demographic change (right). The number of case refers to in Figure 4.4

Procedure

1. For each agglomeration, calculate the change ratio in total population between 2020 and 2015:

$$Pop\_change_i = \frac{Pop\_2015_i}{Pop\_2020_i}$$

   Where:
   - $Pop\_2015_{agg\_i}$ is the total population in agglomeration *i* in 2015
   - $Pop\_2020_{agg\_i}$ is the total population in agglomeration *i* in 2020

2. Apply the change ratio to all noise bands in each agglomeration:

$$Pop\_exposed\_dB_{n2017_{agg\_i}} = Pop\_exposed\_dB_{n2022_{agg\_i}} \cdot Pop\_chang_{agg\_i}$$

   Where:
   - $Pop\_exposed\_dB_{n2017_{agg\_i}}$ is the estimated population exposed to *n* dB in 2017 (new baseline), agglomeration *i* (unique combination of agglomeration and dB at decimal level). This is the output variable and it corresponds to the baseline of the population exposed in 2017. This is the first step.
   - $Pop\_exposed\_dB_{n2022_{agg\_i}}$ is the population exposed to *n* dB in 2022, in agglomeration *i* (unique combination of agglomeration and dB at decimal level).
   - $Pop\_change_{agg\_i}$ is the ratio of change of total population in agglomeration *I* as calculated in previous step (1).

Output:

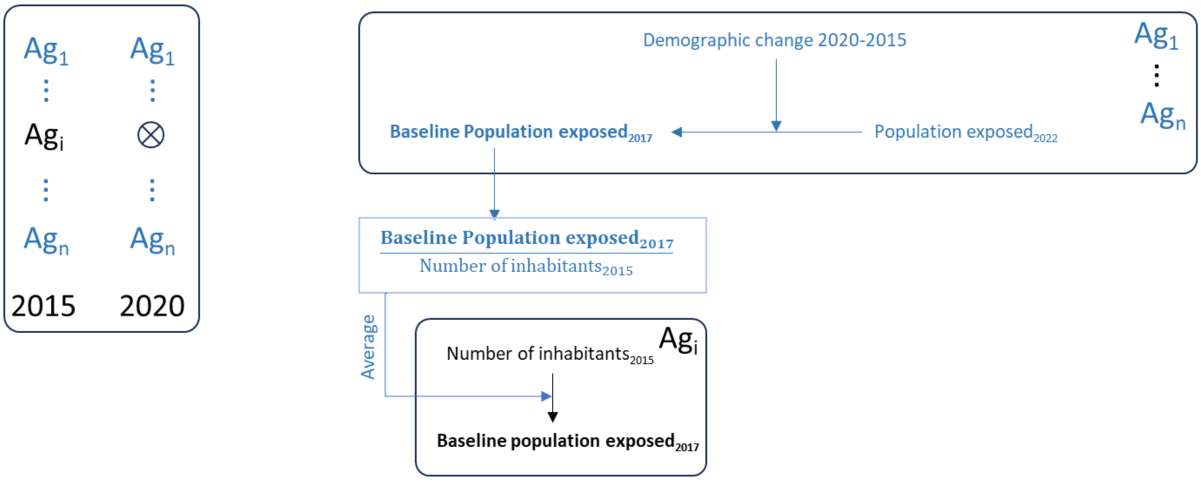
- A new variable is created: $Pop\_exposed\_baseline\_2017_i$ (P*opulation exposed 2017 baseline for agglomeration$_i$)*

Case 2 -Agglomeration not continued in 2020

<u>Overview</u>

An existing agglomeration in 2015 is no longer compliant with the requirements of the END in 2020.

Figure 4.6 Overview of set of agglomerations for case 2 (left) and calculation of demographic change (right). Agglomeration Ag_i has to be reported in 2015, but is outside of the scope of the END in 2020. The number of case refers to in Figure 4.4



<u>Procedure</u>

1. If the 2015 agglomeration is discontinued in 2020 AND is in a country with at least three cities corresponding to case 1 (considered as unchanged between 2015 and 2020) AND data on people exposed is not gap filled:
   a) Select all the agglomerations in that country that have agglomerations considered unchanged (Case 1)
   b) Calculate the ratio between the new estimated baseline population exposed in 2017 and the number of inhabitants in 2015 for the cities in a). The baseline population exposed in 2017 is already calculated under Case 1.

$$Ratio\_pop\_exposed_i = \frac{Pop\_exposed\_baseline\_2017_i}{Number\ of\ inhabitants_i}$$

   Where:
   - $Pop\_exposed\_baseline\_2017_i$ is the estimated population exposed in 2017 (baseline) for agglomeration *i*. These agglomerations are inside case 1, where the exact baseline procedure is explained.
   - $Ratio\_pop\_exposed_i$ is the ratio between population exposed in 2017 and total population (2015)
   - *Number of inhabitants* of the agglomeration for the reference year 2015

   c) Calculate the average of all the agglomerations included in the previous step (a and b)

$$Ratio\ \ exposed\ avg = \frac{\sum_{i=1}^{n} Ratio\ pop\ exposed_i}{n}$$

   Where:
   - *n* is the number of agglomerations in the country which complies with Case 1

- *Ratio pop exposed$_i$* is the ratio between estimated population exposed in 2017 (new baseline) and number of inhabitants in 2015. Calculated in step b).

d) Apply the average change ratio to the agglomerations of case 2 (discontinued in 2020)

$$Pop\_exposed\_dB_{n2017_{agg\_i}} = Number\ of\ inhabitants_{i} \cdot Ratio\ exposed\ avg$$

Where:

- $Pop\_exposed\_dB_{n2017_{agg\_i}}$ is the estimated population exposed to *n* dB in 2017 (new baseline), agglomeration *i* (unique combination of agglomeration and dB at decimal level). This is the output variable and it corresponds to the baseline of the population exposed in 2017.
- $Number\ of\ inhabitnats_{i}$ is the total population of agglomeration *i* in 2015. This agglomeration is the one that is discontinued in 2020.
- *Ratio exposed avg* is the ratio between the estimated population exposed in 2017 (new baseline) and number of inhabitants in 2015. Calculated in step c).

2. If the agglomeration is in a country with less than three agglomerations of case 1 (considered as unchanged between 2015 and 2020). The case is similar to step 1, but we will use the European average.
   a) Select all the European agglomerations that are considered as unchanged (Case 1)
   b) Calculate the ratio between the new estimated baseline of population exposed in 2017 and the number of inhabitants in 2015 for the cities in a). The baseline of population exposed in 2017 is already calculated under Case 1.

$$Ratio\_pop\_exposed_i = \frac{Est\ pop\ exposed\ baseline\_2017_i}{Number\ of\ inhabitants\ _i}$$

Where:

- $Est\ pop\ exposed\ baseline\ 2017_i$ is the estimated population exposed in 2017 (baseline) for agglomeration *i*. These agglomerations are inside case 1 where the exact procedure to obtain the baseline is explained.
- $Ratio\_pop\_exposed_i$ is the ratio between the population exposed in 2017 and the number of inhabitants for reference year 2015.
- *Number of inhabitants$_i$:* total population of the agglomeration for the reference year 2015.

c) Calculate the average of all the agglomerations included in the previous step a) and b)

$$Ratio\ \ exposed\ avg = \frac{\sum_{i=1}^{n} Ratio\ pop\ exposed_i}{n}$$

Where:

- *n* is the total number of agglomerations in Europe which comply with Case 1
- *Ratio pop exposed$_i$* is the ratio between population exposed in 2017 (baseline) and the *number of inhabitants* in 2015. Calculated in step b).

d) Apply the average change ratio to the agglomeration of case 2 (discontinued in 2020)

$$Pop\_exposed\_dB_{n2017_{agg\_i}} = Number\ of\ inhabitants_{i} \cdot Ratio\ exposed\ avg$$

Where:

- $Pop\_exposed\_dB_{n2017_{agg\_i}}$ is the estimated population exposed to *n* dB in 2017 (new baseline), agglomeration *i* (unique combination of agglomeration and dB at decimal level). This is the output variable and it corresponds to the baseline of the population exposed in 2017.
- $Number\ of\ inhabitants_{i}$ is the total population of agglomeration *i* in 2015. This agglomeration is the one that is discontinued in 2020.
- *Ratio exposed avg* is the ratio between the baseline of population exposed 2017 and the number of inhabitants in 2015 -calculated in step c).

<u>Output</u>:

3. A new variable is created: $Pop\_exposed\_baseline\_2017_i$ (*Population exposed 2017 baseline for agglomeration$_i$*).

Case 3- new agglomeration in 2020

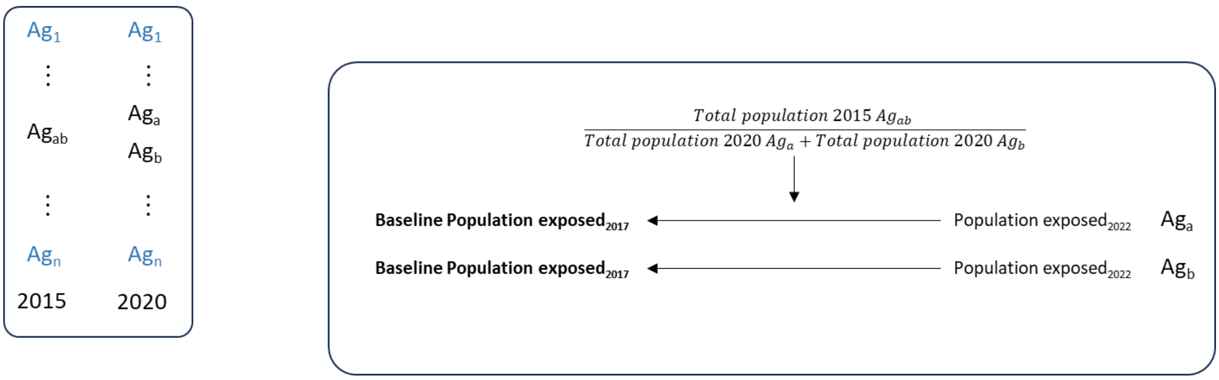
This agglomeration is not going to be included in the estimations of the new baseline for 2017 exposure data.

Case 4-agglomerations segregated in 2020

<u>Overview</u>

An existing agglomeration in 2015 is reported as two separated agglomerations in 2020.

Figure 4.7 Overview of set of agglomerations for case 4 (left) and calculation of demographic change (right). Agglomeration Ag_{ab} in 2015 is reported as two separate agglomerations in 2020. As a result the baseline is calculated separately for the two agglomerations reported separately in 2020 (right side). The number of case refers to in Figure 4.4



<u>Procedure</u>

1. If the noise source has to be reported in both agglomerations in 2020, then
   a. Calculate the ratio of population change summing the total population of the two agglomerations in 2020

$$Pop\ change_{ab} = \frac{Pop\ 2015\ Agg_{ab}}{Pop\ 2020_a + Pop\ 2020_b}$$

Where:

- $Pop\ change_{ab}$ is the demographic change calculated aggregating 2020 data
- $Pop\ 2015\ Agg_{ab}$ is the number of inhabitants in agglomeration *ab* in 2015 (see Figure 4.7 for nomenclature of agglomerations).
- $Pop\ 2020_a$ is the number of inhabitants in agglomeration *a* in 2020 (see Figure 4.7 for nomenclature of agglomerations).
- $Pop\ 2020_b$ is the number of inhabitants in agglomeration *b* in 2020 (see Figure 4.7 for nomenclature of agglomerations).

b. Apply the change ratio to all noise bands in each agglomeration reported in 2020 (only the case of $agglomeration_a$ is presented below, same procedure would apply for $agglomeration_b$):

$$Pop\_exposed\_dB_{n2017_{agg\_a}} = Pop\_exposed\_dB_{n2022_{agg\_a}} \cdot Pop\ change_{ab}$$

Where:

- $Pop\_exposed\_dB_{n2017_{agg\_a}}$ is the estimated population exposed to *n* dB in 2017 (new baseline), corresponding to agglomeration *a* in 2020 (unique combination of agglomeration and dB at decimal level). This is the output variable and it corresponds to the baseline of the population exposed in 2017. This is the first step.
- $Pop\_exposed\_dB_{n2022_{agg\_a}}$ is the population exposed to *n* dB in 2022, in agglomeration *a* (unique combination of agglomeration and dB at decimal level).
- Pop_change_{ab} is the ratio of change of number of inhabitants as calculated in previous step (1).

c. A new variable is created with one value for each agglomeration reported in 2020: *Population exposed 2017 baseline*

2. If the noise source has to be reported ONLY in one of the two agglomerations in 2020, then

a. Calculate the ratio of population change summing the total population of the two agglomerations in 2020

$$Pop\ change_{ab} = \frac{Pop\ 2015\ Agg_{ab}}{Pop\ 2020_a + Pop\ 2020_b}$$

Where:

- $Pop\ change_{ab}$ is the demographic change calculated aggregating 2020 data
- $Pop\ 2015\ Agg_{ab}$ is the total population in agglomeration *ab* in 2015 (see Figure 4.7 for nomenclature of agglomerations).
- $Pop\ 2020_a$ is the total population in agglomeration *a* in 2020 (see Figure 4.7 for nomenclature of agglomerations).
- $Pop\ 2020_b$ is the total population in agglomeration *b* in 2020 (see Figure 4.7 for nomenclature of agglomerations).

b. Apply the change ratio to all noise bands to the agglomeration that has to report the noise source (in the calculation below it is exemplified for $agglomeration_a$):

$Pop\_exposed\_dB_{n2017_{agg\_a}} = Pop\_exposed\_dB_{n2022_{agg\_a}} \cdot Pop\ chang_{ab}$

Where:

- $Pop\_exposed\_dB_{n2017_{agg\_a}}$ is the estimated population exposed to *n* dB in 2017 (new baseline), corresponding to agglomeration *a* in 2020 (unique combination of agglomeration and dB at decimal level). This is the output variable and it corresponds to the baseline of the population exposed in 2017. This is the first step.
- $Pop\_exposed\_dB_{n2022_{agg\_a}}$ is the population exposed to *n* dB in 2022, in agglomeration *a* (unique combination of agglomeration and dB at decimal level).
- Pop_change_{ab} is the ratio of change of total population as calculated in previous step (1).

c. Output.

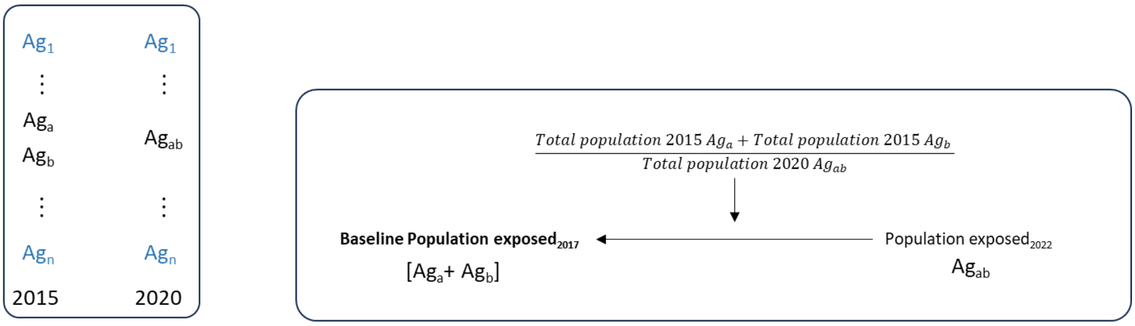
A new variable is created: $Pop\_exposed\_baseline\_2017_i$ (*Population exposed 2017 baseline for agglomeration$_i$*)

Case 5 -agglomerations merged in 2020

Overview

In case of merging agglomerations in 2020, the baseline will already merge both and consider them as a single one.

Figure 4.8 Overview of set of agglomerations for case 5 in Figure 4.4 (left) and calculation of demographic change (right). Two agglomerations in 2015 merge into a single agglomeration in 2020. As a result the baseline is calculated aggregating the two agglomerations reported separately in 2015 (right side)



Procedure

1. If the noise source has to be reported in at least one agglomeration in 2015, then
   a. Calculate the ratio of population change summing the total population of the two agglomerations in 2020

$$Pop\ change_{ab} = \frac{Pop\ 2015\ Agg_{ab}}{Pop\ 2020_a + Pop\ 2020_b}$$

Where:

- $Pop\ change_{ab}$ is the demographic change calculated aggregating 2020 data
- $Pop\ 2015\ Agg_{ab}$ is the number of inhabitants in agglomeration *ab* in 2015 (see Figure 4.7 for nomenclature of agglomerations).

- $Pop\ 2020_a$ is the number of inhabitants in agglomeration *a* in 2020 (see Figure 4.7 for nomenclature of agglomerations).
- $Pop\ 2020_b$ is the number of inhabitants in agglomeration *b* in 2020 (see Figure 4.7 for nomenclature of agglomerations).

b. Apply the change ratio to all noise bands in each agglomeration reported in 2020 (only the case of agglomeration$_a$ is presented below, same procedure would apply for agglomeration$_b$):

$$Pop\_exposed\_dB_{n2017_{agg\_a}} = Pop\_exposed\_dB_{n2022_{agg\_a}} \cdot Pop\ change_{ab}$$

Where:

- $Pop\_exposed\_dB_{n2017_{agg\_a}}$ is the estimated population exposed to *n* dB in 2017 (new baseline), corresponding to agglomeration *a* in 2020 (unique combination of agglomeration and dB at decimal level). This is the output variable and it corresponds to the baseline of the population exposed in 2017. This is the first step.
- $Pop\_exposed\_dB_{n2022_{agg\_a}}$ is the population exposed to *n* dB in 2022, in agglomeration *a* (unique combination of agglomeration and dB at decimal level).
- Pop_change_{ab} is the ratio of change of number of inhabitants as calculated in previous step (1).

c. A new variable is created with one value for each agglomeration reported in 2020: *Population exposed 2017 baseline*

3. If the noise source does not have to be reported in 2020 proceed as case 2 described above.

    a. Output.
    A new variable is created: $Pop\_exposed\_baseline\_2017_i$ (*Population exposed 2017 baseline for agglomeration$_i$*)

4.4.2 Road traffic noise inside agglomerations

Road traffic noise depends on traffic flow and on 'at source' factors, including vehicle speed, type of vehicle, the friction between the tyres and the road surface generating rolling noise, and the design of the propulsion system causing propulsion noise. The noise received at the receptor is influenced by the distance between the road and the receptor, the intervening noise barrier, and the insulation of the receptor. The insulation is not considered in this approach, as it is only pertinent for indoor noise levels.

Table 4.1 provides an overview of the references and specifications for the factors considered for calculating the 2017 estimated exposure baseline.

Figure 4.9 provides an overview of the workflow to calculate road traffic noise baseline inside agglomerations.

The following factors have been excluded since they have been considered not significantly contributing to road traffic noise changes for the period 2017-2022 or are too complex to model for each of the agglomerations of the END:

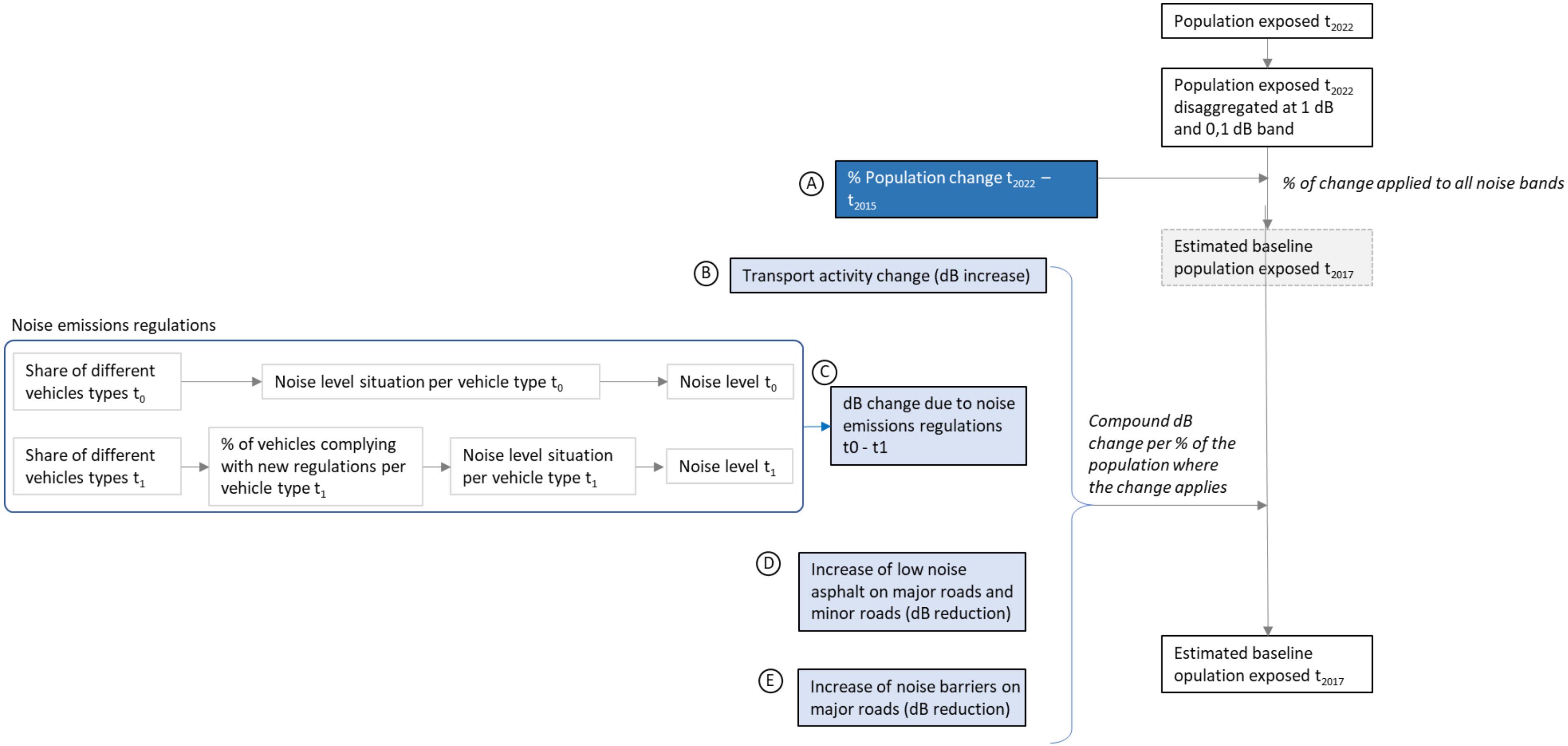
Tyre noise: Noise reduction due to tyre noise is somehow considered when integrating other measures, such as the regulation of the sound level of motor vehicles or speed regulation. Moreover, we assume all tyres have met the 2016 limits, and the effect is related to road surface type. Emissions from noise tyres are regulated by Regulation 117 (UNECE, 2011) and have been applicable since 2016. Given that car tyres are considered to have an average life of 4 years, it is assumed that by 2022, all tyres in use will meet the requirements set in the Regulation. Therefore, tyre noise does not require adjustments except that the noise performance of the tyre depends on the road surface type, which is included in the model by considering the low noise asphalt (see factor D in Table 4.1). It should be noted that lowering the noise limit values for tyres would have effectively reduced noise at the source.

- **Urban planning**: A general strategy cannot be specified for solutions aimed at infrastructure and urban spatial planning (such as traffic rerouting). The change in exposure distributions can only be derived from test-site calculations or ad hoc arguments; therefore, no quantitative noise change has been provided.
- **Road extension**: Although agglomerations are expected to grow, the corresponding increase in road length is considered negligible. Expansion of transport networks (all types inside and outside agglomerations) accounted for 0,3 % for 2012-2018 (CORINE Land Cover; EEA, 2019). Although CORINE Land Cover does not fully reflect changes in road length, this value provides a reference for the magnitude of change.
- **Electrical vehicles:** Noise reduction from the electrification of the fleet between 2017 and 2022 is assumed to be negligible.
- **Speed limits:** Speed limit reduction is not considered since there is no specific regulation at the European level.

Table 4.1 Overview of the factors related to road traffic noise inside agglomerations for estimating 2017 baseline. Cells in red indicate those factors contributing to increased noise pollution (backward trend 2022 -> 2017). Green indicates that the considered factor decreases dB (noise pollution reduction)

Factor	Reference	Trend 2017 - 2022	Backward trend to estimate 2017 baseline
A. Population change	Population change based on data reported DF1-5.	The trend is agglomeration-specific. All options are feasible.	The trend is agglomeration-specific. All options are feasible.
B. Transport activity change	Road traffic growth forecast (in Gpkm), and the freight traffic growth (in Gtkm) based on the EU Reference Scenario (EC, et al., 2021b) and PRIMES model (E3 Modelling, 2018).	Road traffic forecast is provided at a country level. It is assumed 3 dB increase per doubling traffic volume.	The trend is country specific.
C. Regulation on the sound level of motor vehicles	Share of vehicles from ACEA 2022 (ACEA, 2022). Percentage of vehicles complying with new regulations (EC, et al., 2021a) and emission values (Linear regression from EC, et al., 2021a).	The decrease in emissions is based on the vehicle fleet, the change in the percentage of vehicles complying with regulation on sound level of motor vehicles of 2015, 2016, 2020/2022.	Increase i.e (higher levels in 2017 compared to 2022
D. Low noise asphalt	It is assumed 2 dB reduction on major roads and 1 dB reduction on other roads. Phenomena project (EC, et al., 2021a) and END Noise Action Plans (Blanes et al., 2020; Fons-Esteve et al., 2021)	2 % increase of low noise asphalt from 2017 -2 dB on 2 % of major roads inside agglomerations -1 dB on 2 % of non-major roads	Increase i.e. higher levels in 2017 compared to 2022
E. Noise barriers on major roads inside agglomerations	It is estimated a 10 dB reduction because of implementing new noise barriers (EC, et al., 2021a). Percentage of increase of major roads are own estimates based on data from countries and END Noise Action Plans.	0,5 % increase in noise barriers on major roads -10 dB on 0,5 % of major roads	Increase i.e. higher levels in 2017 compared to 2022

Figure 4.9 General workflow for road traffic noise inside agglomerations. Demographic changes (A) (in dark blue), factors related to traffic flow (B), technological changes resulting from policy measures (C), and other noise abatement measures (D and E) contribute to the population change exposed to road traffic noise between t_{2022} and t_{2017}. Boxes in grey refer to intermediate calculations. Letters link to summary Table 4.1, which provides the reference values used



The following sections provide the detailed calculation for each factor. Demographic change (factor A) has already been explained in section 4.4.1 since the approach is common for all noise sources inside agglomerations.

Factor B Transport activity change

The Primes model provides the transport activity data based on the EU Reference Scenario 2020 as the number of passengers and tones of goods (Gpkm and Gtkm, respectively). This data is also available at country level, which allows to reflect interregional differences. While the traffic parameter used by the END is traffic volume, the transport activity data obtained from the EU Reference scenario refers to number of passengers and tones of goods (Gpkm and Gtkm, respectively). Therefore, a linear relationship has been assumed between the increase of passengers and the increase in the traffic volume (i.e. constant occupancy of vehicles over the period analysed). Similarly, a linear relationship has been assumed between the increase of tons of goods and the increase in freight traffic volume.

Data is available at a country level, and 2015, 2020 and 2025 have been selected to estimate the baseline. Since Primes only covers EU countries, for the following non-EU countries the transport activity change of a neighbouring country will be applied as indicated below:

- Norway will use the values of transport activity change from Sweden;
- Switzerland will use the values of transport activity change from Austria;
- Iceland will use the values of transport activity change from Denmark;
- Lichtenstein will use the values of transport activity change from Austria.

Assumptions:

- The same percentage of change of traffic is applied to both inside and outside agglomerations;
- Uniform reduction of dB to all noise bands.

Approach:

1. Select the following groups of vehicles from the Reference Scenario 2020 (outcome of the Primes model available at *Main results on energy, transport and GHG emissions*([1]))
    - Passenger transport
        - Buses and coaches
        - Passenger cars
        - Powered two-wheelers
    - Freight transport
        - Heavy goods and light commercial vehicles
2. Calculate the % of change for each group, per country, for the following periods
    - 2015-2020,
    - 2020-2025,
3. Calculate the dB change for each of the two groups of vehicles. It is assumed to be 3 dB per doubling the traffic volume (Kephalopoulos, Paviotti, & Anfosso-Lédée, 2012). Therefore, the following formula is applied to calculate the change in dB for the period 2017 – 2022:

$$dB = 10 \cdot \log\left(1 + \frac{\%\, increase\ of\ traffic}{100}\right)$$

([1]) https://energy.ec.europa.eu/document/download/1485062e-2d65-47cb-887a-a755edc2ec36_en?filename=ref2020_energy-transport-ghg.xlsx

4. Calculate the share of the passenger transport and freight transport from ACEA Vehicle in Use Report (ACEA, 2022). The following equivalence is assumed:

Type of transport	EU Reference scenario (change of traffic)	ACEA (share of type of vehicle)
Passenger transport	Buses and coaches Passenger cars Powered two-wheelers	Buses Passenger cars
Freight transport	Heavy goods and light commercial vehicles	Light commercial vehicles Medium and heavy commercial vehicles

5. Calculate the final dB change per country due to changes in traffic by considering the outcome of step 3 (dB change per type of vehicle) and step 4 (% of each type of vehicle):

$$dB\ traffic_{\ change} = 10 \cdot log\left[\frac{passenger\ share \cdot 10^{(dB\ passenger/10)} + freight\ share \cdot 10^{(dB\ freight/10)}}{100}\right]$$

Passenger share = Share of passenger transport as % of total road transport (step 4)
Freight share = Share of freight transport as % of total road transport (step 4)
dB passenger = dB increase for a given period due to the rise in passenger traffic (step 3)
dB freight = dB increase for a given period due to the rise in freight traffic (step 3)

6. The dB change is integrated with the dB changes of the other factors as explained in Figure 4.3

Factor C. Regulation of the sound level of motor vehicles

EU sound level limits for vehicles changed in 2016 and 2020. We apply this regulation to all cars at any speed. As new model vehicles come into service, the percentage of the fleet that complies with the newer limits will increase. Percentage compliance with vehicle emission limits will increase yearly, with a commensurate reduction in noise. That compliance is predicted using linear interpolation from the data shown in the following table.

Table 4.2 Percentage compliance with vehicle emission limits for 2016-2020 extrapolated to 2022. 2015* refers to the period up to and including 2015. Source: linear interpolation from Table 5.16 (EC, et al., 2021a)

Vehicle	Years		
	2015*	2016	2020/22
Car (C1)	89	2	4
Van (C2)	89	2	5
Bus (C3)	89	2	3
Heavy truck (C3)	89	3	4

Next table presents the foreseen EU noise limits for vehicles categorised as Regulation 540/2014 and adapted to the broader categories of the Dutch calculation method.

Table 4.3 EU vehicle noise limits for 2016-2026, with conversion to equivalent limit values for each vehicle category of the Dutch calculation method

	EU limits					Equivalent limit values				
Vehicle class EU Regulation	2015 Current	2016 New vehicle types	New vehicle types from 2020 and new regulation from 2022	New vehicle types from 2024 and new regulation from 2026	Vehicle category for NL calculation method	2014/15	2016	2020	2024	Scenario 3 2030+quiet vehicles
M1 (PMR≤120kW/t)	72	72	70	68	LV (Light)	72.3	72.1	70.2	68.3	65.3
M1 (120<PMR≤160kW/t)	73	73	71	69						
M2 (m ≤ 2,5t)	74-75	72	70	69						
M2 (2,5t<m≤3,5t)	75	74	72	71						
N1 (m ≤ 2,5t)	73	72	71	69						
N1 (2,5t < m ≤ 3,5t)	74	74	73	71						
M2 (3,5t<m≤5t, Pn≤135kW)	76	75	73	72	MV (Medium)	76.9	77.6	75.8	74.7	71.7
M2 (3,5t<m≤5t, Pn>135kW)	76-78	75	74	72						
M3 (Pn≤150kW)	77-78	76	74	73						
M3 (150<Pn≤250kW)	79	78	77	76						
M3 (Pn>250kW)	79-81	80	78	77						
N2 (Pn≤135kW)	75-77	77	75	74						
N2 (Pn>135kW)	78-80	78	76	75						
N3 (Pn≤150kW)	78-79	79	77	76	HV (Heavy)	80.7	82.2	80.7	78.7	75.7
N3 (150<Pn≤250kW)	81-83	81	79	77						
N3 (Pn>250kW)	81-83	82	81	79						

Notes: Table 2 in Dittrich and Sliggers (2015).
Source: Dittrich and Sliggers (2015).

The baseline conditions of the road vehicle fleet, including the proportions of electric vehicles, can be obtained with reference to the ACEA Vehicle in Use Report (ACEA, 2022), which presents vehicle numbers annually from 2011 up to 2020 and in detail for 2020 subdivided into vehicle categories and Member States.

Approach:

1. Calculate the percentage of the type of vehicle (baseline and increase).
   The baseline conditions of the road vehicle fleet, including the proportions of electric vehicles, can be obtained with reference to the ACEA Vehicle in Use Report (ACEA, 2022), which presents vehicle numbers annually from 2011 up to 2020 and in detail for 2020 subdivided into vehicle categories and Member States. The annual increase is derived from the % of change 2019-2020 and applied uniformly to estimate the percentage of vehicles in 2022. The following vehicle types are considered.
   - Cars
   - Vans
   - Buses
   - Trucks
2. For each type of vehicle (previous step), determine the percentage of vehicles complying with the new noise regulations (Table A).
3. Determine the noise level situation in t_0 and t_1 as follows:

$$Level\ situation\ t_i = 10 \cdot log\left[\frac{\sum_{n=1}^{4}\sum_{y=1}^{4} \%\ vehicle\ type_{ny} \cdot \%\ compliance_{ny} \cdot 10^{(dB\ limit_{ny}/10)}}{100}\right]$$

Where

- *n* accounts for the type of vehicle (step 1)

- *y* accounts for the years where new sound level limits enter into force (i.e. 2014/15, 2016, 2022 -Table A)
- *% vehicle type*$_{ny}$ represent the % of vehicles of type *n* for the year *y* (a year where new sound level limits enter into force);
- % *compliance*$_{ny}$ is the percentage of vehicle type *n* compliant with the noise limit set in year *y*.
- *dB limit* is the equivalent limit value per vehicle type $_n$ and year $_y$ obtained from Table B.

4. Calculate the difference between t_{2022} and t_{2017} to get the dB increase for the given period.
5. The dB change is integrated with the dB changes of the other factors as explained in Figure 4.3

E. Low noise asphalt on major roads and other roads in agglomerations

Since quiet asphalt is more effective at higher speeds when the dominating noise source is the road/tyre interaction, a differential dB reduction has been considered (2017-2022): 2 dB reduction on major roads and 1 dB reduction on other roads. The value selected allows for some in-service degradation of noise performance, probably leading to a slight overestimation of noise reduction from propulsion sources. Since we are backdating, then the outcome of applying low noise asphalt is a dB increase (2022 – 2017).

Assumptions:

- Uniform increase of dB in all noise bands
- The percentage of major roads per agglomeration is derived from the ratio between people exposed to major roads and total people exposed to road traffic noise from the data reported by MS. The ratio is considered a proxy for the percentage of major roads. When data not available the EU average will apply.

Approach:

1. Calculate the percentage of major roads and other roads.
   The percentage of major roads per agglomeration is derived from the ratio between people exposed to major roads and total people exposed to road traffic noise, from the data reported by MS. When data not available the EU average will apply.
2. Apply the noise increase values provided in Table 4.1 per each noise band, considering the % of major roads and other roads.

F. Noise barriers on major roads in agglomerations

In EC, et al., 2021a, it is estimated that 5 % of the total EU road length benefits from a noise barrier. A source of the estimation is not cited, and it is considered unlikely that data would be available at EU scale to inform it. Further research has not provided data to support or refute such assumptions. It is, therefore, likely that those assumptions were made based on examples and extrapolations, which could have been optimistic if based on a national or regional example from a country where integration of noise control in infrastructure is well developed. Based on estimations from Germany and proxy information from the Noise Action Plans, more conservative values have been adopted as presented in Table 4.1.

Assumptions: We assimilate the proportion of people exposed to major roads as percentage of major roads.

Approach:

1. Calculate the % of major roads (see E)
2. The dB change is integrated with the dB changes of the other factors as explained in Figure 4.3

4.4.3 Rail traffic noise inside agglomerations

Table 4.4 provides an overview of the references and specifications for the different factors considered for calculating the estimated new 2017 baseline.

Figure 4.10 provides an overview of the workflow to calculate rail traffic noise baseline inside agglomerations. This workflow is developed in a stepwise process where the several factors that interact with noise exposure are progressively integrated (see Figure 4.3).

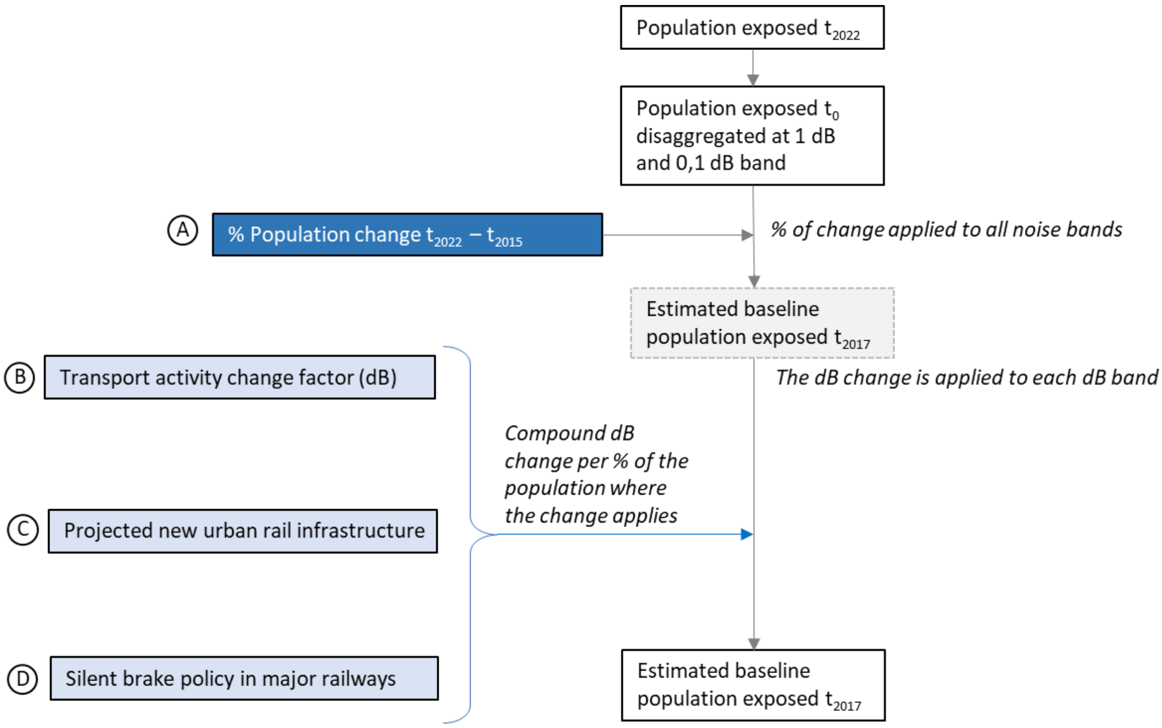
Since the railway network in Europe is mainly electrified (EC, 2017), and rail runs almost exclusively on electricity in urban areas as of 2017, the electrification factor has not been included in estimating the new 2017 exposure baseline dataset.

Moreover, it should be considered that noise barriers are not included in since we opted to prioritise those measures subject to European regulations. Also, the Phenomena study (EC, et al., 2021a) concluded that the effects of noise barriers are small, as they affect only a limited percentage of the railway lengths. It has also been considered that noise barriers for railways are already widely applied, and therefore, there is less room for an increase. Moreover, the dB increase of new lines considers the whole infrastructure, including noise barriers in urbanised areas.

Table 4.4 Overview of the factors related to rail traffic noise inside agglomerations for estimating 2017 baseline. Cells in red indicate those factors contributing to increased noise pollution (backward trend 2022 -> 2017). Green indicates that the considered factor decreases dB (noise pollution reduction)

Factor	Reference	Trend 2017 - 2022	Backward trend to estimate 2017 baseline
A. Population change	Population change based on data reported DF1-5.	The trend is agglomeration-specific. All options are feasible.	The trend is agglomeration-specific. All options are feasible.
B. Transport activity change	Projections based on International Union of Railways (IEA and IUR, 2017)	Increase by 12 % of rail activity +0,5 dB	Decrease i.e. lower levels in 2017 compared to 2022
C. Projected new urban rail infrastructure	(UITP, 2019)	+0,3 dB	Decrease i.e. lower levels in 2017 compared to 2022
D. Silent brake policy in major railways	(EUAR, 2018)	-0,3 dB	Increase i.e. higher levels in 2017 compared to 2022

Figure 4.10 General workflow for rail traffic noise inside agglomerations. Demographic changes (A) (in dark blue), factors related to traffic flow (B), new urban rail infrastructure (C) and other noise abatement measures (D) contribute to the population change exposed to rail traffic noise between t_0 and t_1. Boxes in grey refer to intermediate calculations. Letters link to summary Table 4.4, which provides the reference values used



The following sections provide the detailed calculation for each factor. Demographic change (A) has already been explained in section 4.4.1 since the approach is common for all noise sources inside agglomerations.

Factor B. Rail traffic growth

The PRIMES model (E3 Modelling, 2018) provides the transport activity data based on the EU Reference Scenario 2020 (EC, et al. 2021b) as the number of passengers and tones of goods (Gpkm and Gtkm, respectively) as described in the previous section on road traffic noise.

However, this model does not allow to differentiate urban railways. Therefore, a projection for urban rail transport developed by the International Energy Agency and International Union of Railways (IEA and IUR, 2017) have been adopted:

- Baseline scenario, where urban transport activity in Europe will grow by 30 %, from 95 billion passenger-km in 2017 to 126 billion passenger-km in 2030.
- By way of linear interpolation, a decrease in urban rail activity of 12 % is estimated from 2022 to 2017, corresponding to a 0,5 dB decrease to calculate the estimated baseline for 2017 reference year.

Assumptions:

- The same urban rail traffic change applied to all agglomerations (resulting in a decrease from 2020 to 2015);
- Corresponding noise change (decrease 2020 to 2015) applied to all noise bands.

Approach:

1. The dB change provided in Table 4.4 is applied to all dB bands calculated in the previous step (A. population change).

Factor C. Projected new urban rail infrastructure

Changes in urban rail infrastructure are derived from the forecast provided by UITP (2019) for the period 2014 -2021, leading to an increase of 580 km of new light rail transit in 2021. The same trend for this period is projected to 2022, resulting in the figures in Table 4.5. These changes, presented in chronological sequence, are, in the end, reversed to obtain the factor change to backdate from 2022 to 2017.

Table 4.5 Projected new urban rail infrastructure (UITP, 2019)

	2017	2022	dB change for backdating 2022->2017
Kilometers (Gpkm)	9 188	9 767	
Gpkm % change	--	6 %	
dB change	--	0.3	-0,3

Assumptions:

- All scenarios are based on the same growth per year. As we are backdating, there is a decrease in rail infrastructure from 2022 to 2017.

Approach:

1. The dB change (decrease) provided in Table 4.4 is integrated with the dB changes of the other factors, as explained in Figure 4.3

Factor D. Silent brake policy in major railways in agglomerations

The silent brake policy (EUAR, 2014) sets out noise limits for new rail vehicles and renewed or upgraded wagons. It also imposes Member States to designate quieter routes.
Values provided in Table 4.4 are derived from the railway noise reduction total for the EU from the silent brake policy by European Railway Agency (EUAR, 2018).

Assumptions:

- Same level of implementation for 2017 and 2022

Approach:

a. Calculate the percentage of major rails inside agglomerations.
The percentage of major rail per agglomeration is derived from the ratio between people exposed to major rails and total people exposed to rail traffic noise. When data not available the EU average will apply.

b. Integrate the noise change values provided in Table 4.4 with the dB changes of the other factors as explained in Figure 4.3

4.4.4 Aircraft noise inside agglomerations

A major constraint to calculating the baseline for airports is that each airport has its specificities (location of the airport, population living next to the airport, the proportion of the people affected living within or outside an urban area, fleet mix, flight procedures, night movements, degree of implementation of noise control measures under the Balanced Approach, etc.), which significantly influence the outcomes.

Some measures will have a positive effect on one airport, whereas the same measure at another airport may not have an effect at all. Even at a single airport, a noise solution with a benefit at one location may negatively affect another location (e.g. shift of flight tracks). The effects at specific locations and the overall effect for the whole airport will depend on the local situation and the actual scenario considered. However, the baseline proposed in this report is intended to be aggregated at a European level; therefore, local differences may compensate by providing a reasonable European baseline.

Noise reductions for new aircraft are driven by ICAO (2017) and adopted in the EU through Regulation (EU) No 2018/1139 (EU, 2018) and the EASA Certification Noise Levels (EASA, 2018). The most recent reduction in permitted noise standards for subsonic jet and propeller-driven aeroplanes was adopted in 2014, and it is applicable to new aeroplane types submitted for certification on or after 31 December 2017 and on or after 31 December 2020 for aircraft less than 55 tonnes in mass.

Mitigation of aircraft noise associated with airports' operation is regulated by the Balanced Approach Regulation (EU, 2014). For the estimation of the new 2017 exposure baseline, it is considered that no significant changes between 2017 and 2022 occur as regards to the balanced approach. Moreover, changes in population exposure both inside and outside urban areas due to aircraft noise are not expected to be as pronounced as with the other sources, because the receiver points and measurement points in the most exposed façade will be the same as the ones used in previous reporting cycles.

Table 4.6 provides an overview of the references and specifications for the different factors considered for estimating the 2017 exposure baseline and Figure 4.11 provides an overview of the workflow.

Table 4.6 Overview of the factors related to aircraft traffic noise inside agglomerations for estimating 2017 baseline. Cells in red indicate those factors contributing to increased noise pollution (backward trend 2022 -> 2017)

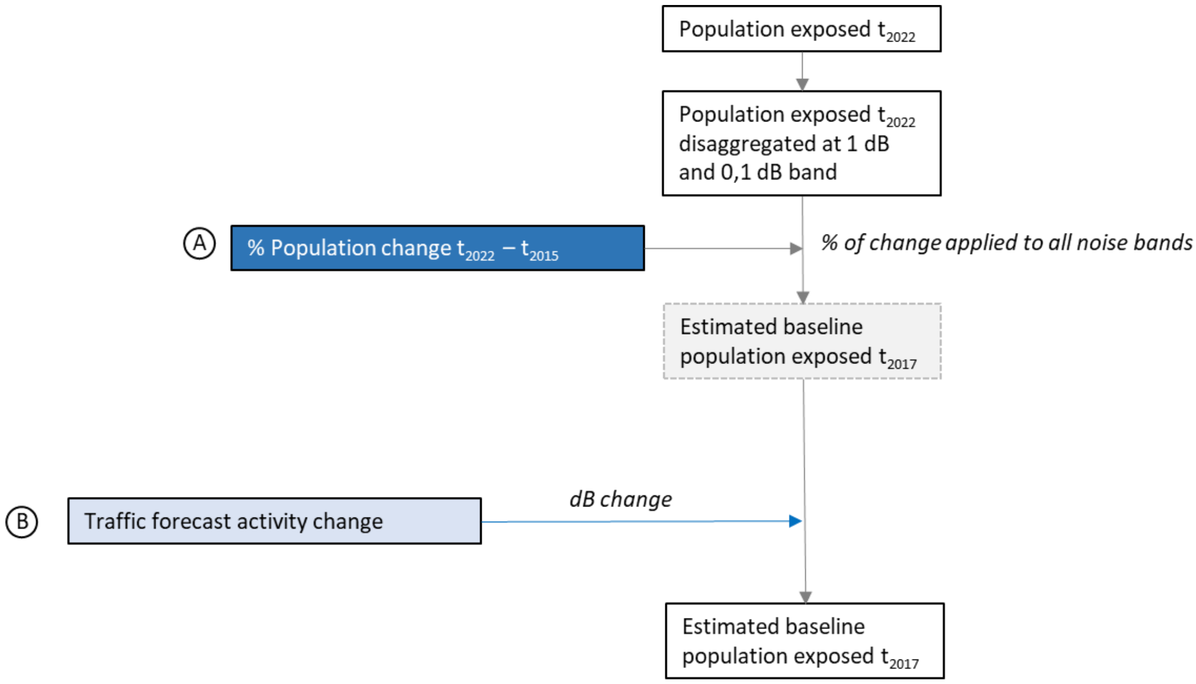
Factor	Reference	Trend 2017 - 2022	Backward trend to estimate 2017 baseline
A. Population change	Population change based on data reported DF1-5.	The trend is agglomeration-specific. All options are feasible.	The trend is agglomeration-specific. All options are feasible.
B. Traffic forecast activity change	"COVID-19 impact on the European air traffic network" (Eurocontrol, 2021). European Aviation Environmental Report (EASA et al., 2022)	Total increase of 2,25dB (not per year) calculating backwards from 2022 to 2017	Increase i.e. higher levels in 2017 compared to 2022

The following factors were not considered in the calculations because it is assumed that there are no significant changes between 2017 and 2022:

- Sound insulation of residential and communal buildings, including government incentives for homeowners. Sound insulation is a valuable mitigation tool as it is a straightforward measure that can be retrofitted in a short timescale. It is unlikely that a regulation is brought forward, and even if it were, it is unlikely that the benefit would be seen within the project timescales or at the EU scale; and

- Extension of land barrier, land use planning including acquisition of dwellings. These mitigation measures are available to regions and airports. However, in the timeframe for this study, they could not be reasonably imposed at EU level. In contrast, land use planning is effective but is subject to long-time scale regional planning. Nonetheless, they are all valuable and effective tools in reducing health impacts of noise and are worthy of consideration, particularly on a national level and with respect to minimising and mitigating impacts of airport expansion.
- Quieter aircraft. Uptake of new technology is assumed to be low between 2017 and 2022 because of the slow introduction of new quieter aircraft coming into service (EASA et al., 2019; ICAO, 2019).

Figure 4.11 General workflow for aircraft traffic noise inside agglomerations. Demographic changes (A) (in dark blue), and factors related to traffic flow (B) contribute to the population change exposed to aircraft traffic noise between t_{2022} and t_{2017}. Boxes in grey refer to intermediate calculations. Letters link to summary Table 4.6, which provides the reference values used

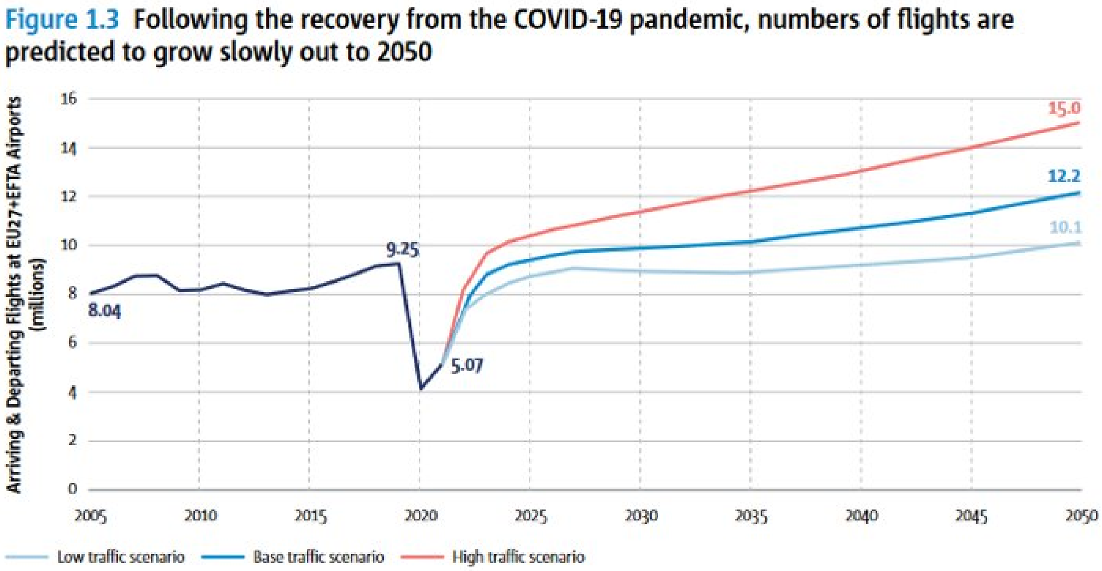


The following section provides the detailed calculation for traffic activity change. Demographic change (Factor A) has already been explained in section 4.4.1 since the approach is common for all noise sources inside agglomerations.

Factor B. Traffic forecast activity change

The report *COVID-19 impact on the European air traffic network* (Eurocontrol, 2021) provides projections on the number of flights for the period 2021- 2027 which account for the impact of the COVID. Additionally, the *European Aviation Environmental Report 2022* (EASA et al., 2022) provides three scenarios for the period 2017 -2040, developed before the COVID. Considering the values provided in both references, the approach detailed in Figure 4.12 and the calculation details below has been adopted.

Figure 4.12 Figure extracted from (EASA et al., 2022) report and calculation that has been applied for estimating 2017 baseline in relation to aircraft noise



In 2016 → 8,51
In 2021→ 5,07
Percentage change from 2021 to 2016 (3,44*100/5,07) = + 67,85%
dB change = 10 log (1+67,85/100)
dB change = **+2,25 dB** from 2021 to 2016 (not per year: the total)

4.4.5 Industrial noise inside agglomerations

Industrial noise is related to local conditions; therefore, factors that could explain changes in people exposed between 2017 and 2022 could not be identified with European data.

The estimation of the 2017 baseline is based only on the demographic change presented in section 4.4.1.

Moreover, it needs to be taken into consideration that estimations for industrial noise are difficult to make because of large amounts of gaps in the data.

4.5 Noise sources outside agglomerations

4.5.1 Common factor: Demographic changes

Calculating demographic changes (2020-2015) is the first step in calculating the new estimated baseline for 2017 (Figure 4.2). The approach is common for all noise sources outside agglomerations, and we assume homogenous population change across all dB ranges. Therefore, the ratio of population change is applied to the population exposed to all noise bands in 2022.

If a specific noise source does not have to be reported in 2017, then the baseline is not calculated, and the demographic change is not needed.

The process to calculate the demographic change for major sources is described as follows:

1. The data needed for the calculation of the demographic change is extracted from Eurostat to work with harmonised data
    a. Total population of the country: 2015 and 2020
    b. Population of cities with more than 100 000 inhabitants: 2015 and 2020. However, the information from Eurostat is uncomplete -for example there is no data for Denmark. Therefore, we have taken the population from the agglomerations reported under the END.
2. Calculate the population change for each country

$$Population\ change_{\square} = \frac{Total\ population\ 2015 \quad - \sum Population\ city\ 2015_{\square}}{Total\ population\ 2020 \quad - \sum Population\ city\ 2000_{\square}}$$

Where:

$Total\ population\ 2015$ is the population of the country in 2015

$Total\ population\ 2020$ is the population of the country in 2020

$Population\ city\ 2015_{\square}$ is the population of cities with more than 100 000 in the country in 2015

$Population\ city\ 2020_{\square}$ is the population of cities with more than 100 000 in the country in 2020

3. Apply the change ratio to all noise bands in each country:

$$Pop\_exposed\_dB_{n2017_{ctry\_i}} = Pop\_exposed\_dB_{n2022_{ctry\_i}} \cdot Pop\_chang_{ctry\_i}$$

Where:

- $Pop\_exposed\_dB_{n2017_{ctry\_i}}$ is the estimated population exposed to *n* dB in 2017 (new baseline), country *i* (unique combination of country and dB at decimal level). This is the output variable and it corresponds to the baseline of the population exposed in 2017. This is the first step.
- $Pop\_exposed\_dB_{n2022_{agg\_i}}$ is the population exposed to *n* dB in 2022, in country *i* (unique combination of country and dB at decimal level).
- $Pop\_change_{agg\_i}$ is the ratio of change of total population in country *I* as calculated in previous step (2).

Output:

- A new variable is created: $Pop\_exposed\_baseline\_2017_i$ (P*opulation exposed 2017 baseline for country$_i$*)

4.5.2 Road traffic noise outside agglomerations

Table 4.7 provides an overview of the scenarios for road traffic noise outside agglomerations, with references and specifications for the factors that are taken into consideration for calculating the 2017 baseline.

Figure 4.13 provides an overview of the workflow to calculate the 2017 estimated road traffic noise exposure outside agglomerations (new baseline).

The following factors have been excluded since they have been considered not significantly contributing to change in road traffic noise between 2015 and 2020:

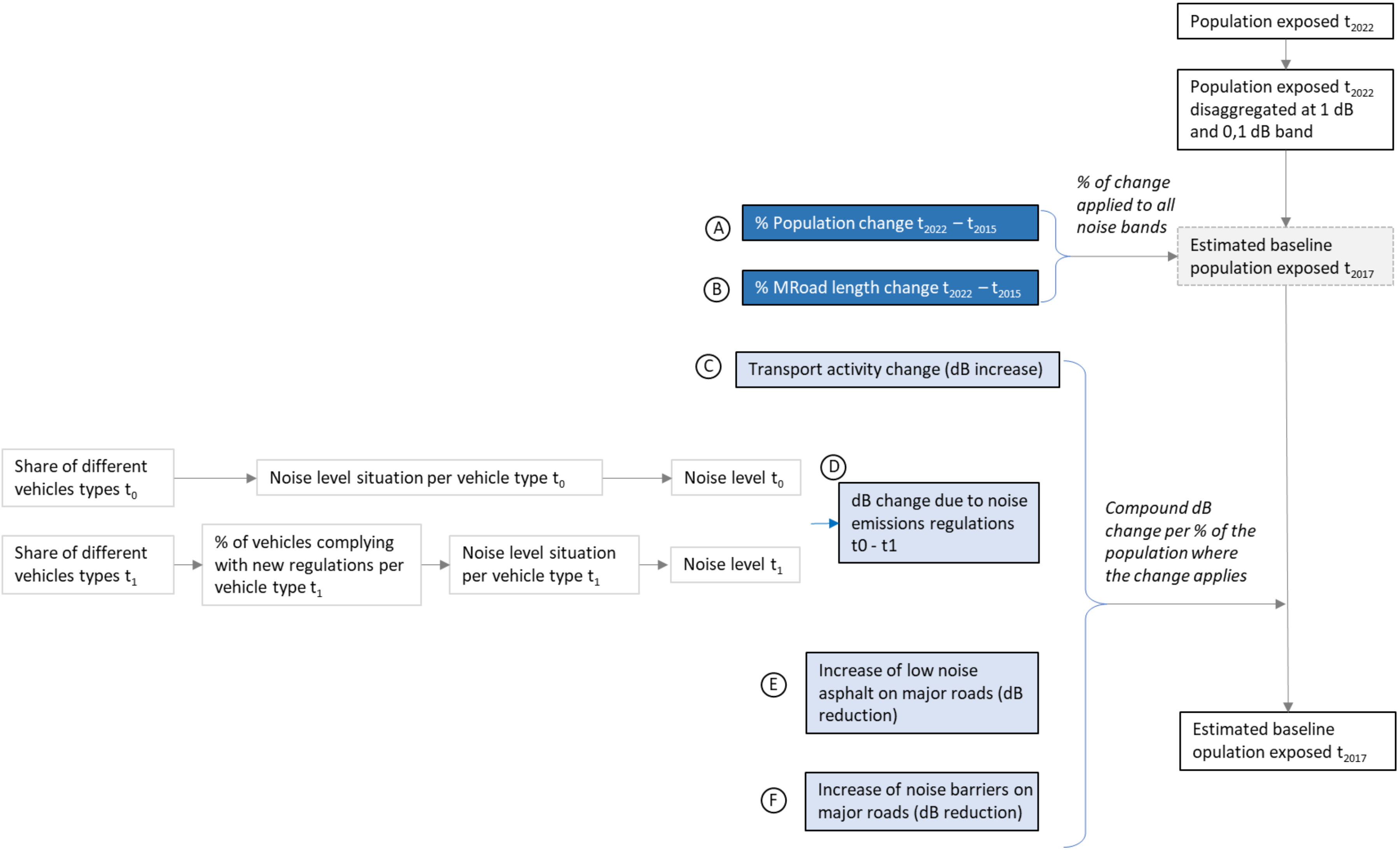
Tyre noise: Noise reduction due to tyre noise is somehow considered when integrating other measures, such as the regulation of the sound level of motor vehicles or speed regulation. Moreover, we assume all tyres have met the 2016 limits, and the effect is related to road surface type. Emissions from noise tyres are regulated by Regulation 117 (UNECE, 2011) and have been applicable since 2016. Given that car tyres are considered to have an average life of 4 years, it is assumed that by 2022, all tyres in use will meet the requirements set in the Regulation. Therefore, tyre noise does not require adjustments except that the noise performance of the tyre depends on the road surface type, which is included in the model by considering the low noise asphalt (see factor D in Table 4.1). It should be noted that lowering the noise limit values for tyres would have effectively reduced noise at the source.

- **Speed limit outside agglomerations**: This is an effective measure; however, there is no specific regulation at the European level, and practices vary from country to country. Therefore, unlike inside agglomerations, where there is a broad convergence to apply this measure, the speed limit is not considered outside agglomerations.

Table 4.7 Overview of the factors related to road traffic noise outside agglomerations for estimating 2017 baseline. Cells in red indicate those factors contributing to increased noise pollution (backward trend 2022 -> 2017). Green shows that the considered factor decreases dB (noise pollution reduction)

Factor	Reference	Trend 2017 - 2022	Backward direction to estimate 2017 baseline
A. Population change	Population change based on data reported DF1-5. Total population at country level (Eurostat).	The trend is country-specific. All options are feasible.	The trend is country-specific.
B Change of major road length	Eurostat	The trend is specific for each country. In general, tends to increase	Specific for each country.
C. Transport activity change	Road traffic growth forecast (in Gpkm) and the freight traffic growth (in Gtkm) based on the EU Reference Scenario (EC, et al., 2021b) and PRIMES model (E3 Modelling, 2018).	Road traffic forecast is provided at a country level. It is assumed 3 dB increase per doubling traffic volume.	General decrease, i.e. lower levels in 2017 compared to 2022. Specific per each country.
D. Noise emissions regulations	Share of vehicles from ACEA 2022 (ACEA, 2022). Percentage of vehicles complying with new regulations (EC, et al., 2021a) and emission values (Linear regression from EC, et al., 2021a).	The decrease in emissions is based on the vehicle fleet, the change in the percentage of vehicles complying with the regulation on the sound level of motor vehicles of 2015, 2016, 2020/2022.	Increase, i.e. higher levels in 2017 compared to 2022
E. Low-noise asphalt on major roads	It is assumed 2 dB reduction on major roads and a 1 dB reduction on other roads. Phenomena project (EC, et al., 2021a) and END Noise Action Plans (Blanes et al., 2020; Fons-Esteve et al., 2021)	2 % increase in low noise asphalt from 2017 -1 dB on 2 % of non-major roads	Increase, i.e. higher levels in 2017 compared to 2022
F. Noise barriers on major roads	Own estimates based on data from countries	0,5 % increase in noise barriers on major roads -10 dB on 0,5 % of major roads	Increase, i.e. higher levels in 2017 compared to 2022

Figure 4.13 General workflow for road traffic noise outside agglomerations. Demographic changes (A) (in dark blue), factors related to change on road network (B), traffic flow (C), technological changes resulting from policy measures (D), and other noise abatement measures (E and F) contribute to the population change exposed to road traffic noise between t_{2022} and t_{2017}. Boxes in grey refer to intermediate calculations. Letters link to summary Table 4.7, which provides the reference values used



The following sections provide the detailed calculation for each factor. Demographic change (Factor A) has already been explained in section 4.5.1 since the approach is common for road and rail traffic noise sources outside agglomerations.

Factor B. Change of road length

Figure 4.14 provides an overview of the workflow to estimate the road length change between 2020-2015 outside agglomerations, which is applied to the baseline obtained after applying the population change (step A in Figure 4.13).

Two elements need to be considered since they determine how changes are calculated:

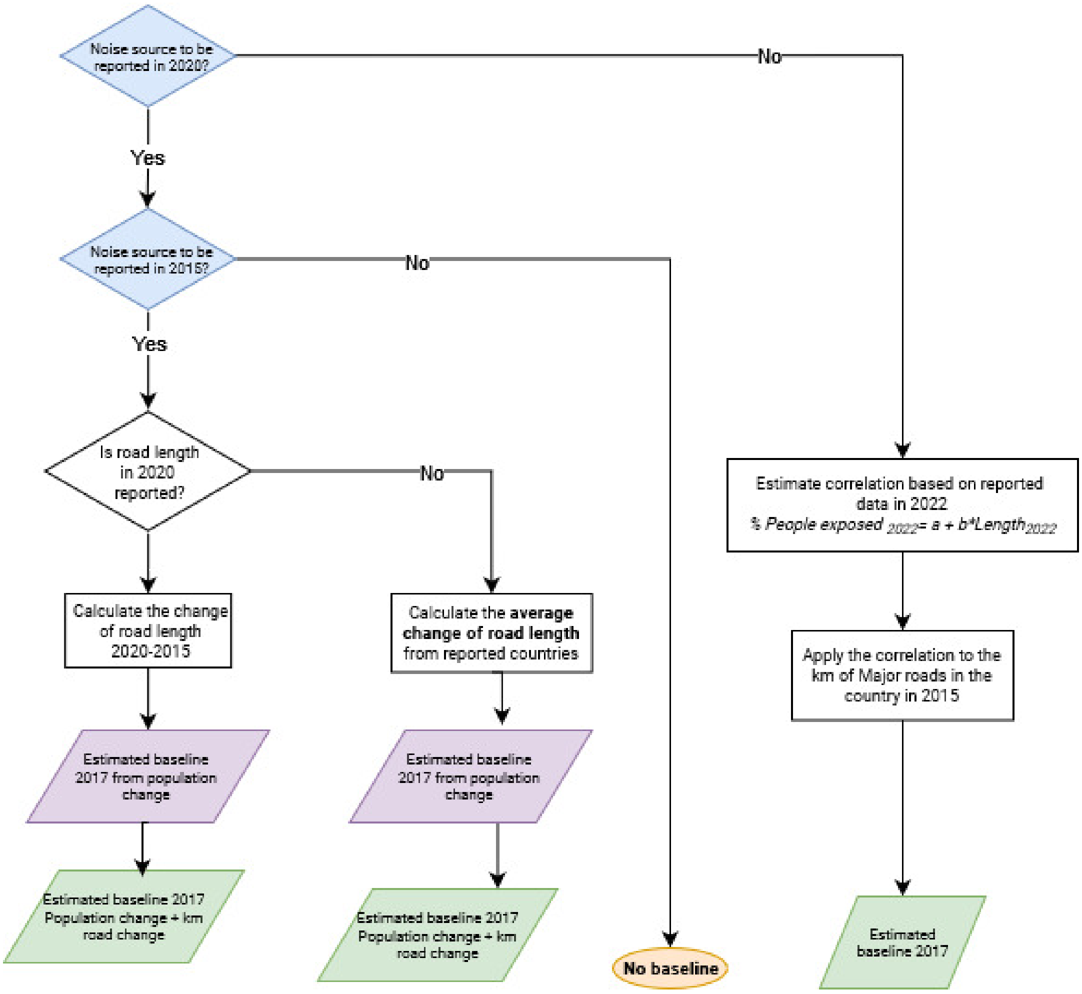
- The reporting obligation on the traffic noise source for a specific year in a country. If a country does not have to report traffic noise outside agglomerations in 2015, then the baseline is not calculated. This is a rare case, however, it has been included to have a general model that could be applied in any case.
- Completeness of data reported. Section 3 already describes the gap-filling approach and section 4.3 provides details for the input data. Figure 4.14 includes all these cases.

The percentage of road length change outside agglomerations between 2020-2015 has been calculated based on Eurostat data:

$$Change\ ratio = \left(1 - \frac{Road\ length\ outside_{2015}}{Road\ length\ outside_{2020}}\right))$$

The change ratio is country-specific.

Figure 4.14 Workflow for calculating the change of major road length 2020-2015 outside agglomerations and its application to people exposed in 2022 (first step for estimating the 2017 baseline -see Figure 4.13). This workflow is applied individually to each country. In blue those steps related to evaluating the noise reporting obligation for major roads in the country. We used the length of major roads provided by Eurostat



Factor C. Transport activity change

The PRIMES model provides the transport activity data based on the EU Reference Scenario 2020 as the number of passengers and tones of goods (Gpkm and Gtkm, respectively). Therefore, a linear relationship has been assumed between the increase of passengers and the increase in the traffic volume (i.e. constant occupancy of vehicles over the period analysed).

Data is available at a country level, and for the purpose of the current scenarios, the years 2015, 2020, 2025 and 2030 have been selected.

Assumptions:

- The same percentage of traffic change is applied to all scenarios;
- Uniform reduction of dB to all noise bands.

Approach: The same approach is applied for road noise inside agglomerations (section 4.4.2, B).

Factor D. Regulation of the sound level of motor vehicles

EU sound level limits for vehicles changed in 2016 and 2020/2022 -and will change further in 2024/2026. We apply this regulation to all cars at any speed. As new model vehicles come into service, the percentage of the fleet that complies with the newer limits will increase. Therefore, percentage compliance with vehicle emission limits will increase year on year, with a commensurate reduction in noise.

The baseline conditions of the road vehicle fleet can be obtained with reference to the ACEA Vehicle in Use Report (ACEA, 2022), which presents vehicle numbers annually from 2011 up to 2020 and in detail for 2020 subdivided into vehicle categories and Member States.

Approach: The same approach as for road noise inside agglomerations is applied (see section 4.4.2, Factor B)).

Factor E. Low noise asphalt on major roads

For quiet road surfaces on major roads (all roads outside agglomerations), a 1 dB reduction is assumed (Wood, 2022). The value selected allows for some in-service degradation of noise performance. This may lead to a slight overestimation of noise reduction from propulsion sources. To backdate, we need to reverse the sign of the trend 2017-2022, resulting in an increase of dB from 2022 to 2017.

Approach:

1. The corresponding dB change for low noise asphalt (see Table 4.7) is integrated with the dB changes of the other factors, as explained in Figure 4.3

Factor F. Noise barriers on major roads

In EC, et al., 2021a, it is estimated that 5 % of the total EU road length benefits from a noise barrier. A source of the estimation is not cited, and it is considered unlikely that data would be available at EU scale to inform it. Further research has not provided data to support or refute such assumptions. Therefore, those assumptions were likely made based on examples and extrapolations, which could have been optimistic if based on a national or regional example from a country where the integration of noise control in infrastructure is well developed. More conservative values have been adopted based on estimations from Germany and proxy information from the Noise Action Plans (Table 4.7).

Approach:

1. The corresponding dB change for noise barriers (Table 4.7) is integrated with the dB changes of the other factors, as explained in Figure 4.3

4.5.3 Rail traffic noise outside agglomerations

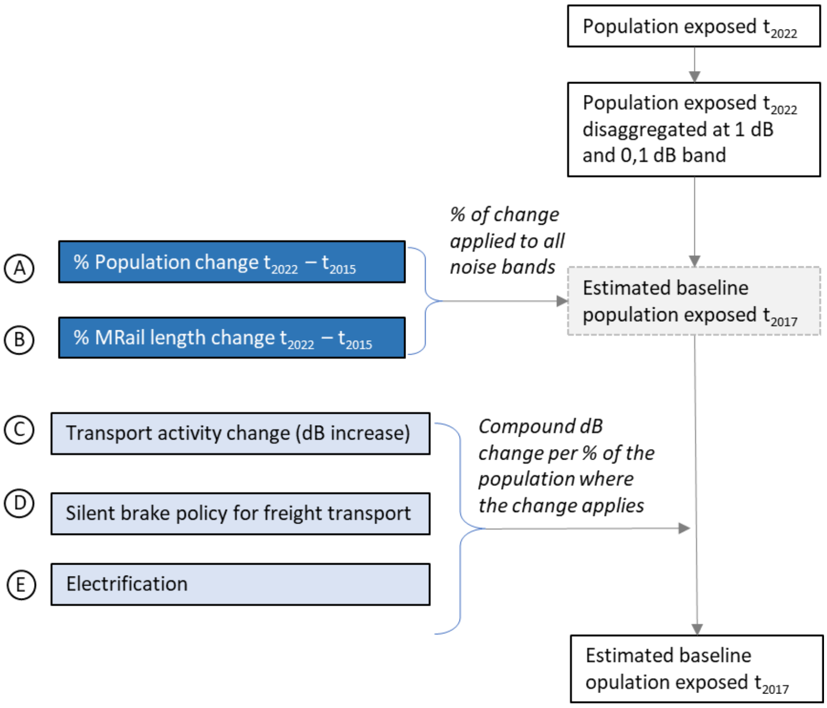
Table 4.8 provides an overview of references and specifications for the factors considered for calculating the 2017 baseline.

Figure 4.15 provides an overview of the workflow to calculate rail traffic noise baseline outside agglomerations.

Table 4.8 Overview of the factors related to rail traffic noise outside agglomerations for estimating 2017 baseline. Cells in red indicate those factors contributing to increased noise pollution (backward trend 2022 -> 2017). Green shows that the considered factor decreases dB (noise pollution reduction)

Factor	Reference	Trend 2017 - 2022	Backward trend to estimate 2017 baseline
A. Population change	Population change based on data reported DF1-5. Total population at country level (Eurostat).	The trend is country-specific. All options are feasible.	The trend is country-specific. All options are viable.
B Change of major rail length	Eurostat	The trend is specific for each country. In general, it tends to increase	Specific for each country.
C. Transport activity change	Rail passenger traffic growth forecast (in Gpkm), and the freight traffic growth (in Gtkm) based on the EU Reference Scenario (EC, et al., 2021b) and PRIMES model (E3 Modelling, 2018)	Rail traffic growth forecast is provided at a country level and for each year of the scenarios. It is assumed 3 dB increase per doubling traffic volume.	General decrease i.e. lower levels in 2017 compared to 2022. Specific for each country.
D. Silent brake policy for freight transport	EUAR, 2018	-0,3 dB	Increase i.e. higher levels in 2017 compared to 2022
E. Electrification	Estimations based on EC, 2017.	-0,1 dB	Increase i.e. higher levels in 2017 compared to 2022

Figure 4.15 General workflow for rail traffic noise outside agglomerations. Demographic changes (A) (in dark blue), factors related to changes in road network (B), traffic flow (C), technological changes resulting from policy measures (D), and other noise abatement measures (E) contribute to the population change exposed to rail traffic noise between t_{2022} and t_{2017}. Boxes in grey refer to intermediate calculations. Letters link to summary Table 4.8, which provides the reference values used



The following sections provide the detailed calculation for each factor. Demographic change (Factor A) has already explained in section 4.5.1 since the approach is common for road and rail traffic noise sources outside agglomerations.

Factor B. Change of rail length

The same approach as the one taken from major roads outside agglomerations, applies to major rails (Figure 4.14).

Two elements need to be considered since they determine how changes are calculated:

- The reporting obligation on the traffic noise source for a specific year in a country. If a country does not have to report traffic noise outside agglomerations in 2015, then the baseline is not calculated.
- Completeness of data reported. Section 3 already describes the gap-filling approach and section 4.3 provides details for the input data. Figure 4.14 includes all these cases.

The percentage of rail length change outside agglomerations between 2020-2015 has been calculated based on Eurostat data:

$$Change\ ratio = \left(1 - \frac{Road\ length\ outside_{2015}}{Road\ length\ outside_{2020}}\right))$$

The change ratio is country-specific.

In the first step, the demographic change was applied to the population exposed to rail traffic noise outside agglomerations in 2022. The rail length factor is then applied to the outcome of the demographic change.

Factor C. Rail traffic growth

The PRIMES model (E3 Modelling, 2018) provides the transport activity data based on the EU Reference Scenario 2020 (EC, et al., 2021b) as the number of passengers and tones of goods (Gpkm and Gtkm, respectively) as described in the previous section on road traffic noise.

Data is available at a country level, and for the purpose of the current scenarios, the years 2015, 2020, and 2025 have been selected.

Assumptions:

- The same percentage of traffic change is applied to all scenarios;
- Uniform reduction of dB to all noise bands.

Approach:

1. It is assumed a 3 dB per doubling the traffic volume (ref). Therefore, the following formula is applied to calculate the change in dB for the period 2017 – 2022.

$$dB = 10 * \log\left(1 + \frac{\%\, increase\ of\ traffic}{100}\right)$$

2. The corresponding dB change is integrated with the dB changes of the other factors as explained in Figure 4.3

Factor D. Silent brake policy in major railways

The silent brake policy (EUAR, 2014) sets out noise limits for new rail vehicles, in addition to renewed or upgraded wagons. It also forces Member States to designate quieter routes.

Values provided in Table 4.8 are derived from the railway noise reduction total for the EU from the silent brake policy by European Railway Agency (EUAR, 2018). As we are calculating backdating, there is going to be an increase in dB when estimating the new 2017 exposure baseline.

Approach:

1. The corresponding dB change (Table 4.8) is integrated with the dB changes of the other factors as explained in Figure 4.3.

Factor E. Electrification

The railway network in Europe is mostly electrified (EC, 2017). In urban areas, rail runs almost exclusively on electricity as of 2017. Outside urban areas, 60 % of the European rail network was already electrified, with 80 % of the traffic running on those lines. On the basis of the scenarios proposed by Wood (Wood, 2022), for the year 2022, a level of 65 % electrification of the entire network is assumed, accounting for slow development of construction schemes due to Covid19.

The decibel change related to this activity is taken as 1dB, which is the difference in pass-by noise level between DMU and EMU vehicles, as defined by the Noise TSI. Values of up to 3 dB have been reported for speed lines up to 110 km/h (UIC, 2021), however, at higher speeds rolling noise is more prominent that traction noise, and therefore, a more conservative value is proposed. As we are calculating backdating, there is going to be an increase in dB when estimating the new 2017 exposure baseline.

Table 4.9 Projections of noise reduction due to electrification of the railway network outside urban areas

	2017	2022	2030
% of electrified network	60%	65%	85%
Relative dB reduction	-	0.1	0.3

Source: own elaboration of (European Commission - Directorate-General for Research and Innovation, 2017) including assumed forecasts

Approach:

1. The corresponding dB change (Table 4.8) is integrated with the dB changes of the other factors as explained in Figure 4.3.

4.5.4 Aircraft noise outside agglomerations

A major constraint to calculate the baseline for airports is that each airport has its specificities (location of the airport, population living next to the airport, the proportion of the people affected living within or outside an urban area, fleet mix, flight procedures, night movements, degree of implementation of noise control measures under the Balanced Approach, etc.), which significantly influence the outcomes.

Some measures will have a positive effect on one airport, whereas the same measure at another airport may not have an effect at all. Even at a single airport, a noise solution with a benefit at one location may negatively affect another location (e.g. shift of flight tracks). The effects at specific locations and the overall effect for the whole airport will depend on the local situation and the actual scenario considered. However, the baseline proposed in this report is intended to be aggregated at a European level; therefore, local differences may compensate by providing reasonable European baseline.

Table 4.10 provides an overview of the references and specifications for the different factors considered for calculating the 2017 baseline and Figure 4.11 provides an overview of the workflow.

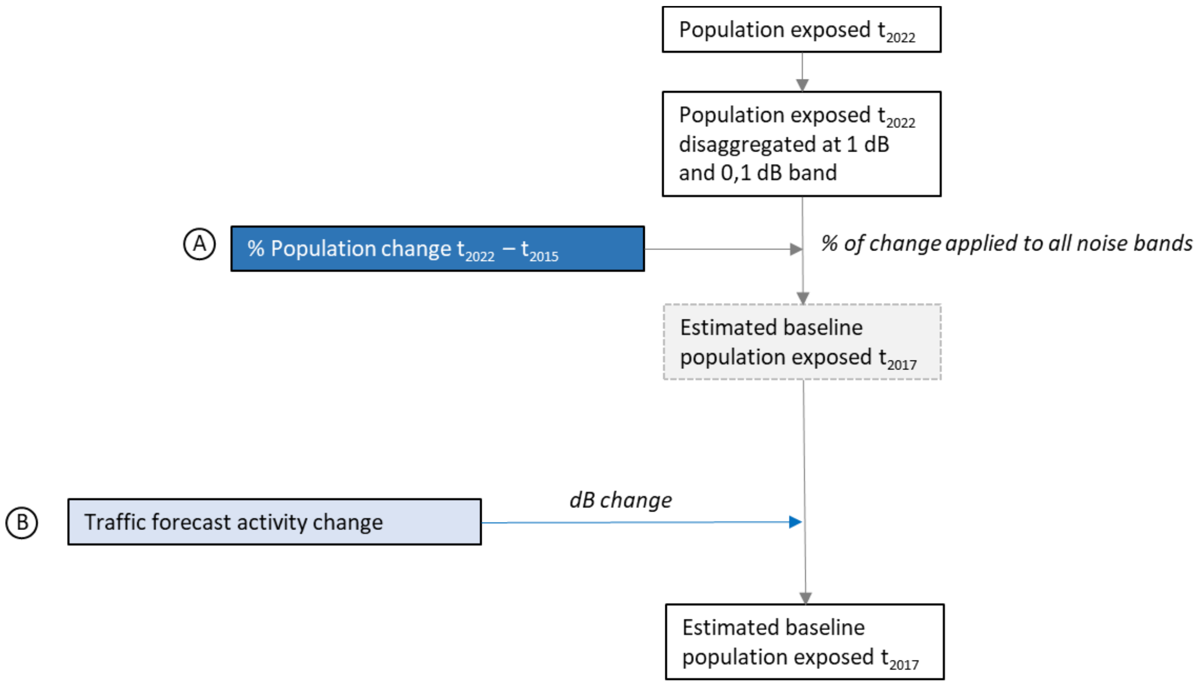
Table 4.10 Overview of the factors related to aircraft traffic noise outside agglomerations for estimating 2017 baseline. Cells in red indicate those factors contributing to increased noise pollution (backward trend 2022 -> 2017)

Factor	Reference	Trend 2017 - 2022	Backward trend to estimate 2017 baseline
A. Population change	Population change based on data reported DF1-5. Total population at country level (Eurostat).	The trend is country-specific. All options are feasible.	The trend is country-specific. All options are feasible.
B. Traffic forecast activity change	“COVID-19 impact on the European air traffic network” (Eurocontrol, 2021). European Aviation Environmental Report (EASA et al., 2022)		Increase, i.e. higher levels in 2017 compared to 2022

The following factors were not considered in the calculations because it is assumed that there are no significant changes between 2017 and 2022:

- Sound insulation of residential and communal buildings, including government incentives for homeowners. Sound insulation is a valuable mitigation tool as it is a straightforward measure that can be retrofitted in a short timescale. It is unlikely that a regulation is brought forward, and even if it were, it is unlikely that the benefit would be seen within the project timescales or at the EU scale; and
- Extension of land barrier, land use planning including acquisition of dwellings. These mitigation measures are available to regions and airports. However, in the timeframe for this study, they could not be reasonably imposed at EU level. In contrast, land use planning is effective but is subject to long-time scale regional planning. Nonetheless, they are all valuable and effective tools in reducing health impacts of noise and are worthy of consideration, particularly on a national level and with respect to minimising and mitigating impacts of airport expansion.
- Quieter aircraft. Uptake of new technology is assumed to be low between 2017 and 2022 because of the slow introduction of new quieter aircraft coming into service (EASA et al., 2019; ICAO, 2019).

Figure 4.16 General workflow for aircraft traffic noise outside agglomerations. Demographic changes (A) (in dark blue), and factors related to traffic flow (B) contribute to the population change exposed to aircraft traffic noise between t_{2022} and t_{2017}. Boxes in grey refer to intermediate calculations. Letters link to summary Table 4.10 which provides the reference values used



The following section provides the detailed calculation for traffic activity change.

Factor A Demographic change

Figure 4.17 provides the workflow for calculating the demographic change.

The first steps in the process are related to the presence of major airports in the country to be reported and, in the positive case, if data has been reported.

Depending on these factors demographic change is calculated differently:

- When the country has major airports to report in 2015 and 2020, and exposure has been reported in 2022, the demographic change is calculated as explained in section 4.5.1. to the 2022 exposed population reference year.
- When exposure data from 2022 is not reported, or the country does not have any major airport fulfilling the END requirements in 2020, the demographic change is obtained from the following ratio -derived from the major airports from the previous bullet point:

$$Demographic\ change_{EU} = \frac{\sum_{i\_1}^{n}\left(\frac{Estimated\ baseline\ 2017_i}{People\ exposed\ 2017_i}\right)}{n\ airtports}$$

Where

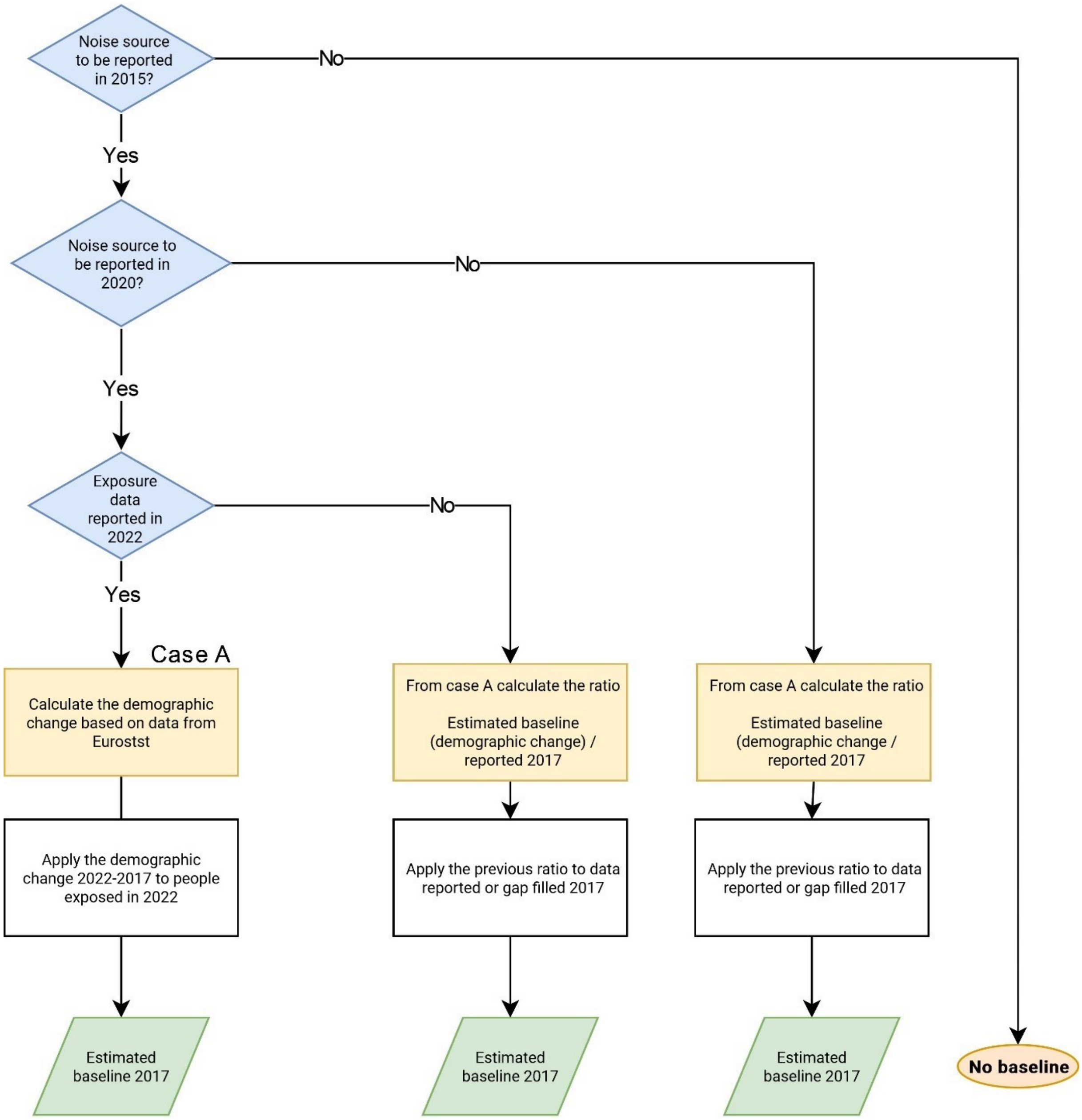
$Demographic\ change_{EU}$ is the average ratio between estimated baseline and resported data on people exposed in 2017 from the major airports where the information is available (reported).

Estimated baseline$_i$ is the estimated baseline after applying demographic change to people exposed in 2022 in major airport *i*. Only major airports with reported data are included.

People exposed 2017*i* is the number of people exposed to noise in 2017 for the major airport i.

n airports is the number of major airports that have been reported in 2022.

Figure 4.17 Workflow for calculating the demographic change 2020-2015 and its application to people exposed in 2022 (first step for the estimation of the 2017 baseline -see Figure 4.2). In blue, steps where the reporting obligation and availability for reported data are checked. In yellow, estimation of the demographic change



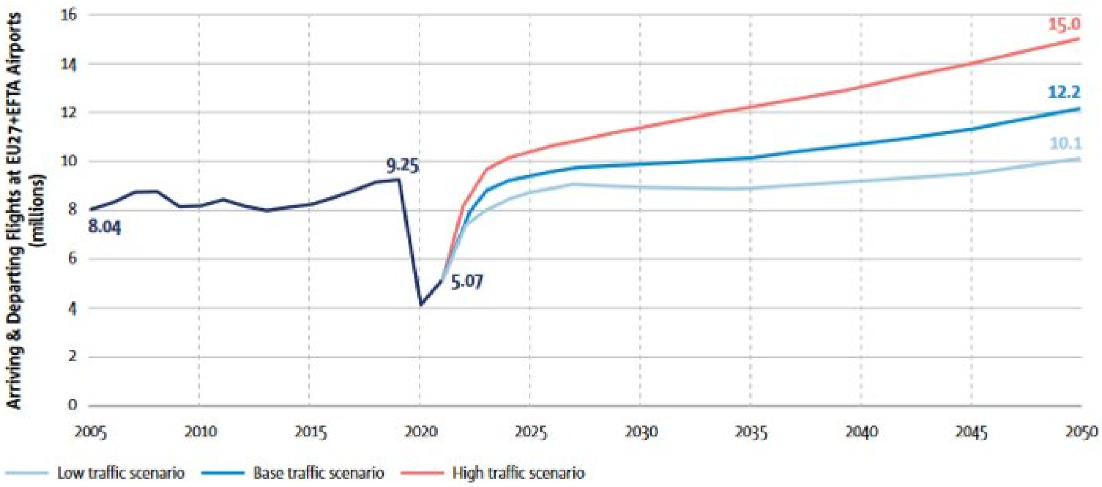
Factor B. Traffic forecast activity change

The same methodology used for aircraft noise inside agglomerations (Section 4.4.4, B. Traffic forecast activity change) is used also for aircraft noise outside agglomerations (copied here for readability).

The report *COVID-19 impact on the European air traffic network* (Eurocontrol, 2021) provides projections on the number of flights for the period 2021- 2027 which account for the impact of the COVID. Additionally, the *European Aviation Environmental Report 2019* (EASA et al., 2022) provides three scenarios for the period 2017 -2040, developed before the COVID. Considering the values provided in both references, the approach detailed in Figure 4.18 and the calculation details below has been adopted.

Figure 4.18 Figure extracted from (EASA et al., 2022) report and calculation that has been applied for estimating 2017 baseline in relation to aircraft noise

Figure 1.3 Following the recovery from the COVID-19 pandemic, numbers of flights are predicted to grow slowly out to 2050



In 2016 → 8,51 In 2021→ 5,07 Percentage change from 2021 to 2016 (3,44*100/5,07) = + 67,85% dB change = 10 log (1+67,85/100) dB change = **+2,25 dB** from 2021 to 2016 (not per year: the total)

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Annex 1. List of agglomerations including the applicable noise sources corresponding to DF1_5 2015 reference year: base data for the estimated 2017 exposure baseline

2015 reference year:

CtryCode	CtryName	UniqueAgglomerationId	AgglomerationName	Inhabitants	Size	DataSource	Road	Rail	Air	Industry
AT	Austria	AG_AT_00_2	Graz	274207	126	RN2	Yes	Yes	Yes	Yes
AT	Austria	AG_AT_00_5	Innsbruck	133596	42	RN2	Yes	Yes	Yes	Yes
AT	Austria	AG_AT_00_3	Linz	221348	112	RN2	Yes	Yes	Yes	Yes
AT	Austria	AG_AT_00_4	Salzburg	148420	66	RN2	Yes	Yes	Yes	Yes
AT	Austria	AG_AT_00_1	Vienna	1862251	459	RN2	Yes	Yes	Yes	Yes
BE	Belgium	BE_B_RBC	Brussels	1175000	160	RN2	Yes	Yes	Yes	Yes
BE	Belgium	BE_f_ag0001	Antwerp	513570	204	RN2	Yes	Yes	Yes	Yes
BE	Belgium	BE_f_ag0003	Bruges	117886	138	RN2	Yes	Yes	No	Yes
BE	Belgium	BE_W_ag1	Charleroi	202480	102	RN2	Yes	Yes	Yes	Yes
BE	Belgium	BE_f_ag0002	Ghent	253266	158	RN2	Yes	Yes	No	Yes
BE	Belgium	BE_W_ag2	Liege	195968	69	RN2	Yes	Yes	No	Yes
BA	Bosnia and Hercegovina	BA_ag_11	Banja Luka	199191	90	RN2	Yes	Yes	Yes	Yes
BA	Bosnia and Hercegovina	BA_ag_a12	Bijeljina	114663	31	RN2	Yes	Yes	Yes	Yes
BA	Bosnia and Hercegovina	BA_ag_a17	Brcko	93028	16	RN2	Yes	Yes	Yes	Yes
BA	Bosnia and Hercegovina	BA_ag_a8	Mostar	113169	36	RN2	Yes	Yes	Yes	Yes
BA	Bosnia and Hercegovina	BA_ag_a11	Prijedor	97588	27	RN2	Yes	Yes	Yes	Yes
BA	Bosnia and Hercegovina	BA_ag_9	Sarajevo	291422	142	RN2	Yes	Yes	Yes	Yes

CtryCode	CtryName	UniqueAgglomerationId	AgglomerationName	Inhabitants	Size	DataSource	Road	Rail	Air	Industry
BA	Bosnia and Hercegovina	BA_ag_3	Tuzla	120441	30	RN2	Yes	Yes	Yes	Yes
BA	Bosnia and Hercegovina	BA_ag_4	Zenica	115134	36	RN2	Yes	Yes	Yes	Yes
BG	Bulgaria	BG_b_ag0004	Burgas	206630	220	RN2	Yes	Yes	Yes	Yes
BG	Bulgaria	BG_b_ag0007	Pleven	111567	85	RN2	Yes	Yes	No	Yes
BG	Bulgaria	BG_b_ag0002	Plovdiv	368983	102	RN2	Yes	Yes	Yes	Yes
BG	Bulgaria	BG_b_ag0006	Ruse	159798	127	RN2	Yes	Yes	No	Yes
BG	Bulgaria	BG_b_ag0001	Sofia	1332817	492	RN2	Yes	Yes	Yes	Yes
BG	Bulgaria	BG_b_ag0005	Stara Zagora	149266	86	RN2	Yes	Yes	No	Yes
BG	Bulgaria	BG_b_ag0003	Varna	355935	154	RN2	Yes	Yes	Yes	Yes
HR	Croatia	ETC_AG_005	Osijek	110493	175	RN2	Yes	Yes	No	Yes
HR	Croatia	AG_HR_00_3	Rijeka	130506	44	RN2	Yes	Yes	No	Yes
HR	Croatia	AG_HR_00_2	Split	178102	80	RN2	Yes	Yes	No	Yes
HR	Croatia	AG_HR_00_1	Zagreb	790017	641	RN2	Yes	Yes	Yes	Yes
CY	Cyprus	AG_CY_00_5	Limassol	193305	66	Email reporter	Yes	No	Yes	Yes
CY	Cyprus	AG_CY_00_1	Nicosia	248130	95	Email reporter	Yes	No	Yes	Yes
CZ	Czechia	AG_CZ_00_002	Brno	409738	328	RN2	Yes	Yes	Yes	Yes
CZ	Czechia	AG_CZ_00_006	Liberec	162189	160	RN2	Yes	Yes	Yes	Yes
CZ	Czechia	AG_CZ_00_007	Olomouc	105230	105	RN2	Yes	Yes	Yes	Yes
CZ	Czechia	AG_CZ_00_003	Ostrava	509290	248	RN2	Yes	Yes	No	Yes
CZ	Czechia	AG_CZ_00_005	Plzen	179403	184	RN2	Yes	Yes	No	Yes
CZ	Czechia	AG_CZ_00_001	Prague	1234005	772	RN2	Yes	Yes	Yes	Yes
CZ	Czechia	AG_CZ_00_004	Teplice	180601	171	RN2	Yes	Yes	Yes	Yes
DK	Denmark	AG_DK_00_3	Aalborg	132864	65	Reporter	Yes	Yes	No	Yes
DK	Denmark	AG_DK_00_1	Aarhus	237797	81	Reporter	Yes	Yes	No	No
DK	Denmark	AG_DK_00_2	Copenhagen	1194507	382	Reporter	Yes	Yes	Yes	No

CtryCode	CtryName	UniqueAgglomerationId	AgglomerationName	Inhabitants	Size	DataSource	Road	Rail	Air	Industry
DK	Denmark	AG_DK_00_4	Odense	188080	101	Reporter	Yes	Yes	No	No
EE	Estonia	AG_EE_00_1	Tallinn	435972	159,2	RN2	Yes	Yes	Yes	Yes
EE	Estonia	AG_EE_00_2	Tartu	96986	38,8	RN2	Yes	Yes	No	Yes
FI	Finland	AG_FI_00_2	Espoo	274583	534	RN2	Yes	Yes	Yes	No
FI	Finland	AG_FI_00_1	Helsinki	635181	216	RN2	Yes	Yes	Yes	No
FI	Finland	AG_FI_00_9	Jyvaskyla	138850	1467	RN2	Yes	Yes	No	No
FI	Finland	AG_FI_00_8	Kauniainen	9397	6	RN2	Yes	Yes	No	No
FI	Finland	AG_FI_00_10	Kuopio	117740	3740	RN2	Yes	Yes	No	No
FI	Finland	AG_FI_00_7	Lahti	119452	518	RN2	Yes	Yes	No	No
FI	Finland	AG_FI_00_6	Oulu	200526	3866	RN2	Yes	Yes	No	No
FI	Finland	AG_FI_00_3	Tampere	228274	525	RN2	Yes	Yes	No	No
FI	Finland	AG_FI_00_5	Turku	187604	306	RN2	Yes	Yes	No	No
FI	Finland	AG_FI_00_4	Vantaa	219341	240	RN2	Yes	Yes	Yes	No
FR	France	AG_FR_00_1	Angers	283200	553	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_2	Arras	110200	306	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_3	Aubergenville	411100	505	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_4	Beauchamp	270700	87	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_5	Bordeaux	774900	578	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_6	Brest	213000	218	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_7	Brunoy	177800	66	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_8	Caen	268900	352	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_9	Cannes	160800	95	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_10	Cergy	205700	84	RN2	Yes	Yes	No	Yes
FR	France	AG_FR_00_11	Clermont-Ferrand	291800	301	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_12	Courcouronnes	347000	221	RN2	Yes	Yes	No	Yes
FR	France	AG_FR_00_13	Dijon	256100	240	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_14	Dunkerque	203800	280	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_15	Grenoble	451800	546	RN2	Yes	Yes	Yes	Yes

CtryCode	CtryName	UniqueAgglomerationId	AgglomerationName	Inhabitants	Size	DataSource	Road	Rail	Air	Industry
FR	France	AG_FR_00_16	Hénin-Beaumont	125900	112	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_17	Le Havre	240300	191	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_18	Le Mans	210900	267	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_19	Le Pecq	341300	139	RN2	Yes	Yes	No	Yes
FR	France	AG_FR_00_20	Lens	245000	239	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_21	Lille	1154100	648	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_22	Lyon	1375000	534	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_23	Marseille	1886800	3149	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_24	Montmorency	183100	74	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_25	Montpellier	457800	422	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_26	Nancy	260700	142	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_27	Nantes	636000	523	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_28	Nice	545000	1466	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_29	Orleans	287100	334	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_30	Orsay	313800	186	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_31	Paris	7068800	814	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_32	Perpignan	268500	617	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_33	Reims	299100	1432	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_34	Rennes	444700	705	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_35	Roissy-en-France	349500	341	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_36	Rouen	499600	664	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_37	Sainte-Geneviève-des-Bois	196000	133	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_38	Saint-Etienne	408700	724	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_39	Strasbourg	491500	338	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_40	Torcy	228900	96	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_41	Toulon	434400	366	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_42	Toulouse	760100	458	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_43	Tours	299100	389	RN2	Yes	Yes	Yes	Yes

CtryCode	CtryName	UniqueAgglomerationId	AgglomerationName	Inhabitants	Size	DataSource	Road	Rail	Air	Industry
FR	France	AG_FR_00_44	Trappes	231100	119	RN2	Yes	Yes	Yes	Yes
FR	France	AG_FR_00_45	Versailles	269200	124	RN2	Yes	Yes	Yes	Yes
DE	Germany	AG_DE_NW_13	Aachen	240484	161	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_BY_3	Augsburg	266647	147	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_NW_24	Bergisch Gladbach	109678	83	RN2	Yes	Yes	Yes	Yes
DE	Germany	AG_DE_BE_1	Berlin	3460725	892	RN2	Yes	Yes	Yes	Yes
DE	Germany	AG_DE_NW_8	Bielefeld	328965	259	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_NW_6	Bochum	361390	146	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_NW_9	Bonn	312207	141	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_NW_22	Bottrop	115780	101	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_NI_2	Braunschweig	250556	193	RN2	Yes	Yes	Yes	Yes
DE	Germany	AG_DE_HB_1	Bremen	549000	317	RN2	Yes	Yes	Yes	Yes
DE	Germany	AG_DE_HB_2	Bremerhaven	109000	94	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_SN_3	Chemnitz	173973	53	RN2	Yes	Yes	No	No
DE	Germany	AG_DE_HE_4	Darmstadt	149743	122	RN2	Yes	Yes	Yes	Yes
DE	Germany	AG_DE_NW_3	Dortmund	578236	281	RN2	Yes	Yes	Yes	Yes
DE	Germany	AG_DE_SN_1	Dresden	509971	186	RN2	Yes	Yes	Yes	No
DE	Germany	AG_DE_NW_5	Duisburg	485580	233	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_NW_2	Dusseldorf	601074	217	RN2	Yes	Yes	Yes	Yes
DE	Germany	AG_DE_BY_8	Erlangen	106326	77	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_NW_4	Essen	570827	210	RN2	Yes	Yes	Yes	Yes
DE	Germany	AG_DE_HE_1	Frankfurt	701350	248	RN2	Yes	Yes	Yes	Yes
DE	Germany	AG_DE_BW_4	Freiburg	219430	153	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_BY_7	Furth	116317	63	RN2	Yes	Yes	Yes	Yes
DE	Germany	AG_DE_NW_11	Gelsenkirchen	258290	105	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_NI_5	Gottingen	121364	117	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_NW_16	Hagen	185823	160	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_ST_1	Halle	231565	136	RN2	Yes	Yes	No	Yes

CtryCode	CtryName	UniqueAgglomerationId	AgglomerationName	Inhabitants	Size	DataSource	Road	Rail	Air	Industry
DE	Germany	AG_DE_HH_1	Hamburg	1896342	1045	RN2	Yes	Yes	Yes	Yes
DE	Germany	AG_DE_NI_1	Hannover	525875	204	RN2	Yes	Yes	Yes	Yes
DE	Germany	AG_DE_BW_5	Heidelberg	145311	109	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_BW_6	Heilbronn	121627	100	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_NW_20	Herne	154507	51	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_BY_6	Ingolstadt	126732	133	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_BW_3	Karlsruhe	288917	173	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_HE_3	Kassel	194087	107	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_SH_1	Kiel	290000	189	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_RP_3	Koblenz	109922	105	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_NW_1	Cologne	1039488	405	RN2	Yes	Yes	Yes	Yes
DE	Germany	AG_DE_NW_14	Krefeld	222424	138	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_SN_2	Leipzig	539039	297	RN2	Yes	Yes	Yes	Yes
DE	Germany	AG_DE_NW_18	Leverkusen	161065	79	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_SH_2	Lubeck	250000	298	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_RP_1	Ludwigshafen	165362	78	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_ST_2	Magdeburg	231021	202	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_RP_2	Mainz	209402	98	RN2	Yes	Yes	Yes	Yes
DE	Germany	AG_DE_BW_2	Mannheim	309795	145	RN2	Yes	Yes	Yes	Yes
DE	Germany	AG_DE_NW_26	Moers	102935	68	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_NW_12	Monchengladbach	255975	170	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_NW_17	Mulheim an der Ruhr	166769	91	RN2	Yes	Yes	Yes	Yes
DE	Germany	AG_DE_BY_1	Munich	1378176	311	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_NW_10	Munster	300149	303	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_NW_21	Neuss	152256	100	RN2	Yes	Yes	Yes	Yes
DE	Germany	AG_DE_BY_2	Nuremberg	510602	187	RN2	Yes	Yes	Yes	Yes
DE	Germany	AG_DE_NW_15	Oberhausen	209210	77	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_HE_5	Offenbach	119203	45	RN2	Yes	Yes	Yes	Yes

CtryCode	CtryName	UniqueAgglomerationId	AgglomerationName	Inhabitants	Size	DataSource	Road	Rail	Air	Industry
DE	Germany	AG_DE_NI_4	Oldenburg	162481	103	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_NI_3	Osnabruck	165021	120	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_BW_8	Pforzheim	119423	98	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_BB_1	Potsdam	161468	188	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_NW_23	Recklinghausen	114523	66	RN2	Yes	Yes	No	No
DE	Germany	AG_DE_BY_4	Regensburg	136577	81	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_NW_25	Remscheid	109024	75	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_BW_9	Reutlingen	112458	87	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_MV_1	Rostock	203431	169	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_SL_1	Saarbrucken	231556	219	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_NW_19	Solingen	156369	90	RN2	Yes	Yes	No	No
DE	Germany	AG_DE_BW_1	Stuttgart	581858	211	RN2	Yes	Yes	Yes	Yes
DE	Germany	AG_DE_BW_7	Ulm	121434	119	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_HE_2	Wiesbaden	273871	204	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_NW_7	Wuppertal	343494	168	RN2	Yes	Yes	No	Yes
DE	Germany	AG_DE_BY_5	Wurzburg	133808	88	RN2	Yes	Yes	No	Yes
EL	Greece	ETC_AG_002	Athens North	284460	41	Email reporter	Yes	Yes	Yes	Yes
EL	Greece	ETC_AG_001	Athens Center	745514	44	Email reporter	Yes	Yes	Yes	Yes
EL	Greece	EL_AG_0007	Ioannina	72200	12	Email reporter	Yes	No	Yes	Yes
EL	Greece	EL_AG_0005	Iraklion	144774	26	Email reporter	Yes	No	Yes	Yes
EL	Greece	EL_AG_0008	Larissa	125038	19	Email reporter	Yes	Yes	Yes	Yes
EL	Greece	EL_AG_0004	Patras	171634	32	Email reporter	Yes	Yes	No	Yes
EL	Greece	EL_AG_0003	Piraeus	431409	60	Email reporter	Yes	Yes	No	Yes

CtryCode	CtryName	UniqueAgglomerationId	AgglomerationName	Inhabitants	Size	DataSource	Road	Rail	Air	Industry
EL	Greece	agglo2	Thessaloniki	390064	22	Email reporter	Yes	Yes	Yes	Yes
EL	Greece	EL_AG_0006	Volos	107348	13	Email reporter	Yes	Yes	Yes	Yes
HU	Hungary	HU_a_ag0001	Budapest	2158871	1130	RN2	Yes	Yes	Yes	Yes
HU	Hungary	HU_a_ag0002	Debrecen	203059	462	RN2	Yes	Yes	Yes	Yes
HU	Hungary	HU_a_ag0006	Gyor	131564	175	RN2	Yes	Yes	No	Yes
HU	Hungary	HU_a_ag0008	Kecskemet	111724	323	RN2	Yes	Yes	Yes	Yes
HU	Hungary	HU_a_ag0003	Miskolc	158101	237	RN2	Yes	Yes	Yes	Yes
HU	Hungary	HU_a_ag0007	Nyiregyhaza	118058	275	RN2	Yes	Yes	Yes	Yes
HU	Hungary	HU_a_ag0005	Pecs	145347	163	RN2	Yes	Yes	Yes	Yes
HU	Hungary	HU_a_ag0004	Szeged	162621	281	RN2	Yes	Yes	Yes	Yes
IS	Iceland	IS_a_ag0006	Akureyri	18787	138	RN2	Yes	No	No	Yes
IS	Iceland	IS_a_ag0005	Gardabaer	15709	71	RN2	Yes	No	No	Yes
IS	Iceland	IS_a_ag0001	Hafnafjordur	29412	143	RN2	Yes	No	No	Yes
IS	Iceland	IS_a_ag0004	Kopavogur	35970	80	RN2	Yes	No	No	Yes
IS	Iceland	IS_a_ag0003	Mosfellsbaer	10556	185	RN2	Yes	No	No	Yes
IS	Iceland	IS_a_ag0002	Reykjanesbaer	17805	145	RN2	Yes	No	Yes	Yes
IS	Iceland	IS_a_ag0008	Reykjavik	126041	274	RN2	Yes	No	No	Yes
IS	Iceland	IS_a_ag0007	Selfoss	8995	158	RN2	Yes	No	No	Yes
IS	Iceland	IS_a_ag0009	Seltjarnarnes	4575	2	RN2	Yes	No	No	Yes
IE	Ireland	AG_IE_00_1	Dublin	1308900	936	RN2	Yes	Yes	Yes	No
IE	Ireland	AG_IE_00_2	Cork	190900	186	RN2	Yes	Yes	Yes	No
IT	Italy	ETC_AG_006	Andria	100440	400	RN2	Yes	Yes	No	Yes
IT	Italy	AG_IT_00_00001	Bari	326344	117	RN2	Yes	Yes	Yes	Yes
IT	Italy	IT_a_ag00015	Bergamo	120262	40	RN2	Yes	Yes	Yes	No
IT	Italy	AG_IT_00_00002	Bologna	492507	275	RN2	Yes	Yes	Yes	No
IT	Italy	AG_IT_00_00025	Bolzano	106110	52	RN2	Yes	Yes	No	Yes
IT	Italy	IT_a_ag00016	Brescia	197956	91	RN2	Yes	Yes	Yes	Yes

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IT	Italy	AG_IT_00_00013	Cagliari	342800	225	RN2	Yes	Yes	Yes	Yes
IT	Italy	IT_a_ag00003	Catania	293902	182	RN2	Yes	Yes	Yes	Yes
IT	Italy	AG_IT_00_00017	Ferrara	133682	405	RN2	Yes	Yes	No	Yes
IT	Italy	AG_IT_00_00004	Florence	355798	102	RN2	Yes	Yes	Yes	Yes
IT	Italy	AG_IT_00_00018	Foggia	151991	506	RN2	Yes	Yes	Yes	Yes
IT	Italy	AG_IT_00_00019	Forli	118295	2278	RN2	Yes	Yes	No	Yes
IT	Italy	AG_IT_00_00005	Genoa	594733	243	RN2	Yes	Yes	Yes	Yes
IT	Italy	IT_a_ag00020	Latina	117892	277	RN2	Yes	Yes	No	Yes
IT	Italy	AG_IT_00_00021	Livorno	157825	102	RN2	Yes	Yes	No	Yes
IT	Italy	AG_IT_00_00045	MacroAgglo Milan-Monza	2135450	481	RN2	Yes	Yes	Yes	Yes
IT	Italy	IT_a_ag00022	Messina	243222	213	RN2	Yes	Yes	No	Yes
IT	Italy	AG_IT_00_00023	Modena	185000	183	RN2	Yes	Yes	No	Yes
IT	Italy	IT_a_ag00007	Naples	969982	117	Email reporter	Yes	Yes	Yes	Yes
IT	Italy	AG_IT_00_00026	Padova	210400	93	RN2	Yes	Yes	No	Yes
IT	Italy	IT_a_ag00008	Palermo	673581	77	RN2	Yes	Yes	No	No
IT	Italy	AG_IT_00_00027	Parma	190500	261	RN2	Yes	Yes	Yes	Yes
IT	Italy	AG_IT_00_00028	Perugia	149125	449	Email reporter	Yes	Yes	No	Yes
IT	Italy	IT_a_ag00029	Pescara	117166	34	RN2	Yes	Yes	Yes	Yes
IT	Italy	IT_a_ag00030	Piacenza	102355	118	RN2	Yes	Yes	No	No
IT	Italy	AG_IT_00_00031	Prato	193325	97	RN2	Yes	Yes	No	Yes
IT	Italy	AG_IT_00_00032	Ravenna	159057	653	RN2	Yes	Yes	No	Yes
IT	Italy	AG_IT_00_00034	Reggio Emilia	172600	232	RN2	Yes	Yes	Yes	No
IT	Italy	AG_IT_00_00035	Rimini	147346	135	RN2	Yes	Yes	No	Yes
IT	Italy	IT_a_ag00009	Rome	2876614	1286	RN2	Yes	Yes	Yes	Yes
IT	Italy	IT_a_ag00036	Salerno	141848	59	Email reporter	Yes	Yes	Yes	Yes
IT	Italy	IT_a_ag00037	Sassari	111778	69	RN2	Yes	Yes	No	Yes

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IT	Italy	IT_a_ag00038	Syracuse	118442	208	RN2	Yes	Yes	No	No
IT	Italy	AG_IT_00_00039	Taranto	201100	218	RN2	Yes	Yes	No	Yes
IT	Italy	IT_a_ag00040	Terni	111210	212	RN2	Yes	Yes	No	Yes
IT	Italy	AG_IT_00_00041	Trieste	203767	85	RN2	Yes	Yes	No	Yes
IT	Italy	IT_a_ag00010	Turin	1430286	250	RN2	Yes	Yes	No	Yes
IT	Italy	AG_IT_00_00011	Venice	259200	416	RN2	Yes	Yes	Yes	Yes
IT	Italy	IT_a_ag00012	Verona	258500	199	RN2	Yes	Yes	No	Yes
IT	Italy	IT_a_ag00043	Vicenza	100005	78	RN2	Yes	Yes	No	No
LV	Latvia	AG_LV_00_1	Riga	641007	304	RN2	Yes	Yes	Yes	Yes
LT	Lithuania	LT_a_ag0002	Kaunas	295585	157	RN2	Yes	Yes	No	Yes
LT	Lithuania	LT_a_ag0003	Klaipeda	154326	98	RN2	Yes	Yes	No	Yes
LT	Lithuania	LT_a_ag0004	Siauliai	102000	81	RN2	Yes	Yes	Yes	Yes
LT	Lithuania	LT_a_ag0001	Vilnius	574339	401	RN2	Yes	Yes	Yes	Yes
LU	Luxembourg	AG_LU_00_1	Luxembourg	158750	136	Reporter	Yes	Yes	Yes	No
MT	Malta	AG_MT_00_1	Valletta	277600	54	RN2	Yes	No	Yes	Yes
ME	Montenegro	ME_a_ag0001	Podgorica	185937	1441	RN2	Yes	Yes	No	Yes
NL	Netherlands	AG_NL_00_01	Alkmaar	240505	237	RN2	Yes	Yes	No	Yes
NL	Netherlands	AG_NL_00_02	Almere	196932	249	RN2	Yes	Yes	No	No
NL	Netherlands	AG_NL_00_03	Amersfoort	152481	64	RN2	Yes	Yes	No	Yes
NL	Netherlands	AG_NL_00_04	Amsterdam	1678380	890	RN2	Yes	Yes	Yes	Yes
NL	Netherlands	AG_NL_00_05	Apeldoorn	158099	341	RN2	Yes	Yes	No	Yes
NL	Netherlands	AG_NL_00_06	Arnhem	152293	102	RN2	Yes	Yes	No	No
NL	Netherlands	AG_NL_00_07	Breda	180937	129	RN2	Yes	No	No	No
NL	Netherlands	AG_NL_00_09	The Hague	1322251	536	RN2	Yes	Yes	No	Yes
NL	Netherlands	AG_NL_00_10	Eindhoven	447329	276	RN2	Yes	Yes	No	Yes
NL	Netherlands	AG_NL_00_11	Enschede	311903	274	RN2	Yes	Yes	No	Yes
NL	Netherlands	AG_NL_00_12	Gouda	204158	180	RN2	Yes	Yes	No	Yes
NL	Netherlands	AG_NL_00_13	Groningen	200336	84	RN2	Yes	Yes	No	Yes

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NL	Netherlands	AG_NL_00_14	Heerlen	228028	174	RN2	Yes	Yes	Yes	Yes
NL	Netherlands	AG_NL_00_15	Hilversum	217072	161	RN2	Yes	Yes	No	No
NL	Netherlands	AG_NL_00_16	Maastricht	122397	60	RN2	Yes	Yes	No	Yes
NL	Netherlands	AG_NL_00_17	Nijmegen	170681	58	RN2	Yes	Yes	No	Yes
NL	Netherlands	AG_NL_00_18	Rotterdam	1310726	656	RN2	Yes	Yes	Yes	Yes
NL	Netherlands	AG_NL_00_19	Tilburg	211648	119	RN2	Yes	Yes	Yes	Yes
NL	Netherlands	AG_NL_00_20	Utrecht	478138	206	RN2	Yes	Yes	No	Yes
NL	Netherlands	AG_NL_00_21	Zwolle	123861	119	RN2	Yes	Yes	No	No
NL	Netherlands	AG_NL_00_08	s Hertogenbosch	150899	92	RN2	Yes	Yes	No	Yes
NO	Norway	ETC_AG_003	Bergen	277391	465	RN2	Yes	Yes	Yes	Yes
NO	Norway	NO_a_ag0005	Fredrikstad	132351	689	Email reporter	Yes	Yes	Yes	Yes
NO	Norway	NO_a_ag0001	Oslo and adjecent agglomerations	973979	1003	RN2	Yes	Yes	Yes	Yes
NO	Norway	ETC_AG_004	Stavanger	233560	444	RN2	Yes	Yes	Yes	Yes
NO	Norway	NO_a_ag0003	Trondheim	187353	342	RN2	Yes	Yes	Yes	Yes
PL	Poland	AG_PL_20_61	Bialystok	297403	102	RN2 after 01/01/2021	Yes	Yes	No	Yes
PL	Poland	AG_PL_24_61	Bielsko-Biala	173699	124	RN2	Yes	Yes	No	Yes
PL	Poland	AG_PL_04_61	Bydgoszcz	349021	176	RN2 after 01/01/2021	Yes	Yes	Yes	Yes
PL	Poland	AG_PL_24_62	Bytom	146194	69,4	RN2 after 01/01/2021	Yes	Yes	No	Yes
PL	Poland	AG_PL_24_64	Czestochowa	216500	160	RN2 after 01/01/2021	Yes	Yes	No	Yes
PL	Poland	AG_PL_24_65	Dabrowa Gornicza	115188	189	RN2 after 01/01/2021	Yes	Yes	No	Yes
PL	Poland	AG_PL_28_61	Elblag	120142	80	RN2 after 01/01/2021	Yes	Yes	No	Yes
PL	Poland	AG_PL_22_61	Gdansk	468158	262	RN2 after 01/01/2021	Yes	Yes	Yes	Yes

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PL	Poland	AG_PL_22_62	Gdynia	246244	135	RN2 after 01/01/2021	Yes	Yes	No	Yes
PL	Poland	AG_PL_24_66	Gliwice	165456	134	RN2 after 01/01/2021	Yes	Yes	Yes	Yes
PL	Poland	AG_PL_08_61	Gorzow Wielkopolski	123921	86	RN2 after 01/01/2021	Yes	Yes	No	Yes
PL	Poland	AG_PL_24_69	Katowice	293636	165	RN2 after 01/01/2021	Yes	Yes	Yes	Yes
PL	Poland	AG_PL_26_61	Kielce	195266	110	RN2 after 01/01/2021	Yes	Yes	No	Yes
PL	Poland	ETC_AG_006	Koszalin	102081	98	RN2 after 01/01/2021	Yes	Yes	No	Yes
PL	Poland	AG_PL_12_61	Krakow	771069	327	RN2 after 01/01/2021	Yes	Yes	No	Yes
PL	Poland	ETC_AG_007	Legnica	100718	56	RN2	Yes	Yes	No	Yes
PL	Poland	AG_PL_10_61	Lodz	682679	293	RN2 after 01/01/2021	Yes	Yes	No	Yes
PL	Poland	AG_PL_06_63	Lublin	339682	147	RN2 after 01/01/2021	Yes	Yes	No	Yes
PL	Poland	AG_PL_28_62	Olsztyn	173599	88	RN2 after 01/01/2021	Yes	Yes	No	Yes
PL	Poland	AG_PL_16_61	Opole	128137	149	RN2 after 01/01/2021	Yes	Yes	No	Yes
PL	Poland	AG_PL_14_62	Plock	120000	88	RN2 after 01/01/2021	Yes	Yes	No	Yes
PL	Poland	AG_PL_30_64	Poznan	535802	262	RN2 after 01/01/2021	Yes	Yes	Yes	Yes
PL	Poland	AG_PL_14_63	Radom	213029	112	RN2 after 01/01/2021	Yes	Yes	Yes	Yes
PL	Poland	AG_PL_24_72	Ruda Slaska	138000	78	RN2 after 01/01/2021	Yes	Yes	No	Yes
PL	Poland	AG_PL_24_73	Rybnik	131541	148	RN2 after 01/01/2021	Yes	Yes	No	Yes

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PL	Poland	AG_PL_18_63	Rzeszow	187422	116	RN2 after 01/01/2021	Yes	Yes	No	Yes
PL	Poland	AG_PL_24_75	Sosnowiec	191772	91	RN2 after 01/01/2021	Yes	Yes	No	Yes
PL	Poland	AG_PL_32_62	Szczecin	374186	300,5	RN2 after 01/01/2021	Yes	Yes	Yes	Yes
PL	Poland	AG_PL_12_63	Tarnów	109062	72	RN2 after 01/01/2021	Yes	Yes	Yes	Yes
PL	Poland	AG_PL_04_63	Torun	202074	116	RN2 after 01/01/2021	Yes	Yes	No	Yes
PL	Poland	AG_PL_24_77	Tychy	127664	82	RN2 after 01/01/2021	Yes	Yes	No	Yes
PL	Poland	AG_PL_02_65	Walbrzych	111896	85	RN2 after 01/01/2021	Yes	Yes	No	Yes
PL	Poland	AG_PL_14_65	Warsaw	1777972	517	RN2 after 01/01/2021	Yes	Yes	Yes	Yes
PL	Poland	AG_PL_04_64	Wloclawek	102608	85	RN2 after 01/01/2021	Yes	Yes	No	Yes
PL	Poland	AG_PL_02_64	Wroclaw	745231	293	RN2 after 01/01/2021	Yes	Yes	Yes	Yes
PL	Poland	AG_PL_24_78	Zabrze	172806	80	RN2 after 01/01/2021	Yes	Yes	No	Yes
PL	Poland	AG_PL_08_62	Zielona Gora	140874	279	RN2 after 01/01/2021	Yes	Yes	Yes	Yes
PT	Portugal	AG_PT_00_1	Amadora	175136	24	RN2	Yes	Yes	No	No
PT	Portugal	AG_PT_00_2	Lisbon	547733	85	RN2	Yes	Yes	Yes	No
PT	Portugal	AG_PT_00_3	Matosinhos	175478	62	RN2	Yes	No	Yes	Yes
PT	Portugal	AG_PT_00_4	Odivelas	144549	27	RN2	Yes	Yes	Yes	No
PT	Portugal	AG_PT_00_5	Oeiras	172120	46	RN2	Yes	Yes	No	Yes
PT	Portugal	AG_PT_00_6	Porto	237591	42	RN2	Yes	Yes	Yes	No
RO	Romania	RO_a_ag9262	Arad	179230	4106	RN2	Yes	Yes	No	Yes
RO	Romania	RO_a_ag20297	Bacau	197003	3880	RN2	Yes	Yes	Yes	Yes

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RO	Romania	RO_a_ag106318	Baia Mare	147425	3564	RN2	Yes	Yes	Yes	Yes
RO	Romania	RO_a_ag35731	Botosani	121793	1950	RN2	Yes	Yes	No	Yes
RO	Romania	RO_a_ag42682	Braila	208201	3674	RN2	Yes	Yes	No	Yes
RO	Romania	RO_a_ag40198	Brasov	290167	11056	RN2	Yes	Yes	No	Yes
RO	Romania	RO_a_ag179132	Bucharest	2106144	24190	RN2	Yes	Yes	Yes	Yes
RO	Romania	RO_a_ag44818	Buzau	134498	4720	RN2	Yes	Yes	Yes	Yes
RO	Romania	RO_a_ag54975	Cluj-Napoca	321687	10472	RN2	Yes	Yes	Yes	Yes
RO	Romania	RO_a_ag60419	Constanta	316777	6042	RN2	Yes	Yes	No	Yes
RO	Romania	RO_a_ag69900	Craiova	304089	7063	RN2	Yes	Yes	Yes	Yes
RO	Romania	RO_a_ag75098	Galati	305093	6452	RN2	Yes	Yes	No	Yes
RO	Romania	RO_a_ag95060	Iasi	362142	6924	RN2	Yes	Yes	Yes	Yes
RO	Romania	RO_a_ag26564	Oradea	196367	8182	RN2	Yes	Yes	Yes	Yes
RO	Romania	RO_a_ag13169	Pitesti	175653	2812	RN2	Yes	Yes	No	Yes
RO	Romania	RO_a_ag130534	Ploiesti	231491	5412	RN2	Yes	Yes	No	Yes
RO	Romania	RO_a_ag136483	Satu Mare	121128	4186	RN2	Yes	Yes	Yes	Yes
RO	Romania	RO_a_ag143450	Sibiu	169317	5007	RN2	Yes	Yes	Yes	Yes
RO	Romania	RO_a_ag114319	Targu Mures	149543	3266	RN2	Yes	Yes	Yes	Yes
RO	Romania	RO_a_ag155243	Timisoara	331988	7600	RN2	Yes	Yes	No	Yes
SK	Slovakia	SK_a_ag001	Bratislava	493734	444	RN2	Yes	Yes	Yes	Yes
SK	Slovakia	SK_b_ag002	Kosicka	226192	113	RN2	Yes	Yes	Yes	Yes
SI	Slovenia	SI_a_ag001	Ljubljana	274500	275	RN2	Yes	Yes	No	Yes
SI	Slovenia	SI_a_ag002	Maribor	106400	147	RN2	Yes	Yes	No	Yes
ES	Spain	AG_ES_11_15030	A Coruna	245700	39	RN2	Yes	Yes	No	Yes
ES	Spain	AG_ES_42_02003	Albacete	172487	30	RN2	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_30_28005	Alcala de Henares	194310	88	RN2	Yes	Yes	No	Yes
ES	Spain	AG_ES_30_28006	Alcobendas	115896	45	RN2	Yes	Yes	Yes	No
ES	Spain	ES_a_ag37	Alcorcon	170336	34	RN2	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_61_11004	Algeciras	117974	86	RN2	Yes	Yes	Yes	Yes

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ES	Spain	AG_ES_52_03014	Alicante	334221	57	RN2 after 01/01/2021	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_61_04013	Almeria	193351	22	RN2	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_43_06015	Badajoz	137144	20	RN2	Yes	Yes	No	No
ES	Spain	AG_ES_51_00001	Baix Llobregat I	238594	37	RN2 after 01/01/2021	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_51_00002	Baix Llobregat II	195777	73	RN2 after 01/01/2021	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_51_08019	Barcelones I	1657012	105	RN2 after 01/01/2021	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_51_00003	Barcelones II	331099	28	RN2 after 01/01/2021	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_21_48020	Bilbao	345474	41	RN2	Yes	Yes	No	Yes
ES	Spain	ES_a_ag21	Burgos	174252	107	RN2	Yes	Yes	No	Yes
ES	Spain	AG_ES_61_11012	Cadiz	177776	11	RN2	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_62_30016	Cartagena	151887	23	RN2	Yes	Yes	No	Yes
ES	Spain	AG_ES_52_12040	Castellon de la Plana	173841	43	RN2	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_22_00008	Pamplona	340197	13	RN2	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_61_14021	Cordoba	328041	31	RN2	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_21_20069	San Sebastian - Donostia	180271	61	RN2	Yes	Yes	No	Yes
ES	Spain	AG_ES_61_41038	Dos Hermanas	130369	161	RN2	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_52_03065	Elche	211249	23	RN2 after 01/01/2021	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_30_28058	Fuenlabrada	204838	37	RN2	Yes	Yes	No	Yes
ES	Spain	AG_ES_30_28065	Getafe	183764	79	RN2	Yes	Yes	No	Yes
ES	Spain	AG_ES_12_33024	Gijon	275735	182	RN2	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_51_00005	Girones	132493	46	RN2 after 01/01/2021	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_61_18087	Granada	258750	88	RN2	Yes	Yes	No	Yes
ES	Spain	AG_ES_61_21041	Huelva	147212	151	RN2	Yes	Yes	No	Yes

CtryCode	CtryName	UniqueAgglomerationId	AgglomerationName	Inhabitants	Size	DataSource	Road	Rail	Air	Industry
ES	Spain	ES_a_ag31	Jaen	115837	424	RN2	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_61_11020	Jerez de la Frontera	212876	44	RN2	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_70_35016	Las Palmas de Gran Canaria	378998	103	RN2 after 01/01/2021	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_30_28074	Leganes	186696	43	RN2	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_41_24089	Leon	129884	39	RN2	Yes	Yes	No	Yes
ES	Spain	AG_ES_51_25120	Lleida	138144	212	RN2	Yes	Yes	No	Yes
ES	Spain	AG_ES_23_26089	Logrono	151962	20	RN2	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_30_28079	Madrid	3165883	604	RN2	Yes	Yes	Yes	No
ES	Spain	AG_ES_61_29067	Malaga	575611	98	RN2 after 01/01/2021	Yes	Yes	Yes	Yes
ES	Spain	ETC_AG_008	Marbella	138679	117	RN2	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_51_08121	Mataro	126159	23	RN2	Yes	Yes	No	Yes
ES	Spain	ES_a_ag41	Mostoles	205712	45	RN2	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_62_30030	Murcia	441003	886	RN2	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_12_33044	Oviedo	221870	187	RN2	Yes	Yes	No	Yes
ES	Spain	AG_ES_53_7040	Palma de Mallorca	417480	62	RN2 after 01/01/2021	Yes	Yes	Yes	Yes
ES	Spain	ES_a_ag66	Parla	125323	25	RN2	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_51_43123	Reus	104560	53	RN2	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_41_37274	Salamanca	149423	25	RN2 after 01/01/2021	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_70_38023	San Cristobal de La Laguna	153009	102	RN2	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_70_38038	Santa Cruz de Tenerife	205279	150	RN2	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_13_39075	Santander	176256	35	RN2	Yes	Yes	No	Yes
ES	Spain	AG_ES_61_41091	Sevilla	696676	140	RN2	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_51_00004	Tarragones	143170	65	RN2 after 01/01/2021	Yes	Yes	Yes	Yes
ES	Spain	ES_a_ag68	Telde	102070	102	RN2	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_30_28148	Torrejon de Ardoz	126878	33	RN2	Yes	Yes	Yes	Yes

CtryCode	CtryName	UniqueAgglomerationId	AgglomerationName	Inhabitants	Size	DataSource	Road	Rail	Air	Industry
ES	Spain	AG_ES_52_46250	Valencia	791632	135	RN2	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_41_47186	Valladolid	306830	198	RN2	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_51_00006	Valles Occidental I	253547	47	RN2	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_51_00007	Valles Occidental II	222912	90	RN2	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_11_36057	Vigo	289784	105	RN2	Yes	Yes	No	Yes
ES	Spain	AG_ES_21_01059	Vitoria - Gazteiz	244634	277	RN2	Yes	Yes	Yes	Yes
ES	Spain	AG_ES_24_50297	Zaragoza	666058	967	RN2	Yes	Yes	Yes	Yes
SE	Sweden	SE_a_ag1490	Boras	107022	910	RN2	Yes	Yes	No	Yes
SE	Sweden	SE_a_ag0484	Eskilstuna	100923	1100	RN2	Yes	Yes	No	No
SE	Sweden	SE_a_ag1480	Gothenburg	541145	450	RN2	Yes	Yes	No	Yes
SE	Sweden	SE_a_ag1283	Helsingborg	135344	344	RN2	Yes	Yes	No	Yes
SE	Sweden	SE_a_ag0126	Huddinge	104185	131	RN2	Yes	Yes	No	No
SE	Sweden	SE_a_ag0680	Jonkoping	132140	1480	RN2	Yes	Yes	No	Yes
SE	Sweden	SE_a_ag0580	Linkoping	151881	1427	RN2	Yes	Yes	No	Yes
SE	Sweden	SE_a_ag1281	Lund	115968	427	RN2	Yes	Yes	No	Yes
SE	Sweden	SE_a_ag1280	Malmo	318107	157	RN2	Yes	Yes	No	Yes
SE	Sweden	SE_a_ag0581	Norrkoping	135283	1495	RN2	Yes	Yes	Yes	Yes
SE	Sweden	SE_a_ag1880	Orebro	142618	1373	RN2	Yes	Yes	Yes	Yes
SE	Sweden	SE_a_ag0180	Stockholm	911989	187	RN2	Yes	Yes	No	Yes
SE	Sweden	SE_a_ag2480	Umea	119613	2317	RN2	Yes	Yes	Yes	Yes
SE	Sweden	SE_a_ag0380	Uppsala	207362	2183	RN2	Yes	Yes	Yes	Yes
SE	Sweden	SE_a_ag1980	Vasteras	143702	958	RN2	Yes	Yes	Yes	Yes
CH	Switzerland	CH_a_ag0008	Baden-Brugg	105606	91	RN2	Yes	Yes	Yes	Yes
CH	Switzerland	CH_a_ag0006	Basel	527225	695	RN2	Yes	Yes	Yes	Yes
CH	Switzerland	CH_a_ag0003	Bern	398873	781	RN2	Yes	Yes	Yes	Yes
CH	Switzerland	CH_a_ag0014	Biel/Bienne	101271	169	RN2	Yes	Yes	Yes	Yes
CH	Switzerland	CH_a_ag0012	Fribourg	100111	222	RN2	Yes	Yes	Yes	Yes
CH	Switzerland	CH_a_ag0011	Geneva	552305	538	RN2	Yes	Yes	Yes	Yes

CtryCode	CtryName	UniqueAgglomerationId	AgglomerationName	Inhabitants	Size	DataSource	Road	Rail	Air	Industry
CH	Switzerland	CH_a_ag0010	Lausanne	389614	774	RN2	Yes	Yes	Yes	Yes
CH	Switzerland	CH_a_ag0004	Lucerne	220741	292	RN2	Yes	Yes	Yes	Yes
CH	Switzerland	CH_a_ag0009	Lugano	145576	307	RN2	Yes	Yes	Yes	Yes
CH	Switzerland	CH_a_ag0007	St. Gallen	162795	318	RN2	Yes	Yes	Yes	Yes
CH	Switzerland	CH_a_ag0001	Winterthur	133691	148	RN2	Yes	Yes	Yes	Yes
CH	Switzerland	CH_a_ag0013	Zug	121269	228	RN2	Yes	Yes	Yes	Yes
CH	Switzerland	CH_a_ag0002	Zurich	1280944	1309	RN2	Yes	Yes	Yes	Yes

Annex 2. List of countries included in the estimated 2017 exposure baseline for major roads (DF1_5 2015 reference year as source data)

Country	**Estimation of major roads 2017 exposure baseline**
AT	Yes
BA	Yes
BE	Yes
BG	Yes
CH	Yes
CY	Yes
CZ	Yes
DE	Yes
DK	Yes
EE	Yes
ES	Yes
FI	Yes
FR	Yes
EL	Yes
HR	Yes
HU	Yes
IE	Yes
IS	Yes
IT	Yes
LI	No
LT	Yes
LU	Yes
LV	Yes
ME	Yes
MK	Yes
MT	Yes
NL	Yes
NO	Yes
PL	Yes
PT	Yes
RO	Yes
SE	Yes
SI	Yes
SK	Yes

Annex 3. List of countries included in the estimated 2017 exposure baseline for major railways (DF1_5 2015 reference year as source data)

Country	Estimation of major railways 2017 exposure baseline
AT	Yes
BA	Yes
BE	Yes
BG	No
CH	Yes
CY	No
CZ	Yes
DE	Yes
DK	Yes
EE	No
ES	Yes
FI	Yes
FR	Yes
EL	Yes
HR	Yes
HU	Yes
IE	Yes
IS	No
IT	Yes
LI	No
LT	Yes
LU	Yes
LV	Yes
ME	No
MK	No
MT	No
NL	Yes
NO	Yes
PL	Yes
PT	Yes
RO	Yes
SE	Yes
SI	Yes
SK	Yes

Annex 4. List of major airports corresponding to DF1_5 2015 reference year: base data for the estimated 2017 exposure baseline

Country	ICAO	Major airport name
AT	LOWW	Airport Vienna
BE	EBBR	Brussels Airport
BG	LBSF	Sofia Airport
CH	LSGG	Geneva Cointrin Airport
CH	LSZH	Zurich Airport
CZ	LKPR	Prague Airport
DE	EDDB	Berlin Schonefeld Airport
DE	EDDF	Frankfurt Airport
DE	EDDH	Hamburg
DE	EDDK	Cologne Bonn
DE	EDDL	Dusseldorf
DE	EDDM	Munich Airport
DE	EDDP	Leipzig-Halle
DE	EDDS	Stuttgart
DE	EDDV	Hannover-Langenhagen
DE	EDDN	Nuremberg Airport
DE	EDDT	Berlin Tegel Airport
DK	EKCH	Copenhagen Airport, Kastrup
ES	GCLP	Gran Canaria airport
ES	GCRR	Lanzarote - César Manrique airport
ES	GCTS	Reina Sofía airport
ES	GCXO	Los Rodeos airport
ES	LEAL	Alicante-Elche airport
ES	LEBL	Barcelona-El Prat airport
ES	LEIB	Eivissa airport
ES	LEMD	Adolfo Suárez Madrid-Barajas airport
ES	LEMG	Málaga-Costa del Sol airport
ES	LEPA	Son San Joan airport
ES	LEVC	Valencia airport
FI	EFHK	Helsinki-Vantaa
FI	EFHF	Helsinki - Malmo airport
FR	LFBD	Bordeaux Mérignac
FR	LFBO	Toulouse Blagnac
FR	LFLL	Lyon St Exupéry
FR	LFML	Marseille Procence
FR	LFMN	Nice Côte d''Azur
FR	LFPB	Paris Le Bourget
FR	LFPG	Paris Charles de Gaulle

Country	ICAO	Major airport name
FR	LFPO	Paris Orly
FR	LFSB	Bâle Mulhouse
GR	LGAV	Athens International Airport "Eleftherios Venizelos"
HU	LHBP	Budapest Ferihegy International Airport
IE	EIDW	Dublin Airport
IS	BIKF	Keflavík International Airport
IT	LICC	Catania Fontanarossa - Vincenzo Bellini
IT	LIMC	Milan Malpensa International Airport
IT	LIME	Milan Bergamo Airport
IT	LIML	Milan Linate International airport
IT	LIPE	Bologna Guglielmo Marconi Airport
IT	LIPZ	Venezia airport
IT	LIRA	g.b. Pastine
IT	LIRF	Leonardo da Vinci
IT	LIRN	Naples Airport
IT	LIMF	Turin airport
LU	ELLX	Luxembourg Findel Airport
LV	EVRA	Riga International Airport
NL	EHAM	Schiphol Airport
NO	ENBR	Bergen/Flesland Airport
NO	ENGM	Oslo/Gardermoen Airport
NO	ENVA	Trondheim/Værnes Airport
NO	ENZV	Stavanger/ Sola Airport
PL	EPWA	Warsaw Chopin Airport
PL	EPKK	Krakow
PT	LPPR	Aeroporto Francisco Sá Carneiro
PT	LPPT	Aeroporto General Humberto Delgado
RO	LROP	Bucharest Henri Coandă International Airport
SE	ESGG	Göteborg-Landvetter Airport
SE	ESSA	Stockholm-Arlanda Airport
SE	ESSB	Stockholm-Bromma Airport
CY	LCLK	Larnaca International Airport
CY	LCPH	Paphos International Airport

Annex 5. List of entities declaring 0 population exposed in 2017 reference dataset

Railway noise inside agglomerations:

Country	Agglomeration
Italy	Taranto
Italy	Syracuse
Poland	Rzeszow
Poland	Olszlyn
Poland	Kielce
Portugal	Odivelas
Spain	Alcobendas
Spain	Burgos
Spain	Cartagena
Spain	Granada
Spain	Huelva
Spain	Leon
Bulgaria	Burgas

Aircraft noise inside agglomerations:

Country	Agglomeration
Bulgaria	Burgas
Bulgaria	Plovdiv
Bulgaria	Sofia
Croatia	Zagreb
Czechia	Liberec
Czechia	Olomuc
Czechia	Teplice
Finland	Jyvaskyla
France	Brunoy
France	Strasbourg
Germany	Mulheim an der Ruhr
Germany	Mainz
Hungary	Debrecen
Hungary	Kecskemet
Hungary	Miskolc
Hungary	Nyiregyhaza
Hungary	Pecs

Aircraft noise inside agglomerations:

Country	Agglomeration
Italy	Foggia
Poland	Bydgoszcz
Poland	Gliwice
Poland	Katowice
Poland	Radom
Portugal	Odivelas
Romania	Bacau
Romania	Baia Mare
Romania	Craiova
Romania	Oradea
Romania	Sibiu
Romania	Satu Mare
Spain	Pamplona
Spain	Valencia
Spain	Vitoria
Sweden	Norrkoping
Sweden	Orebro
Sweden	Uppsala
Sweden	Vasteras
Switzerland	Basel
Switzerland	Bern
Switzerland	Biel/Bienne
Switzerland	Fribourg
Switzerland	Baden-Brugg
Switzerland	Lausanne
Switzerland	Lucerne
Switzerland	Lugano
Switzerland	St. Gallen
Switzerland	Winterthur
Switzerland	Zug

Industrial noise inside agglomerations:

Country	Agglomeration
Austria	Graz
Austria	Innsbruck
Austria	Salzburg
Austria	Vienna
Bulgaria	Plovdiv

Industrial noise inside agglomerations:

Country	Agglomeration
Croatia	Rijeka
Croatia	Split
Czech Republic	Brno
Czech Republic	Liberec
Czech Republic	Ostrava
Czech Republic	Prague
Estonia	Tartu
Finland	Lahti
Germany	Freiburg
Germany	Heidelberg
Germany	Pforzheim
Germany	Reutlingen
Germany	Ulm
Germany	Erlangen
Germany	Furth
Germany	Wurzburg
Germany	Potsdam
Germany	Kassel
Germany	Offenbach
Germany	Rostock
Germany	Oldenburg
Germany	Osnabruck
Germany	Aachen
Germany	Bielefeld
Germany	Bottrop
Germany	Dortmund
Germany	Leverkusen
Germany	Moers
Germany	Monchengladbach
Germany	Munster
Germany	Remscheid
Germany	Koblenz
Germany	Magdeburg
Hungary	Debrecen
Hungary	Gyor
Hungary	Kecskemet
Hungary	Miskolc
Hungary	Nyiregyhaza
Hungary	Pecs

Industrial noise inside agglomerations:

Country	Agglomeration
Hungary	Szeged
Iceland	Akureyri
Iceland	Gardabaer
Iceland	Kopavogur
Iceland	Mosfellsbaer
Iceland	Reykjanesbaer
Iceland	Reykjavik
Iceland	Selfoss
Iceland	Seltjarnarnes
Italy	Andria
Italy	Cagliari
Italy	Florence
Italy	Forli
Italy	Rome
Italy	Taranto
Italy	Trieste
Italy	Venice
Italy	Padova
Lithuania	Siauliai
Malta	Valletta
Montenegro	Podgorica
Poland	Bytom
Poland	Gorzow Wielkopolski
Poland	Kielce
Poland	Olsztyn
Poland	Opole
Poland	Plock
Poland	Radom
Poland	Rzeszow
Portugal	Oeiras
Romania	Arad
Romania	Baia Mare
Romania	Botosani
Romania	Braila
Romania	Cluj-Napoca
Romania	Constanta
Romania	Iasi
Romania	Oradea
Romania	Pitesti

Industrial noise inside agglomerations:

Country	Agglomeration
Romania	Satu Mare
Slovenia	Maribor
Spain	Burgos
Spain	Huelva
Spain	Reus
Spain	San Sebastian - Donostia
Spain	Valencia
Spain	Vitoria - Gazteiz
Sweden	Boras
Sweden	Gothenburg
Sweden	Helsingborg
Sweden	Jonkoping
Sweden	Linkoping
Sweden	Lund
Sweden	Norrkoping
Sweden	Orebro
Sweden	Stockholm
Sweden	Umea
Sweden	Uppsala
Sweden	Vasteras

Major airports:

Country	ICAO Code	Airport_name
Bulgaria	LBSF	Sofia Airport
Spain	LEAL	Alicante-Elche Airport
Switzerland	LSGG	Geneva Cointrin Airport
Switzerland	LSZH	Zurich Airport

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