Noise exposure scenarios in 2020 and 2030 outlooks for EU 28

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Preface

This study summarizes the estimated trend projection of noise population exposed to both L_{den} and L_{night} indicators above the END thresholds to the future 2020 (short term) and 2030 (mid-term) years across the EU28 in at unchanged policies scenario. Data of population exposed at the different noise bands (dB) by each source (i.e. road, rail, air, and industry), distinguishing between urban and rural population, have been aggregated at country level and summarized at EU28 level both for L_{den} and L_{night} exposure values. The scenarios have been calculated based on the assumption that current policies and planned objectives related to population and transport trends will be achieved and implemented, as well as land use change projections corresponding to a baseline or reference scenario.

Contents

Summary

General findings:
- The calculated projections show that the number of people exposed to high noise levels would increase in all noise sources (roads, railways and aircraft noise) except for industries inside agglomerations by 2020 (short term scenario).
- Prediction of exposure values for L_{night} follow the same pattern obtained with the calculations for L_{den} in short and mid-term scenario.

Specifically concerning road traffic noise:
- Exposure to major roads outside agglomerations potentially shows the highest incremental rates compared with the rest of transport sources in the overall period (16%) and also in the period 2020-2030 (11%)
- Taking into account the urban policies and targets mainly for road transport inside cities applied in the mid-term scenario, the number of people exposed predicted is very similar to the prediction obtained for the short-term scenario, envisaging a maintenance of the number of people exposed from 2020 onwards.

Specifically concerning railways traffic noise:
- Exposure to railway noise (both inside and outside agglomerations) presents an overall increase of 12% and 9% respectively considering the whole period (2017 – 2030). Short term scenario shows an increase of 7% inside urban areas and an extra 5% of increase between short and mid-term scenario, providing a final balance of the above mentioned 12% of increase of the people exposed to railways noise inside agglomerations, compared with values estimated in 2017 baseline reference year

Specifically concerning the aviation sector:
- By 2030, future technological improvements could imply a stabilization of aircraft noise exposure and potentially a mean reduction of nearly 2% compared with exposure values corresponding to 2017 reference year, both inside and outside urban agglomerations.

Acknowledgements

1   Introduction

Traditional traffic noise prediction models (as well as rail traffic and aircraft traffic models) are developed to fit for town planners and for noise abatement and control. They are not designed to estimate projections of noise exposure at regional scale.

Data required by noise traffic models include: roadway input (pavement type, local topography, roadway length, etc.), traffic characteristics (traffic volumes, vehicles categories, vehicles speed and flow, etc.), receptor locations, noise barriers description, building rows and meteorological conditions (e.g. relative air humidity). The availability of this local data, the high speed processing computers and skilled operators required to run these models, make them unsuitable for the calculation of large-scale projections.

Moreover, the majority of those models are not fitted to provide yearly-averaged noise indicators, such as L_{den} and L_{night} in accordance with the Noise Directive (END). From the 9 models developed in recent years and reviewed by Garg and Maji, (2014) only the CNOSSOS-EU model includes data on population exposure.

The proposed method looks for a final number of EU population exposed to noise levels to the future 2020 and 2030 years. Data of population exposed at the different noise bands (dB) by each source (i.e. road, rail, air, and industry), distinguishing between urban and rural population[1], are going to be aggregated both at country level and summarized at EU28 level, both for L_{den} and L_{night} exposure values. The spatial coverage of the calculations cover the EU28 member states: Switzerland, Iceland, Liechtenstein, Norway, Turkey are excluded from this assessment because the projections on transport activity are based on the "EU reference scenario 2016" (European Commission, 2016) which only contain estimated projections for the EU28 member states.

Differentiated methodological approaches and auxiliary data are proposed for each transport noise source. The reference population is the END database 2017 gap filled, updated with data reported by member countries until 01/01/2019 (the methodology applied to produce the gap filled dataset is explained in ETC/ATNI (2019)). The macroeconomic and demographic assumptions used in the Reference Scenario (European Commission, 2016) provide the framework projections on how the END exposed population 2017 will perform in the coming decades. Therefore, the noise exposure projection achieved in this assessment is driven by trends supplied by upstream models or other sources.

The proposed approach considered the positive impact of urban targets (i.e. urban target of the "2011 White Paper on Transport") that will inevitably counteract the expansion of the transport networks and the demographic increase in urban areas. There have been also taken into consideration the technology developments foreseen in the aviation sector which would influence the results obtained on the estimations of exposure to aircraft noise by 2020 and 2030, and the Commission Regulation (EU) No 1304/2014 on the technical specification for interoperability relating to the subsystem 'rolling stock — noise' that would influence the results obtained on the estimations of exposure to railway noise by 2020 and 2030.

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[1] Rural population = outside END agglomeration

2   Scope of the document

The aim of this document is to calculate a trend projection of noise population exposure changes across the EU-28 in a scenario at unchanged policies (i.e. baseline scenario or reference scenario). Results are presented distinguishing between two time periods: up to 2020 (the short term) and 2030 (the medium term) for both L_{den} and L_{night} indicators above the END thresholds.

As highlighted in the "EU reference scenario 2016" (European Commission, 2016), the exercise developed by the current task is focused on trend projections and not forecasts, with the provision of several noise exposure values to different noise sources as one of the possible future situations given certain conditions. The results obtained can help inform the debate on where currently adopted policies might lead the EU and whether further policy development, including the longer term, is needed (European Commission, 2016).

The calculated projections are based on the assumption that current policies and planned objectives related to population and transport trends will be achieved and implemented, as well as land use change projections developed by JRC (Lavalle et al., 2014). Therefore, the results obtained would correspond to a baseline scenario (also referred as reference scenario).

This document provides a description of the methodology, the data used to calculate the estimations of such projections and the results obtained per each noise indicator and each noise source.

3   Data inputs

3.1   Reference population exposure data baseline

The data used for this assessment is based on the data reported by countries under the END. The data is reported in 5dB bands. The END distribution of L_{den} consists of five dB intervals: 55-59, 60-64, 65-69, 70-74, >75, while the intervals for L_{night} consist on the following dB values: 50-54, 55-59, 60-64, 65-69, >70.

The reference population (People exposed at t_0) is going to be the estimated gap filled population exposure to each noise source inside (air, industry, rail and road noise) and outside agglomerations (major roads, major railways and major airports exposure data) of the END database, for 2017 reference year. The dataset containing the 2017 baseline estimated exposure gap filled data has been calculated following the methodology described in ETC/ATNI (2019).

The spatial coverage of the calculations cover the EU28 member states: Switzerland, Iceland, Liechtenstein, Norway, Turkey are excluded from this assessment because projections on transport activity are based on the "EU reference scenario 2016" (European Commission, 2016) which only contain estimated projections for the EU28 member states.

3.2   EU population projection

The availability of population data at grid level provide detailed and accurate information about the population distribution in Europe. In this sense, the projected population distribution maps from 2010 to 2050 of the Land-Use based Integrated Sustainability Assessment (LUISA) (Lavalle et al., 2014) are used to calculate city-specific and country-specific population cumulative annual growth indices.

The population grid created by the JRC is based on LAU population (EUROPOP2010) and CORINE land cover (CLC 2006). The core module of LUISA allocates population, services and activities to the most optimal 100m grid cells, given predefined suitability maps, regional demands and the supply of resources in a region. LUISA simulates the dynamic process of population and land use change on an annual basis, starting in 2006 and continuing until 2050 (Kompil et al., 2015).

The EU28 population projection to 2020, 2030 and 2050 disaggregated at 100x100 m grid has been used in the current activity on noise exposure projection, allowing data aggregation to the desired level, i.e. agglomerations and countries. The population distribution rasters from the LUISA platform can be downloaded at: https://data.jrc.ec.europa.eu/collection/luisa.

3.3   EU Transport activity projection

Projections on transport activity are based on the "EU reference scenario 2016" (European Commission, 2016) which provides transport activity growth by countries. The Reference Scenario is a model-derived simulation to reflect current trends and developments in the EU energy system and in GHG emissions. The modelling suite used for the Reference Scenario is based on a series of interlinked models which combine technical and economic changes. The PRIMES-TREMOVE model provides detailed projections (per country[2]) for the evolution of the entire transport sector in terms of transport activity by mode and transport mean, energy consumption, emissions, fleet development, new technologies and alternative fuels. This information has been used to calculate the changes

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[2]   Download excel files per country level at: https://data.europa.eu/euodp/data/dataset/energy-modelling/resource/9c3eaead-81b8-4a3d-a23d-4dd4a13f3c6e

applied to the exposed population at country level. In Table 3.1, there is the summary of the values per EU-28 member states.

Specifically concerning railways' noise exposure, the recommendation n. 006REC1072 of the European Union Agency for Railways on "The amendment of Commission Regulation (EU) No 1304/2014 on the technical specification for interoperability relating to the subsystem 'rolling stock — noise'" have been taken into consideration to calculate the changes to the exposed population.

Table 3.1. Summary energy balance and indicators per EU28: Reference scenario

SUMMARY ENERGY BALANCE AND INDICATORS (B)	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050	'00-'10	'10-'20	'20-'30	'30-'50
												Annual % Change			
TRANSPORT															
Passenger transport activity (Gpkm)	5964	6295	6449	6735	7152	7509	7880	8201	8507	8796	9053	0,8	1,0	1,0	0,7
Public road transport	549	541	528	546	570	587	604	622	636	653	667	-0,4	0,8	0,6	0,5
Private cars and motorcycles	4466	4721	4843	5001	5255	5457	5676	5849	6003	6156	6279	0,8	0,8	0,8	0,5
Rail	450	464	499	540	591	644	693	739	788	833	878	1,0	1,7	1,6	1,2
Aviation [3]	458	528	539	608	693	776	860	944	1031	1104	1177	1,7	2,5	2,2	1,6
Inland navigation	42	42	40	40	43	44	46	48	49	51	52	-0,3	0,5	0,7	0,6
Freight transport activity (Gtkm)	2295	2612	2556	2704	2981	3220	3457	3631	3802	3937	4051	1,1	1,5	1,5	0,8
Heavy goods and light commercial vehicles	1589	1853	1809	1915	2109	2277	2446	2564	2672	2763	2835	1,3	1,5	1,5	0,7
Rail	405	416	394	428	482	533	580	619	662	695	724	-0,3	2,0	1,9	1,1
Inland navigation	300	343	354	361	389	411	432	449	467	480	492	1,7	1,0	1,0	0,7
Energy demand in transport (ktoe) [4]	341525	364526	359402	358062	350945	344898	341463	343372	347354	351233	355025	0,5	-0,2	-0,3	0,2
Public road transport	8775	8725	8834	9040	9281	9298	9281	9361	9431	9542	9649	0,1	0,5	0,0	0,2
Private cars and motorcycles	206270	212102	211618	204765	190035	179668	174380	172933	172584	172413	172419	0,3	-1,1	-0,9	-0,1
Heavy goods and light commercial vehicles	67279	79273	76918	78507	81943	83785	85822	87786	89517	90948	92230	1,3	0,6	0,5	0,4
Rail	8168	7668	7129	7395	7863	8317	8637	8864	9044	9042	9018	-1,4	1,0	0,9	0,2
Aviation	44876	49959	49230	53303	56489	58294	57606	58516	60692	63134	65483	0,9	1,4	0,2	0,6
Inland navigation	6156	6798	5673	5051	5334	5536	5737	5912	6086	6155	6225	-0,8	-0,6	0,7	0,4
By transport activity															
Passenger transport	266294	275041	273897	271237	260066	251683	245768	245422	247427	249871	252399	0,3	-0,5	-0,6	0,1
Freight transport	75231	89484	85505	86825	90878	93215	95695	97950	99926	101361	102626	1,3	0,6	0,5	0,4
Other indicators															
Electricity in road transport (%)	0,0	0,0	0,0	0,0	0,2	0,4	0,9	1,2	1,5	1,9	2,3				
Biofuels in total fuels (excl.hydrogen and electricity) (%)	0,2	0,9	3,7	4,6	6,1	6,2	6,2	6,3	6,3	6,5	6,6				

Source: Reference Scenario (European Commission, 2016)

3.4 Aircraft transport activity projection

The activities of the aviation sector in Europe are contributing to noise impacts (among others), and the past improvements in areas such as technology and design of the aircrafts has not compensate pressures on the environment due to the increase in the demand for air travel. As it is recognized in the European aviation environmental report 2016 (European Aviation Safety Agency, European Union and European Environment Agency, 2016), the number of flights has increased by 80% between 1990 and 2014 and this trend is forecast to continue. Environmental impacts of European aviation have increased over the past 25 years and therefore, the environmental challenge for this sector is going to increase.

In the European Aviation Environmental Report 2016, the STAPES noise model has been used to calculate the noise contour maps as well as the number of people exposed for 45 major European airports, covering both the EU28 and the EFTA region. For each traffic forecast of the number of airports, advanced and low technology improvements rates have been applied, as can be seen in Figure 3.1.

Figure 3.1. Forecasts in the number of people exposed due to aircraft noise taking into consideration different traffic forecasts and technology improvements
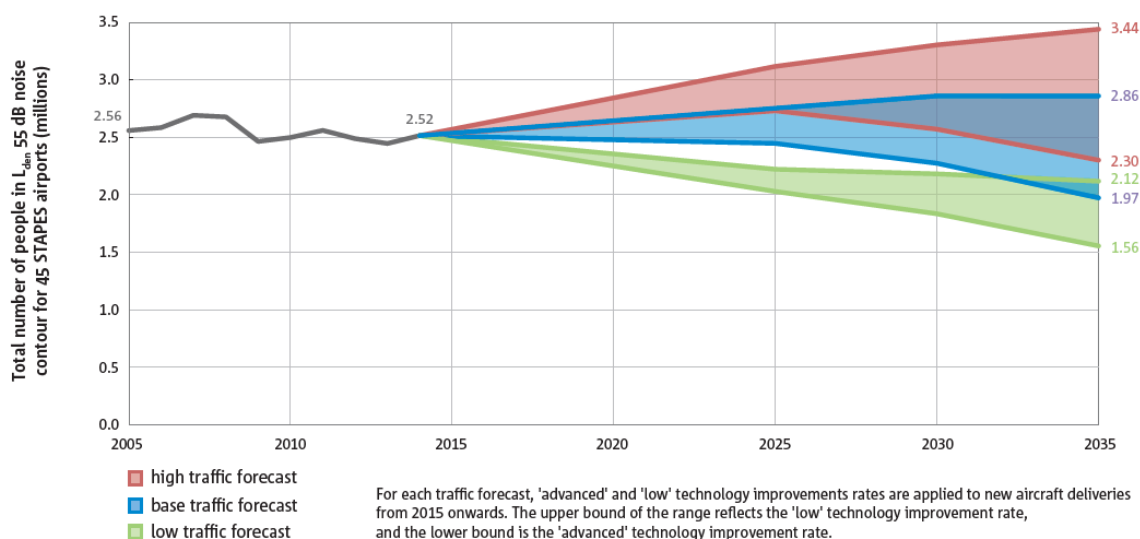
Source: European Aviation Environmental Report 2016 (EASA, EU and EEA, 2016)

3.5 Urban targets

With their high population densities and high share of short-distance trips, there is a greater potential for cities to move towards low-carbon transport than for the transport system as a whole, through the development of walking, cycling, public transport – and the early market introduction of vehicles powered by alternative fuels (EC, 2013).

In contrast to the forecast increase of transport intensity and population growth in EU28, an expected reduction of road noise emissions in urban areas is assumed due to specific urban regulations and technological improvements. While there have been several European policy initiatives targeting urban transport, it was not until the 2011 Transport Policy White Paper that an attempt was made to set clear goals for clean urban transport at the European level (Gudmundsson et al., 2015), namely:
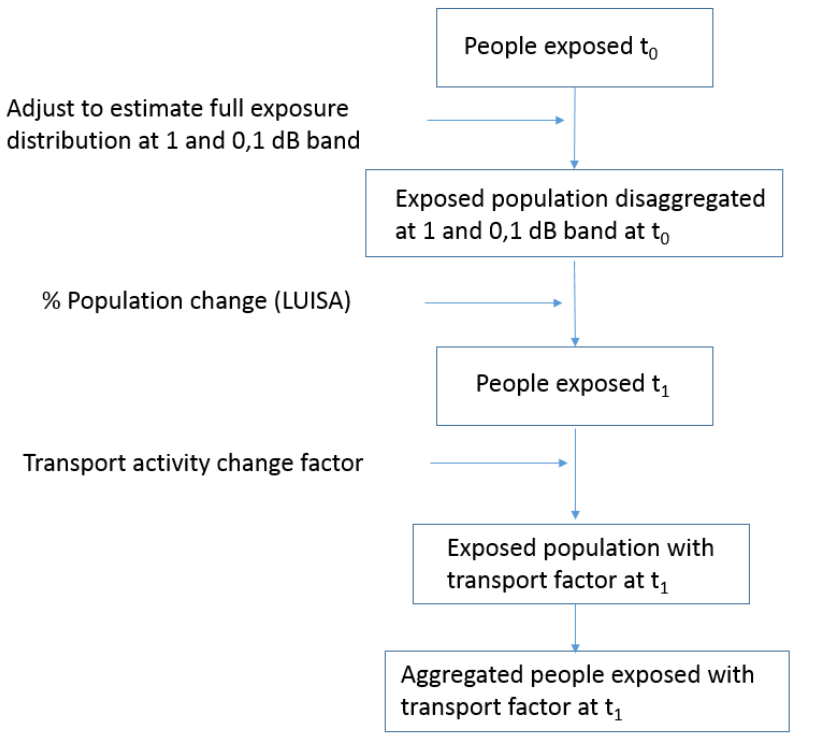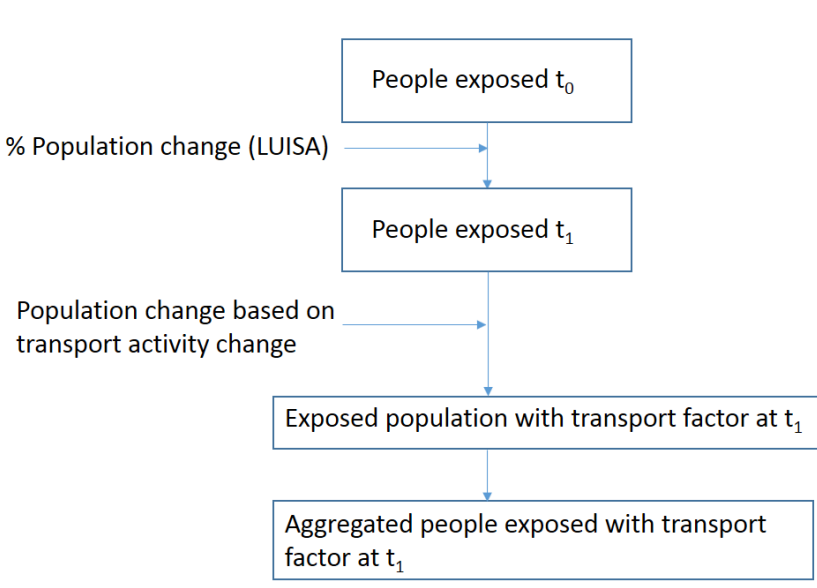
- "To halve the use of conventionally-fuelled cars in urban transport by 2030; and to phase them out by 2050;" and
- "To achieve essentially CO_2-free city logistics in major urban centres by 2030."

4   Conceptual model

The conceptual model presented arouse, as starting point, from the previous model developed by Extrium and Acustica for the European Environment Agency (Extrium, 2013), but it has been further refined with components identified in more recent publications.

The approach consists in the following phases depending on the noise source (see Table 4.1):

Table 4.1. Conceptual model applied per each noise source

Noise source	Conceptual model
1. Road exposure inside agglomerations 2. Rail exposure inside agglomerations 3. Major roads exposure outside agglomerations 4. Major rails exposure outside agglomerations	People exposed t_0 Adjust to estimate full exposure distribution at 1 and 0,1 dB band Exposed population disaggregated at 1 and 0,1 dB band at t_0 % Population change (LUISA) People exposed t_1 Transport activity change factor Exposed population with transport factor at t_1 Aggregated people exposed with transport factor at t_1
1. Air exposure inside agglomerations 2. Major air exposure outside agglomerations	People exposed t_0 % Population change (LUISA) People exposed t_1 Population change based on transport activity change Exposed population with transport factor at t_1 Aggregated people exposed with transport factor at t_1

1. Industrial exposure inside agglomerations	

People exposed t_0

% exposure change between 2012 and 2017

Aggregated people exposed at t_1
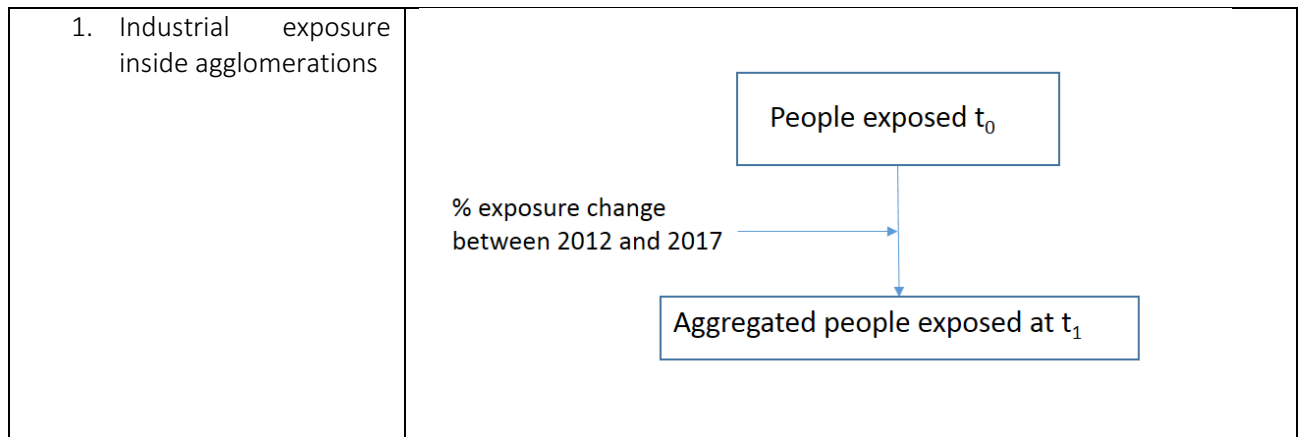
Main steps in the model are:

(i)   Disaggregation of population exposed from 5 dB band to 1 dB band with precision of 1 decimal. This is required to apply, at the end, the dB change for the projected period for road and rail exposure (inside and outside urban areas).

(ii)   Apply the population growth rate (obtained from the LUISA model (Lavalle et al., 2014)) to the population disaggregated at 0,1 dB noise level, for road, rail and air exposure both inside and outside urban areas

(iii)   Estimate noise level change at noise source (dB) according to: transport activity change, regulations and technology improvements

    a. In the case of road and rail exposure, the dB change is derived from the transport activity change factor (input data EU Reference Scenario (2016))

    b. In the case of air exposure, forecast of the number of people exposed due to aircraft noise has been used to estimate the percent change to be applied (input data European Aviation Environmental Report (2016))

(iv)   In the case of industrial noise, the percent annual change encountered when comparing 2007-2012-2017 reference years have been applied to the baselined data to calculate the number of people exposed to 2020 and 2030. This noise source is considered different than the rest of transport noise sources because (1) is highly dependent on the location of the industrial areas in the municipalities and therefore the influence of the population growth could be considered negligible and (2) the changes foreseen in industrial areas would not directly imply a change in the number of people exposed.

This conceptual model is applied to the number of people exposed to both $L_{den} \geq 55dB$ and $L_{night} \geq 50dB$ indicators.

5 Methodology

5.1 Overview

Factors influencing noise exposure behave differently inside and outside urban areas. Assigning the same projected trend to the entire exposed population as a whole (i.e. regional average rates) entails to assume a broad generalization that might strongly bias results; i.e. country population annual rates cannot reflect urbanization processes or other differentiated territorial demographic behaviour within countries.

Therefore, the proposed approach differentiates between exposure calculations inside and outside agglomerations reported under the END (2002/49/EC), adding specific urban regulations and technological improvements forecasted to be implemented in 2030. This differentiation can be observed in the following detailed model developed for road transport noise (Figure 5.1), but the differentiation between exposure calculations inside and outside END agglomerations is also applied in the calculations for rail and air noise exposure.

Figure 5.1. Detailed conceptual model
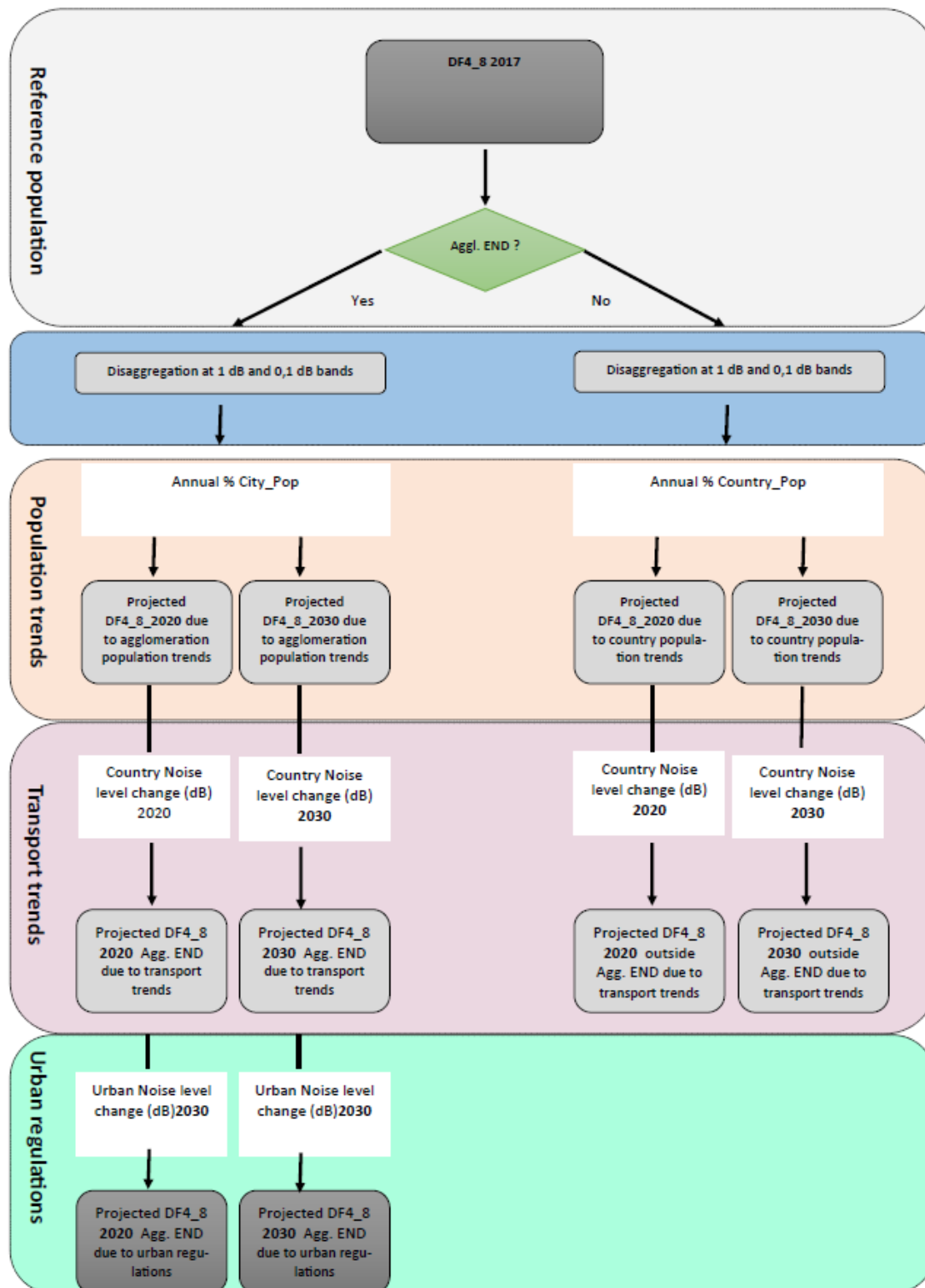
5.2   Disaggregation of population at 1dB (with precision of 1 decimal)

In order to quantify the potential impact of future dB changes on population, the exposed population need to be disaggregated at 1 dB and at 0,1 dB, as most of the projected dB changes to 2020 and 2030 are non-integer values.

The following workflow have been followed in the case of exposure values due to road and rail transport infrastructures inside and outside agglomerations:

1. Estimate the percentage of people exposed to lower dB bands: 50-54 dB and 45-49 dB L_{den}, and 40-44 dB and 45-49 dB L_{night}
2. Redistribute the population exposed into 1 dB
3. Redistribute the population exposed into 0,1 dB

In Table 5.1, there is a summary of the method used for the estimation of population exposed to lower noise levels in case the country is not providing voluntarily this information. Assumptions taken in each case have been also highlighted.

Table 5.1. Method to estimate lower noise levels per noise source

NOISE SOURCE	EXPOSURE ESTIMATION AT LOWER NOISE LEVELS METHOD	ASSUMPTIONS
Road noise exposure inside agglomerations	Option 1: Use the values provided by the country Option 2: Use the estimations calculated at country level in Houthuijs et al., 2017	Distribution over all noise bands has a normal distribution
Rail noise exposure inside agglomerations	Option 1: Use the values provided by the country Option 2: Use the percentages calculated at European level in Wiebe et al., 2016	Distribution over all noise bands has an exponential distribution. Proportionate distribution assumed as the same behaviour as for major roads outside agglomerations.
Major roads exposure outside agglomerations	Option 1: Use the values provided by the country Option 2: Use the percentages calculated at European level in Wiebe et al., 2016	Distribution over all noise bands has an exponential distribution
Major rail exposure outside agglomerations	Option 1: Use the values provided by the country Option 2: Use the percentages calculated at European level in Wiebe et al., 2016	Distribution over all noise bands has an exponential distribution Proportionate distribution assumed as the same behaviour as for major roads outside agglomerations.

5.2.1 *Extrapolation to lower noise levels for road noise exposure inside agglomeration*

If there is no information available for lower noise values, the percentages for noise bands distribution below 55 dB L_{den} and 50 dB L_{night} has been calculated based on the assumption that the distribution over all noise bands has a normal distribution (see Figure 5.2) (Wiebe et al., 2016).

Figure 5.2. END agglomeration population exposed to road traffic noise in 2012
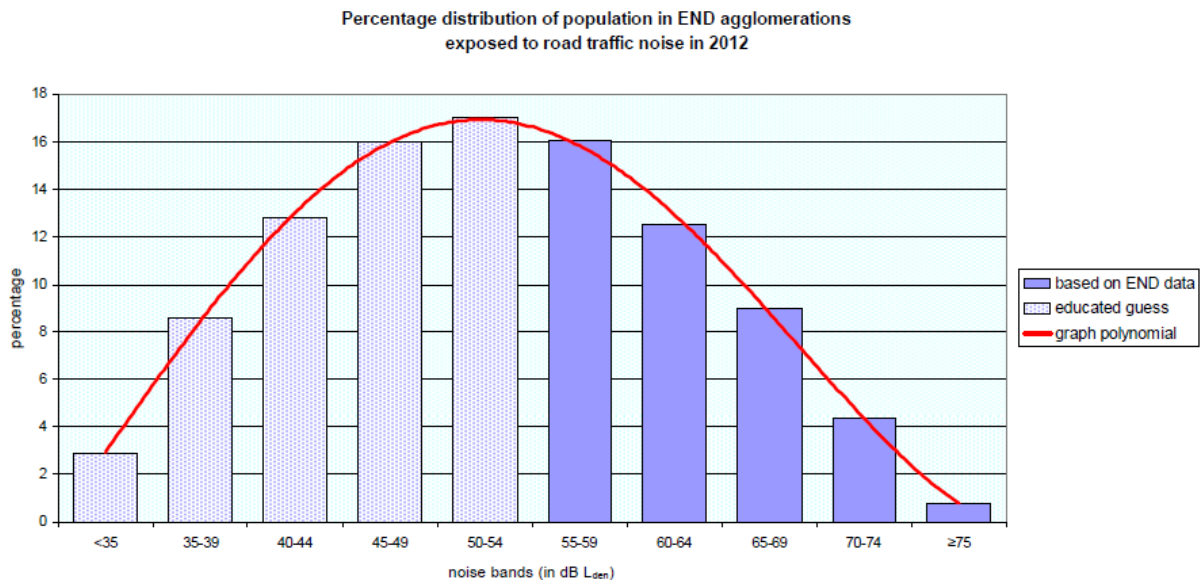
Source: Wiebe et al., 2016

But, instead of using global estimations at EU level, country percentages of noise bands below 55 dB L_{den} and below 50 dB L_{night} have been used, based on the statistical approach for the extrapolation of exposed population to lower noise levels proposed in the ETC/ACM technical paper (Houthuijs et al., 2017). This technical report estimates road traffic noise distribution per decibel for a range of 40-70 dB L_{den} and for a range of 30-60 dB L_{night}, for non-END agglomerations, for END agglomerations and for the total population separately. The statistical methodology approach is explained in more detail in Van Den Hout et al. (2011).

Distribution values per 5 dB band applied at country level can be consulted at Houthuijs et al., 2017.

Once the estimated exposure values at lower dB bands have been calculated, the method redistributes the percentage of people exposed into 1 dB, using the extended END distribution with the two additional intervals 45-49 and 50-54 dB for L_{den} and 40-44 and 45-49 dB for L_{night} (calculated in the previous step), with percentages *N*-1 and *N*-0 respectively.

For each 5 dB interval, the mean gradient dN/dL (in % per dB) is calculated, given by:

$$\left(dN/dL\right)_j = \tfrac{1}{2}[\tfrac{1}{5}(N_{j+1} - N_j) + \tfrac{1}{5}(N_j - N_{j-1})]$$

Where:

dN/dL: Mean gradient
N_j: Interval j (e.g. 55-59dB)
N_{j+1}: Upper interval
N_{j-1}: Lower interval

Next, the distribution is refined by replacing each 5 dB interval by five 1 dB intervals.

$$N_{j,k} = \tfrac{1}{5}[N_j + (dN/dL)_j(k-3)]$$

Where:
index k = 1, 2, …, 5 runs over the five 1 dB intervals in 5 dB interval j.

The output of this process is the percentage of the population exposed to road traffic noise inside agglomerations at 1 dB per each agglomeration.

5.2.2 *Extrapolation to lower noise levels for rail noise exposure inside agglomerations and for major roads and major railways exposure outside agglomerations.*

If there is no information available for lower noise values, the percentages for noise bands distribution below 55 dB L_{den} and 50 dB L_{night} has been calculated based on the assumption that the distribution over all noise bands has an exponential distribution (see Figure 5.3) (Wiebe et al., 2016).

Figure 5.3. Population outside END agglomeration exposed to major road traffic noise in 2012
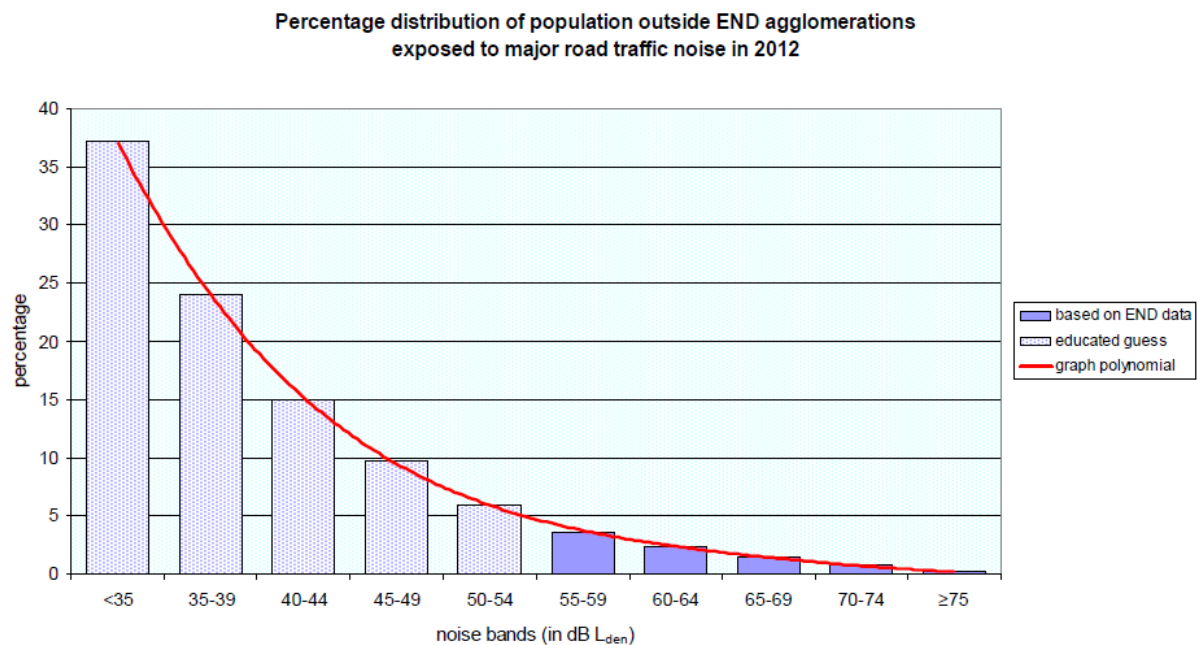
Source: Wiebe et al., 2016

EU estimations calculated by Wiebe et al. (2016), have been used to derive the relative fraction of the lower bands based on the total population exposed equal or higher than 55 dB L_{den} and 50 dB L_{night}. The relative fractions applied for L_{den} are detailed in Table 5.2.

Table 5.2. Calculated relative fraction for lower noise bands based on Wiebe et al., 2016 estimations for major road traffic noise in 2012 (L_{den})

	Lden	<35	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	>75	total
Noise exposure (in million)	Reported data (2012)						12,2	7,9	4,9	2,4	0,6	337,2
	Wiebe et al., 2016 calculations	125,1	80,9	50,6	32,7	19,9						
Calculated relative fraction	As percentage of total exposed ≥ 55dB					0,71071						
	As percentage of total exposed ≥ 50dB	2,61169	1,68894	1,05637	0,68267							

Source: Wiebe et al., 2016. Calculations RIVM, 2018.

It has been assumed that the difference between L_{den} and L_{night} is a 10 dB shift, so the relative fractions applied for L_{night} are the ones detailed in **Error! Reference source not found.**.
Error! Not a valid link. Source: Wiebe et al., 2016. Calculations RIVM, 2018.

Finally, it has been assumed that the relative fractions used to estimate the percentage of people exposed to lower bands applied for major road traffic noise (**Error! Reference source not found.**) can also be used to estimate the percentage of people exposed to lower noise bands due to rail noise exposure inside agglomerations and major rail exposure outside agglomerations.

5.2.3 *Redistribute the people exposed into 0,1 dB*

Most of the projected dB changes to 2020 and 2030 are non-integer values. Consequently, we need again to increase the dB resolution and refine it up to 0,1 dB intervals (δL decibels), and this will be done by dividing into 1/10 the percentage of people exposed per each dB band.

5.3 Demographic projections

The second step followed is the projection of population exposed disaggregated at 0,1 dB at t_0 according to expected population change to obtain the projected population at t_1 (2020 and 2030 respectively).

In order to calculate the expected population change, the LUISA population grid model (https://data.jrc.ec.europa.eu/collection/luisa) has been used. This model allows the calculation of different growth rates per each urban area defined by the END, and also at country level discarding the END urban agglomerations.

Accordingly, the corresponding population values (at t_{2010}, t_{2020}, t_{2030}) have been determined using spatial metrics from LUISA population grid for the years 2010, 2020 and 2030. An example of how the population values for each specific END agglomeration have been calculated, is illustrated in Figure 5.4. The area of END agglomerations delimitates the area to sum up the population values for each year. The same areas are used to erase its surface from the country coverage and sum up the population values at country level for each year.

Figure 5.4. Process to calculate the sum of the population values for each country and END agglomeration (example: Lithuania) in years 2010, 2020 and 2030.
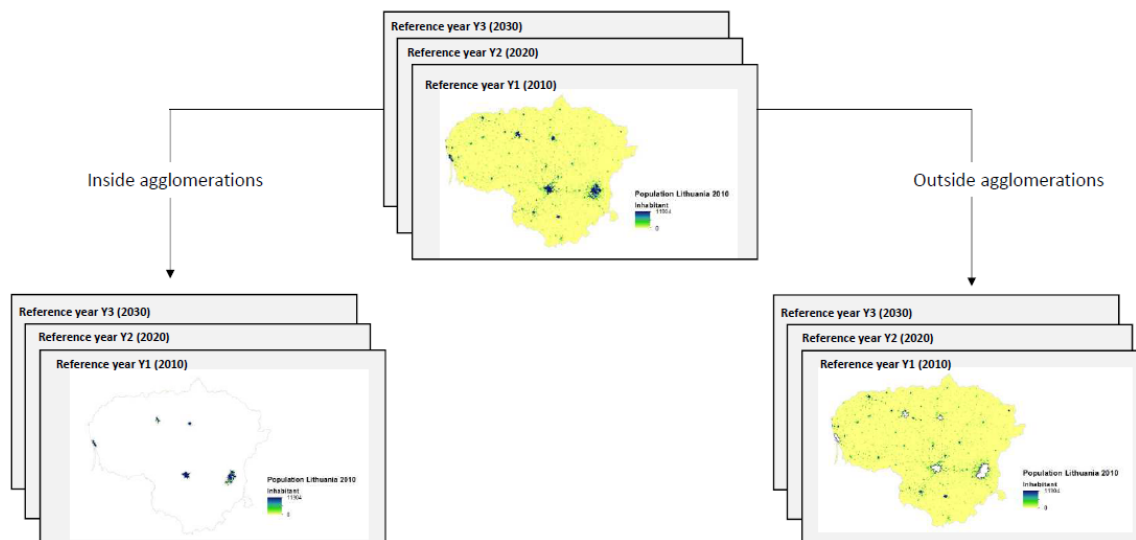
Once the population have been assigned to each of the studied areas, the Cumulative Average Growth Rate, often expressed as CAGR, for the period 2010-20 and 2020-2030 has been calculated. Cumulative growth is a term used to describe a percentage of increase over a set period of time. The resulting rate for each period will be applied to the reference population (People disaggregated and exposed at t_0).

Figure 5.5. Cumulative annual growth to estimate the impact of demographic trends in noise exposed population
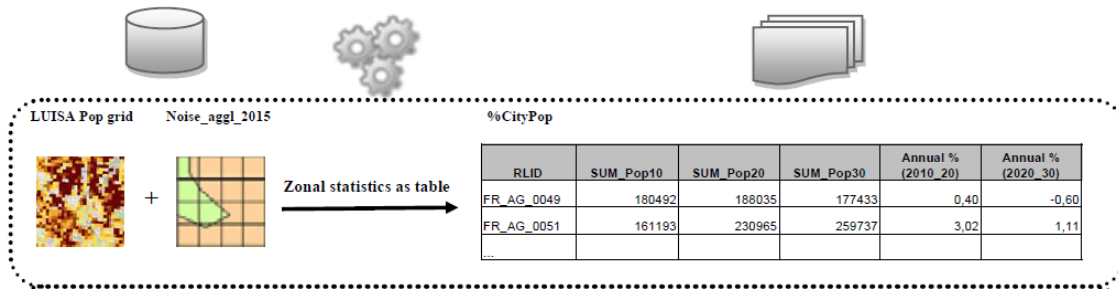
As a result, a specific CAGR for each END agglomeration and for each country, or countryside population (excluding population living in agglomerations) is obtained. CAGR calculated per each agglomeration and country (excluding population living in agglomerations) can be found in Annex 2 and Annex 3 respectively.

In order to calculate CAGRs, the essential values are: the population P_0 (or starting value), the population at P_1 (or ending value), and the T (or period of time to measure growth).

$$CAGR_{t0-t1} = ((Pop_1/Pop_0)^{\wedge} 1/T)) -1$$

Once the complete list of CAGR have been calculated, the resulting rates are used to project future values of population exposed to noise using the following formula per each studied period:

$$P_{exposed\ 2020} = P_{exposed2017}(1 + CAGR)^{\wedge}3$$

$$P_{exposed\ 2030} = P_{exposed2020}(1 + CAGR)^{\wedge}10.$$

It should be highlighted that overseas parts of the European territory (France and Spain, in this case) are not covered by LUISA population grid model. In these two cases, the mean value for agglomerations at country level per each country have been applied in the following agglomerations:
- France: Saint-Denise-de-la-Reunion, Saint-Pierre, Fort-de-France, Pointe-a-Pitre – Les Abymes
- Spain: Las Palmas de Gran Canaria, Santa Cruz de Tenerife, Telde, San Cristóbal de la Laguna

5.4   Road and rail transport projections: freight and passenger transport

The macroeconomic and demographic assumptions used in the Reference Scenario (European Commission, 2016) provide the framework projections on how the END exposed population in 2017 will evolve in the coming decades.

Based on the expected EU transport sector behaviour for years 2020 and 2030, the dB changes expected can be obtained. This process entails:
- (i)   calculate rates of growth by countries,
- (ii)   traduce the activity change into dB change,
- (iii)   determine the differentiated impact of road freight transport inside urban agglomerations.

An overview of projected transport activity at EU-28 is presented in Table 5.3 based on PRIMES model. This data is also available at country level (see section 3.3), which allows to reflect interregional differences. While the traffic parameter used by the END directive 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, it has been assumed a linear relationship between the increase of

passengers and the increase of the traffic volume (i.e. constant occupancy of vehicles over the period analysed).

Table 5.3. Transport activity (Passanger-Gpkm & Freight-Gtkm) projected to 2020 and 2030 at EU-28

		2020	2030
Road			
Road-passenger	Public road transport	570,5	604
	Private cars and motorcycles	5255,3	5676,5
Road- freight	Heavy goods and light commercial vehicles	2109,5	2445,6
Rail			
Rail-passenger		590,8	692,7
Rail- freight		482,2	580,3

Source: Compiled from Appendix 2 (pp. 144-145) from the report European Commission, (2016)

The EU Reference Scenario 2016 estimates the activity transport change expressed in passenger-kilometres (and tonne-kilometre for freight transport). These transport statistics are breaking down by transport type up to 2050 (intervals of 5 years) and presented separately for each EU28 member state. Rates of growth have been calculated in Table 5.4 (using the projected values aggregated at EU28). A complete list of transport activity rates by country have been calculated to estimate the noise exposure outlook at country level.

From the growth rates calculated for both periods, the decibel change has been derived using the criteria: "a doubling in traffic flow produces a 3dB increase in noise level". Applying this criteria to the potential change in the transport activity, a specific dB change per each transport activity is obtained (see Table 5.5).

Table 5.4. Summary of traffic growth forecast and indicated change in noise emission levels at EU28

		2015[3]-2020		2020-2030	
		Activity change (%)	**dB change**	Activity change (%)	**dB change**
Road *Road-passenger*	Public road transport	4,5	0,2	5,9	0,2
	Private cars and motorcycles	5,1	0,2	8	0,3
Road- freight	Heavy goods and light commercial vehicles	10,2	0,4	15,9	0,6
Rail *Rail-passenger*		9,4	0,4	17,3	0,7
Rail- freight		12,8	0,5	20,4	0,8

Source: Activity rates change calculated according to EU Reference data values (see Table 6.4)

Due to the fact that road freight transport is expected to grow at higher rates than passenger transport, if the dB increase from freight transport (see Table 5.4) is imputed equally inside and outside END agglomerations, it will result in an overestimation of the noise impact of freight transport in urban areas.

As cited by (Russo and Comi, 2012) several empirical studies confirmed that the total urban road freight vehicles account for 6– 18% of total urban travel (Cambridge Systematics, 2012; Figliozzi, 2010; Hunt et al., 2004). For the purpose of this project it is assumed that 12% (i.e. the mean value extracted from those empirical studies) of the road freight activity change will be imputed to END agglomerations. In Table 5.5

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[3] The two years of projected transport activity change from 2015-2017 are ignored.

the new values for *Heavy goods and light commercial vehicles* specifically for urban agglomerations and corresponding dB change are presented in bold.

Table 5.5. Summary of traffic growth forecast and indicated change in noise emission levels at EU28, applying a reduction for road freight transport inside agglomerations

		2015[4]-2020		**2020-2030**	
		Activity change (%)	**dB change**	Activity change (%)	**dB change**
Road *Road-passenger*	Public road transport	4,5	0,2	5,9	0,2
	Private cars and motorcycles	5,1	0,2	8	0,3
Road- freight	Heavy goods and light commercial vehicles	10,2 **1,2 (inside Agglomerations)**	0,4 **0,1**	15,9 **1,9 (inside agglomerations)**	0,6 **0,1**
Rail *Rail-passenger*		9,4	0,4	17,3	0,7
Rail- freight		12,8	0,5	20,4	0,8

Concerning rail freight transport, and based on European Union Agency for Railways (2018, a), it has also been taken into consideration (1) the forecast on freight wagons silent fleet considering several assumptions related to fleet renewal (e.g. retrofitting wagons) and (2) the share of freight trains to 18,5%, based on the European Union Agency for Railways (2018, b). The dB change reduction have been applied separately for each EU28 member state.

Detailed tables at country level with the dB reduction applied per noise source can be found in Annex 4.

5.5   Aircraft transport projections

For the purpose of the current analysis and using the results published in the European aviation environmental report 2016 (European Aviation Safety Agency, European Union and European Environment Agency, 2016), the mean value between "advanced" and "low" technology improvement from the base traffic forecast have been used to estimate the projected noise exposure at EU-28 level of the aviation sector.

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[4] The two years of projected transport activity change from 2015-2017 are ignored.
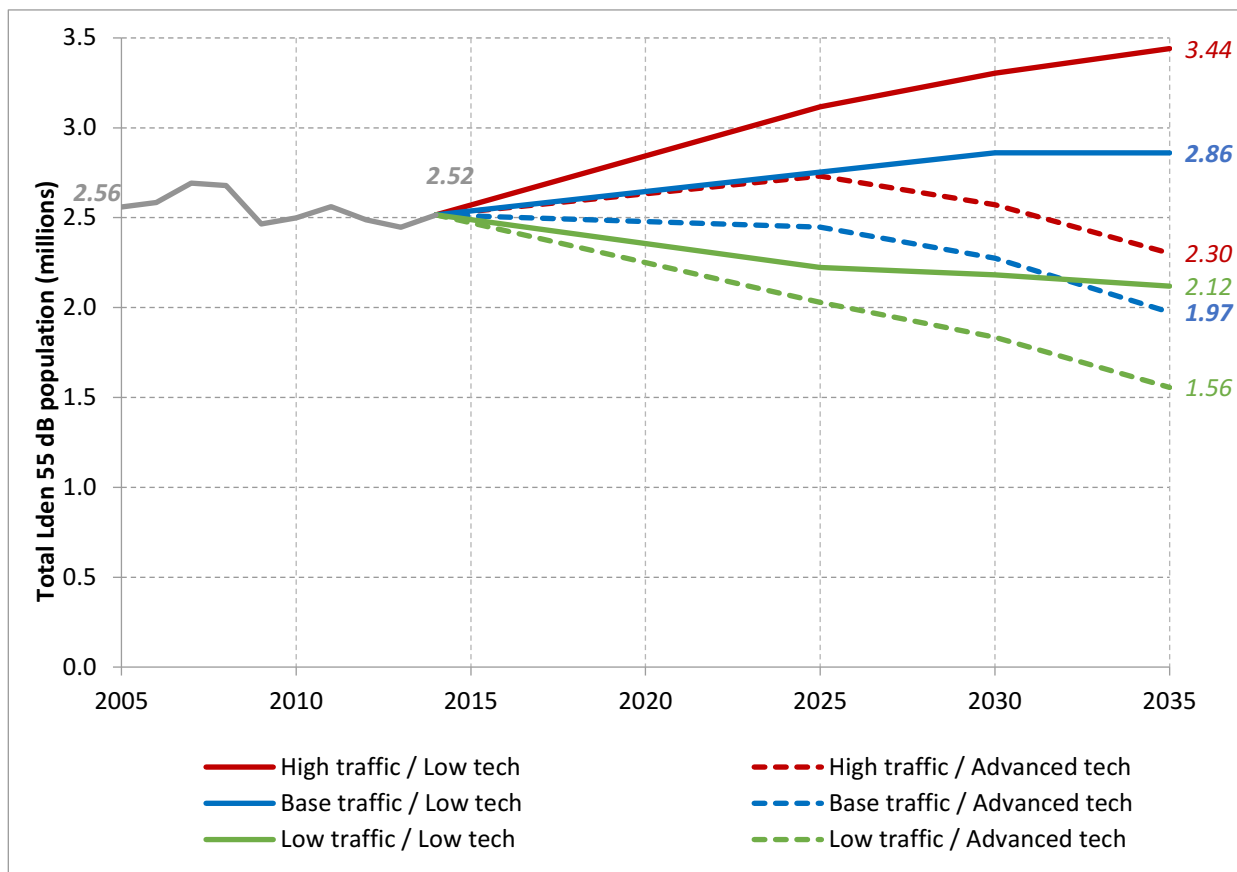
Source: EASA, EU and EEA, 2016

The Cumulative Average Growth Rate (CAGR) has been calculated both for 2020 and 2030, obtaining the following values that have been directly applied to the population exposed at t_1 (with the demographic projection already implemented):

- CARG 2020: 0,00276628567511361
- CAGR 2030: -0,00252873862702041

5.6 Urban targets

The growth trends of both the population and the activity of transport induce to a potential increase of noise exposure in EU by 2030. However, the proposed approach, also includes the positive impact of urban regulations (i.e. urban target of the "2011 White Paper on Transport") that will inevitably counteract the transport and population trend, as well as technology developments in the aviation sector.

Knowing that most probably there will be a strong variation in local circumstances, it has been assumed that END agglomerations will achieve the urban target of the White Paper (i.e. halve the use of 'conventionally fuelled' cars in urban transport by 2030). According to this target we assume that 50% of the total vehicle fleet in the END agglomerations will be electric.

Consequently, the projected dB increase due to the growth of transport activity (Table 5.3) will be counteracted by the impact of the urban measure.

The calculation of the decibel reduction due to the achievement of the urban target set out in the White Paper has been based on the work done by Muirhead, M. (2015) within the DISTANCE project, where a 0.8 dB reduction is estimated for a scenario with 100% electric cars on minor roads. According to this work

we estimated a reduction of 0,4 dB by 2030 due to the replacement of 50% of the vehicle fleet to electric vehicles.

The justification to choose a measure covering solely road traffic is due to its higher impact compared to other transport sources. Road traffic noise, both inside and outside urban areas, is still the most dominant source affecting human exposure above the action levels defined by the END, with the latest available information reported by Member States (ETC/ACM, 2017).

5.7   Model assumptions

5.7.1   *General assumptions*

- The noise level reduction at source is the same as the noise level reduction at the receptor.
- All END agglomerations will achieve the urban target of the 2011 White Paper on Transport
- Relative transport activity change i.e. Passenger (Gpkm) & Freight (Gtkm) is equivalent to relative END traffic volumes
- dB change is derived according to: "a doubling in traffic flow produces a 3dB increase in noise level"
- A dB "shift" of 10 dB to calculate L_{night} relative values below the 50dB threshold (see **Error! Reference source not found.**)

5.7.2   *Assumptions concerning the input data used*

The noise exposure projection proposed in this assessment is driven by future trends supplied by upstream models or other sources. Mainly, on population projection (LUISA) and transport activity projection (EU Reference Scenario, 2016 and European Aviation Environmental Report, 2016). Both demographic and transport projections should ideally be mutually consistent in terms of scenario assumptions. In this sense, the sources feeding the proposed model build on the same assumptions, this is the EU Reference Scenario.

Both start from the assumption that "*the legally binding GHG and RES targets for 2020 will be achieved and that the policies agreed at EU and Member State level until December 2014 will be implemented.*"

However, the main constraint from the input projections proposed is the fact that they differ in the base year used to project data. While the transport activity projection is based on the EU Reference scenario 2016 and on the European Aviation Environmental Report 2016, the population projection from LUISA is based on the previous EU Reference scenario published in 2013, (or an updated configuration 2014) (Barbosa et al., 2015).

The "2015 Ageing Report" (European Commission, 2014) is the starting point of the EU 2016 Reference Scenario giving long term population and GDP growth trends while the short and medium term GDP growth projections were taken from DG ECFIN. Thus, while the Reference scenario 2016 is based on the latest available statistical data from Eurostat at the time of the modelling (EUROPOP2013), the LUISA population projection is based on EUROPOP2010.

5.7.3   *Assumptions concerning the data used for the calculations of exposure* to lower noise *for road traffic noise exposure inside agglomerations*

The method used to estimate exposure to lower noise levels for L_{den} (below 55dB) inside agglomerations was been developed in ETC/ACM (2016), using as input data the estimations from the modelling of the complete territory of Switzerland and The Netherlands.

In the Netherlands, STAMINA (Standard Model Instrumentation for Noise Assessments) is used to calculate the road traffic noise exposure for the whole of the country. Data from 2011 was used in previous

assessments, and a new dataset from 2017 for motorways over 2016 and a dataset for all roads is available at RIVM.

In Switzerland, the Sonbase model (BAFU, 2009) is used to calculate exposure to the road traffic noise for the whole of Switzerland. Data from 2012 was used in previous years.

6   Results

The calculated projections show that the number of people exposed to high noise levels would increase in all noise sources except for industries inside agglomerations by 2020 (short term scenario) (Figure 6.1). Mid-term scenario (2030) with the consideration of policies in the aviation sector, could imply a decrease of the number of people exposed predicting similar and even less exposure values than the ones estimated in 2017 baseline reference year concerning aircraft noise. Taking into account the urban policies and targets mainly for road transport inside cities applied in the mid-term scenario, the number of people exposed predicted is very similar to the prediction obtained for the short-term scenario, envisaging a maintenance of the number of people exposed from 2020 onwards.

Nevertheless, considering all noise sources, an increase of the number of people exposed can be envisaged, primarily represented by the increase of exposure to major roads outside agglomerations followed by the exposure to railways noise both inside and outside agglomerations and by the exposure to road noise inside agglomeration, compared with the values estimated in 2017 baseline reference year (Figure 6.2). Estimated exposure to industrial noise by 2020 and 2030 have been calculated considering the change in reported data in 2012 and 2017, considering a constant change per year.

Figure 6.1. Estimated projections of number of people exposed due to different noise sources at 2020 and 2030 (L_{den})

Table 6.1. Estimated projections of number of people exposed due to different noise sources at 2020 and 2030 (L_{den})

	Inside Urban Areas			Outside Urban Areas		
	2017	**2020**	**2030**	**2017**	**2020**	**2030**
Road noise	78236200	83649928	84323328	30574800	31964507	35585082
Rail noise	10337200	11026608	11558161	10666700	11061328	11596265
Aircraft noise	3028200	3122199	3012531	1072800	1074668	1040536
Industrial noise	782900	696998	473132	-	-	-

Figure 6.2. Estimated percent change exposure at short term (2020) and mid-term (2030) considering 2017 baseline reference year, per noise source.
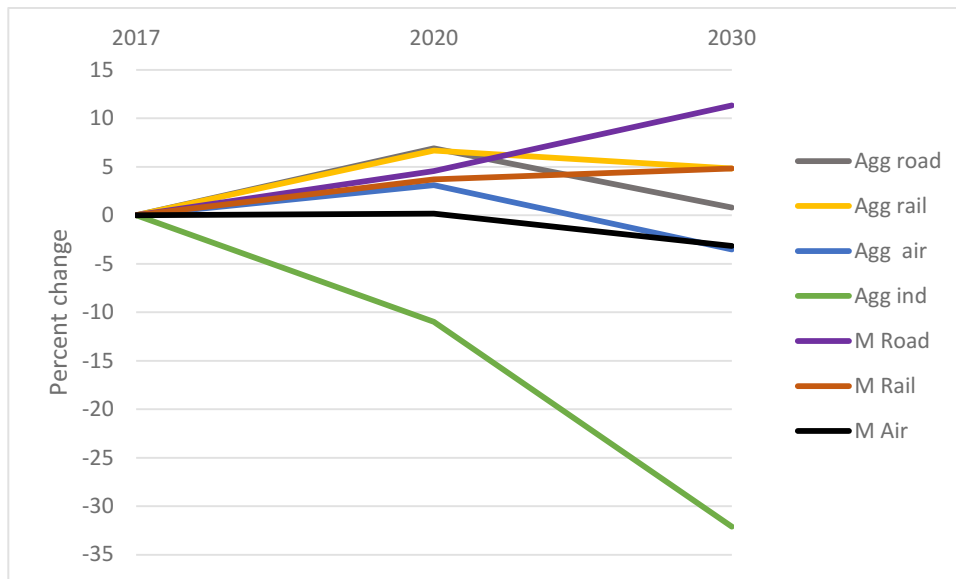
These results are in line with the expected increase of the number of people exposed by 2020, provided the growth trends of both the population and the transport activity. As regards demographic assumptions, EU population is projected to increase over coming decades up to 2050, although with declining growth rates. As regards transport sector assumptions, it is projected a significant activity growth in the EU Reference Scenario (2016), based on transport demand usually linked to GHG emissions (Rijkee and van Essen, 2012).

The highest increase takes place during the period 2010 to 2030, driven by developments in economic activity. This is especially relevant in the case of road and rail transport. Exposure to major roads outside agglomerations potentially shows the highest incremental rates compared with the rest of transport sources in the overall period (16%) and in the period 2020-2030 (11%), followed by railway noise inside and outside agglomerations, where it can be seen an overall increase of 12% and 9% respectively considering the whole period (2017 – 2030). Short term scenario shows an increase of 7% inside urban areas and an extra 5% of increase between short and mid-term scenario, providing a final balance of the above mentioned 12%of increase of the people exposed to railways noise compared with the values estimated in 2017 baseline reference year (Figure 6.3). It should also be considered that the freight transport sector is growing at higher rates than passenger transport, following more closely the GDP developments (European Commission, 2016), which has a direct impact on the rail freight transport forecasts. The forecasts related to freight rail transport, especially related to retrofitting wagons, has been taken into account in the scenarios calculated based on the estimations available in European Union Agency for Railways (2018, a).

Figure 6.3. Change in the number of people exposed to high levels of railway noise inside and outside urban areas. In light blue, estimated percent change from 2017 to 2020 and in dark blue, estimated percent change from 2020 to 2030. In dark grey, percent change for the overall period: 2017-2030.

	Agglomeration rail	Major Rail
■ 2017-2020	6.7	3.7
■ 2020-2030	4.8	4.8
■ 2017-2030	11.8	8.7
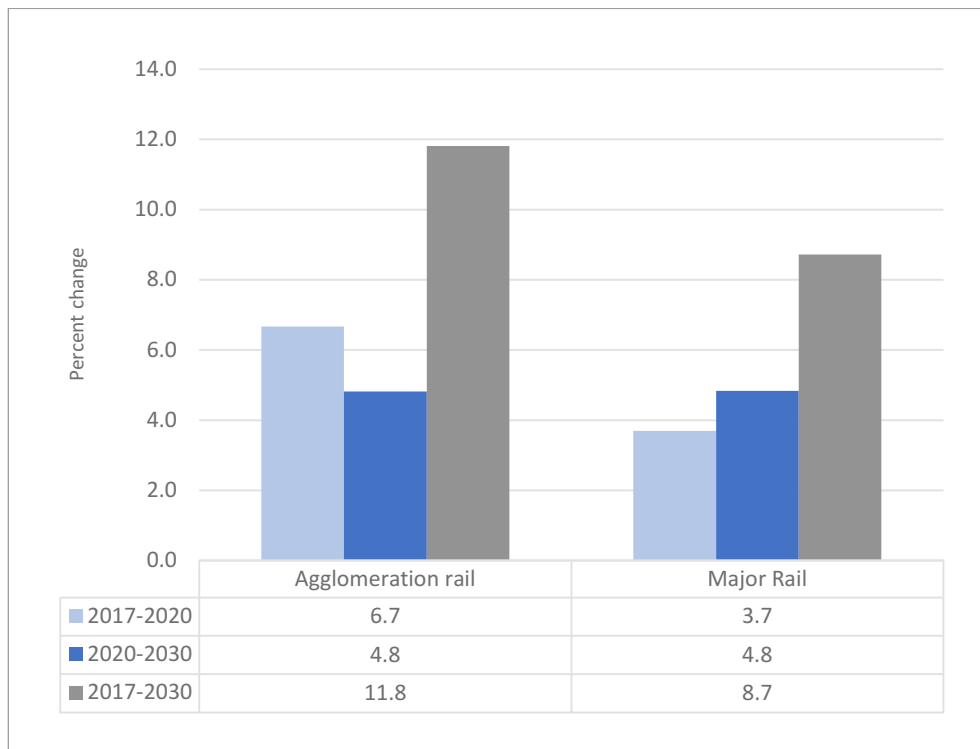
The proposed approach also includes the positive impact of urban targets that will inevitably counteract the transport and population trend in urban areas and therefore influence on the projected number of people exposed to certain noise levels in urban areas. The Clean Urban Transport target established in 2011 Transport Policy White Paper to "halve the use of conventionally-fuelled cars in urban transport by 2030; and to phase them out by 2050;" and "to achieve essentially CO_2-free city logistics in major urban centres by 2030." Based on the assumption that this policy will be implemented and the goal achieved, a reduction of 0,4 dB due to road transport noise could be envisaged, leading to the lowest increase (less than 1%) between short and mid-term scenario people exposed to road traffic noise inside urban areas (Figure 6.4). On the contrary, it can also be observed the highest increase estimated between short and mid-term scenario of people exposed to major roads outside agglomerations.

Figure 6.4. Change in the number of people exposed to high levels of road noise inside and outside urban areas. In light blue, estimated percent change from 2017 to 2020 and in dark blue, estimated percent change from 2020 to 2030. In dark grey, percent change for the overall period: 2017-2030.

	Agglomeration road	Major Road
■ 2017-2020	6.9	4.5
■ 2020-2030	0.8	11.3
■ 2017-2030	7.8	16.4
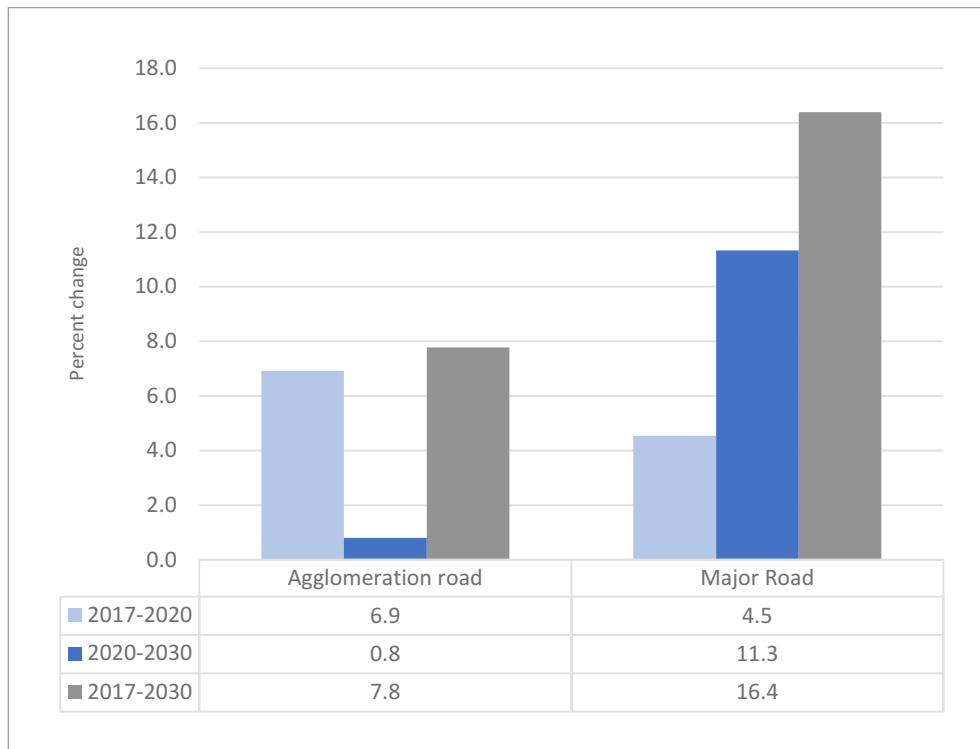
In the aviation sector, EASA (2016) highlighted the fact that emissions and noise exposure in 2014 were around 2005 levels, with the study of 45 European major airports from both Eu28 and EFTA region using the STAPES noise model. The stabilization of the noise exposure situation over this 10 year period in those 45 airports is due to technological improvements, fleet renewal, increased Air Traffic Management efficiency and the economic crisis in 2008 (EASA, 2016).

The current projection under the base (most likely) traffic forecast increase and a 0,2 dB reduction per annum for new aircraft deliveries [5], could maintain the stabilization observed in the period 2005-2014 for the period 2017 – 2020 considering the exposure to aircraft noise both inside and outside urban areas (nearly 3% of increase and 0,2% respectively), and potentially a mean reduction of nearly 2% of people exposed to aircraft noise compared with exposure values corresponding to 2017 baseline reference year (Figure 6.5).

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[5] Mean value between 0,1 dB reduction per annum considering the low technology improvement rate and the 0,3 dB reduction per annum considering the advanced technology improvement rate.

Figure 6.5. Change in the number of people exposed to high levels of aircraft noise inside and outside urban areas. In light blue, estimated percent change from 2017 to 2020 and in dark blue, estimated percent change from 2020 to 2030. In dark grey, percent change for the overall period: 2017-2030.

	Agglomeration air	Major Air
2017-2020	3.1	0.2
2020-2030	-3.5	-3.2
2017-2030	-0.5	-3.0
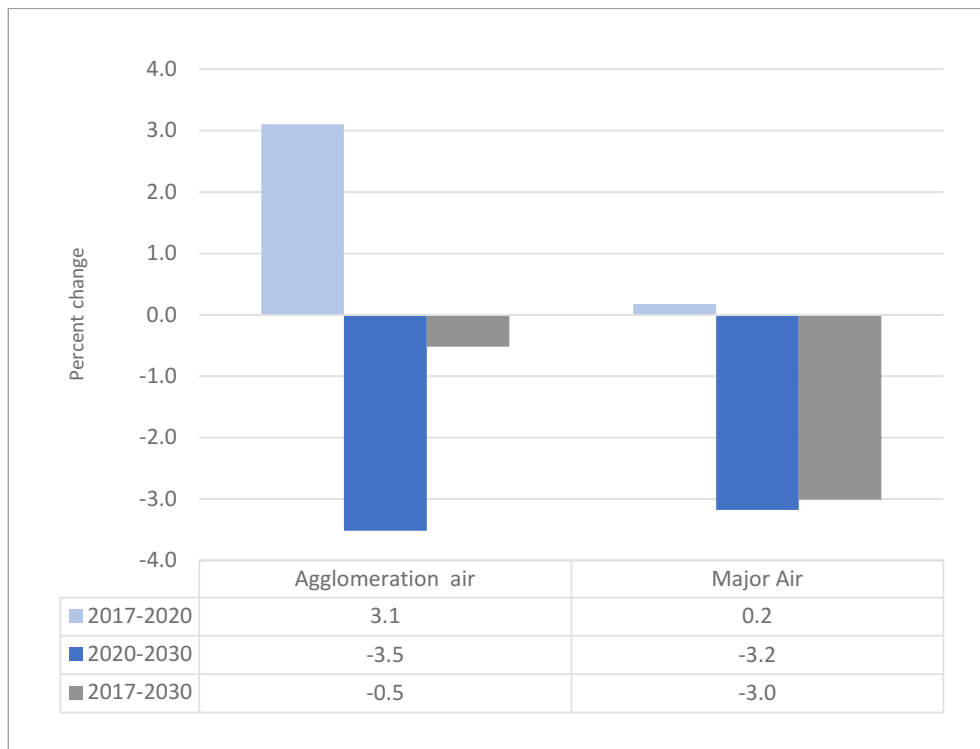
Finally, current noise regulations referring to aspects of environmental health are designed to have impact on populated areas, especially urban agglomerations. In this case, of special interest would be the projections calculated for L_{night} exposure values. As can be seen in Figure 6.6, prediction of exposure values for L_{night} follow the same pattern obtained with the calculations for L_{den} in short and mid-term scenario: an increase of the number of people exposed from the baseline reference year 2017 to the short term scenario (2020) and mid-term scenario (2030) estimations.

Figure 6.6. Estimated projections of number of people exposed due to different noise sources at 2020 and 2030 (L$_{night}$)
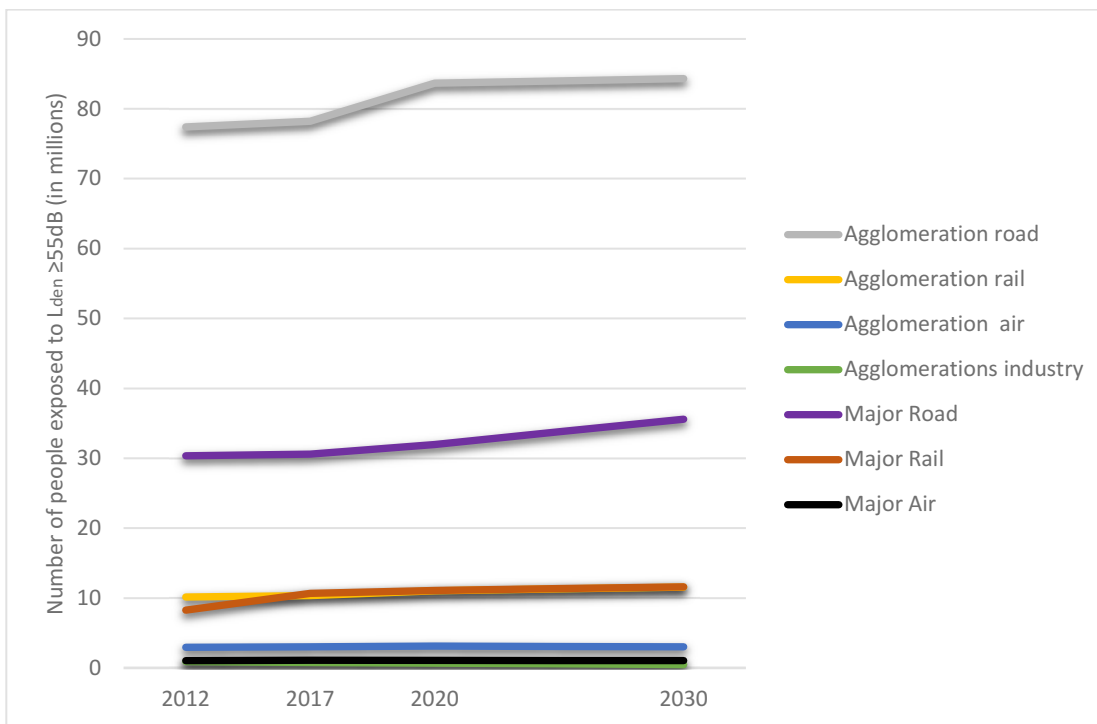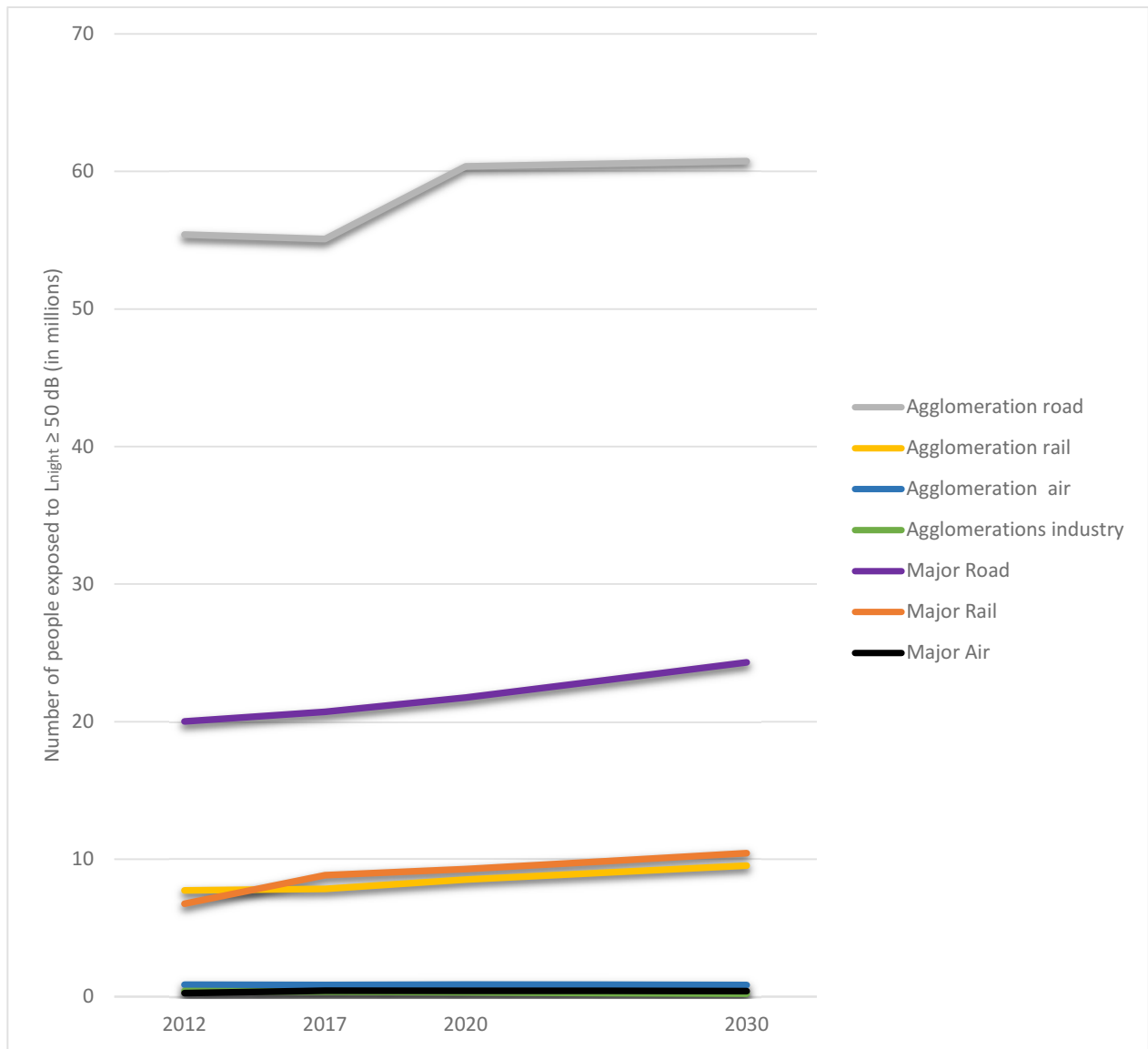

Table 6.2. Estimated projections of number of people exposed due to different noise sources at 2020 and 2030 (L$_{night}$)

	Inside Urban Areas			Outside Urban Areas		
	2017	**2020**	**2030**	**2017**	**2020**	**2030**
Road noise	55088700	60363099	60749785	20705700	21744738	24308674
Rail noise	7833100	8523846	9532171	8826700	9285416	10437717
Aircraft noise	857400	884060	852426	439800	439335	418730
Industrial noise	356900	318732	218619	-	-	-

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Annex 1
Acronyms

CAGR	Cumulative Average Growth Rate
CLC	CORINE Land Cover
CNOSSOS-EU	Common Noise Assessment Methods in Europe
CORINE	Coordination of Information on the Environment
dB	Decibel
EFTA	European Free Trade Association
END	Environment Noise Directive
ETC/ACM	European Topic Centre on Air Pollution and Climate Change Mitigation
EU	European Union
EUROPOP2010	Population projection scenario developed by Eurostat
JRC	Joint Research Centre
L_{den}	The day-evening-night time noise level indicator
L_{night}	The night time noise level indicator
LAU	Local Administrative Units (Eurostat)
LUISA	Land-Use based Integrated Sustainability Assessment
PRIMES-TREMOVE	Transport Model
STAPES	System for Airport Noise Exposure Studies

Annex 2
Cumulative Average Growth Rate (CAGR) for END urban agglomerations

RLID	SUM_POP_10	SUM_POP_20	SUM_POP_30	CAGR10-20	CAGR20-30
AT_AG_0001	1549212	1329244	1198463	-0,0152	-0,0103
AT_AG_0002	231158	220595	211406	-0,00467	-0,00425
AT_AG_0003	204913	188595	177103	-0,00826	-0,00627
AT_AG_0004	146144	145214	142593	-0,00064	-0,00182
AT_AG_0005	118354	107869	101118	-0,00923	-0,00644
BE_AG_0001	481870	508317	498468	0,005357	-0,00195
BE_AG_0002	1061538	1096245	1041573	0,003222	-0,0051
BE_AG_0003	249525	271799	263925	0,008587	-0,00294
BE_AG_0004	122396	130500	123217	0,006432	-0,00573
BE_AG_0005	224460	259209	263578	0,014498	0,001673
BE_AG_0006	205893	218588	207909	0,006001	-0,005
BG_AG_0001	310419	317008	293937	0,002103	-0,00753
BG_AG_0002	1208726	1305220	1271839	0,00771	-0,00259
BG_AG_0003	384965	432391	416541	0,011686	-0,00373
BG_AG_0004	174780	163551	141853	-0,00662	-0,01413
BG_AG_0005	132765	126849	114029	-0,00455	-0,0106
BG_AG_0006	137950	124846	104845	-0,00993	-0,01731
BG_AG_0007	103363	102260	88777	-0,00107	-0,01404
CY_AG_0001	198653	232916	153269	0,016039	-0,04098
CY_AG_0002	150650	173176	104054	0,014032	-0,04966
CZ_a_ag001	1566198	2078018	2323687	0,02868	0,011237
CZ_a_ag002	579645	927695	1103359	0,048152	0,017492
CZ_a_ag003	510263	671867	742820	0,027895	0,01009
CZ_a_ag004	205462	262912	269671	0,024962	0,002542
CZ_a_ag005	287837	505708	621430	0,057975	0,02082
CZ_a_ag006	187921	237626	232933	0,023745	-0,00199
CZ_a_ag007	133208	208527	250106	0,045835	0,018348
DE_AG_0001	264774	278841	281175	0,00519	0,000834
DE_AG_0002	284910	326697	320448	0,01378	-0,00193
DE_AG_0003	417360	424436	372072	0,001683	-0,01308
DE_AG_0004	683745	698862	667651	0,002189	-0,00456
DE_AG_0005	526358	564612	538778	0,00704	-0,00467
DE_AG_0006	280732	287948	282233	0,002541	-0,002
DE_AG_0007	3384877	3372401	3187817	-0,00037	-0,00561
DE_AG_0008	337066	351915	332247	0,00432	-0,00573
DE_AG_0009	408169	424301	410386	0,003884	-0,00333
DE_AG_0010	318154	317214	300898	-0,0003	-0,00527
DE_AG_0011	565590	613790	603568	0,008212	-0,00168
DE_AG_0012	567983	582531	564426	0,002532	-0,00315
DE_AG_0013	601413	624036	604305	0,003699	-0,00321
DE_AG_0014	508842	530779	522585	0,00423	-0,00155
DE_AG_0015	607976	622313	606302	0,002333	-0,0026

RLID	SUM_POP_10	SUM_POP_20	SUM_POP_30	CAGR10-20	CAGR20-30
DE_AG_0016	277413	303712	298306	0,009098	-0,00179
DE_AG_0017	2210164	2500753	2523483	0,012429	0,000905
DE_AG_0018	543209	591955	581385	0,008631	-0,0018
DE_AG_0019	1020657	1042346	998314	0,002105	-0,00431
DE_AG_0020	294899	312099	308348	0,005685	-0,00121
DE_AG_0021	281759	292651	281100	0,0038	-0,00402
DE_AG_0022	253683	243859	234643	-0,00394	-0,00385
DE_AG_0023	337160	378508	385646	0,011635	0,00187
DE_AG_0024	1426845	1675360	1699658	0,016186	0,001441
DE_AG_0025	524188	562482	546639	0,007076	-0,00285
DE_AG_0026	631640	679804	661079	0,007376	-0,00279
DE_AG_0027	348569	337509	318971	-0,00322	-0,00563
DE_AG_0028	245398	258558	241338	0,005238	-0,00687
DE_AG_0029	227665	224396	198939	-0,00145	-0,01197
DE_AG_0030	110233	115880	115225	0,005008	-0,00057
DE_AG_0031	129369	143420	144228	0,010364	0,000562
DE_AG_0032	254170	277704	277421	0,008895	-0,0001
DE_AG_0033	120602	128198	125799	0,006127	-0,00189
DE_AG_0034	135626	149255	139553	0,009622	-0,0067
DE_AG_0035	145196	150087	146817	0,003319	-0,0022
DE_AG_0036	107102	114069	111452	0,006322	-0,00232
DE_AG_0037	126282	136824	136573	0,00805	-0,00018
DE_AG_0038	194017	191292	180117	-0,00141	-0,006
DE_AG_0039	197372	202270	178408	0,002454	-0,01247
DE_AG_0040	155485	175741	181292	0,012321	0,003115
DE_AG_0041	182273	190854	184188	0,004611	-0,00355
DE_AG_0043	111537	128123	131641	0,01396	0,002712
DE_AG_0044	148944	201756	226419	0,030814	0,0116
DE_AG_0045	211630	241247	231277	0,013184	-0,00421
DE_AG_0046	116741	129416	124434	0,010361	-0,00392
DE_AG_0047	246880	256953	255207	0,004007	-0,00068
DE_AG_0048	173375	189494	194421	0,00893	0,00257
DE_AG_0049	267556	291885	289149	0,008741	-0,00094
DE_AG_0050	180016	202743	205604	0,01196	0,001402
DE_AG_0051	198956	205839	196142	0,003407	-0,00481
DE_AG_0052	107953	109380	108095	0,001314	-0,00118
DE_AG_0054	180419	190643	190413	0,005527	-0,00012
DE_AG_0055	280074	293059	287561	0,004542	-0,00189
DE_AG_0056	152775	154205	150038	0,000932	-0,00274
DE_AG_0057	231086	247381	248622	0,006837	0,000501
DE_AG_0058	119271	123167	119527	0,003219	-0,003
DE_AG_0059	166674	187173	188032	0,011667	0,000458
DE_AG_0060	186559	231748	247236	0,021927	0,00649
DE_AG_0061	126500	137959	139292	0,008709	0,000962
DE_AG_0062	149450	162247	163891	0,00825	0,001009
DE_AG_0063	129871	142933	142238	0,00963	-0,00049

RLID	SUM_POP_10	SUM_POP_20	SUM_POP_30	CAGR10-20	CAGR20-30
DE_AG_0064	149093	180970	178965	0,019565	-0,00111
DE_AG_0065	116159	114652	112525	-0,0013	-0,00187
DE_AG_0066	126859	154843	158738	0,020134	0,002487
DE_AG_0067	247786	267558	261864	0,007707	-0,00215
DE_AG_0068	175000	191310	196868	0,008951	0,002868
DE_AG_0069	126895	150237	151376	0,017029	0,000756
DE_AG_0070	149392	169433	165210	0,012668	-0,00252
DE_AG_0071	218546	217266	198538	-0,00059	-0,00897
DE_AG_0072	115391	122649	119766	0,006119	-0,00238
DE_AG_0073	130136	142137	140439	0,00886	-0,0012
DK_AG_0001	1137899	1348925	1453101	0,017158	0,007467
DK_AG_0002	310353	353392	396558	0,013071	0,011591
DK_AG_0003	199698	220474	234956	0,009946	0,006382
DK_AG_0004	180568	200209	215724	0,010379	0,007492
EE_AG_0001	455754	563847	559782	0,021511	-0,00072
EE_AG_0002	116528	134151	123905	0,014183	-0,00791
ES_AG_0001	319876	326786	313990	0,002139	-0,00399
ES_AG_0002	487839	498600	480272	0,002184	-0,00374
ES_AG_0003	1789821	1870483	1818672	0,004418	-0,00281
ES_AG_0004	388082	425624	431381	0,009277	0,001344
ES_AG_0005	383355	379469	371362	-0,00102	-0,00216
ES_AG_0006	334658	332388	321954	-0,00068	-0,00318
ES_AG_0007	298625	293211	285273	-0,00183	-0,00274
ES_AG_0008	0	0	0	0,004327	0,000858
ES_AG_0009	3519455	3708045	3715433	0,005234	0,000199
ES_AG_0010	478073	477444	467449	-0,00013	-0,00211
ES_AG_0011	455915	529907	614822	0,015153	0,014974
ES_AG_0012	210971	197056	173267	-0,0068	-0,01278
ES_AG_0013	0	0	0	0,004327	0,000858
ES_AG_0014	741498	779048	838938	0,004952	0,007434
ES_AG_0015	861252	935573	972086	0,008312	0,003836
ES_AG_0016	303196	276955	252116	-0,00901	-0,00935
ES_AG_0017	339192	352070	338005	0,003733	-0,00407
ES_AG_0018	658397	653671	645309	-0,00072	-0,00129
ES_AG_0019	316877	330990	341211	0,004367	0,003046
ES_AG_0020	107574	100614	93375	-0,00667	-0,00744
ES_AG_0021	195357	222478	258239	0,013085	0,015017
ES_AG_0022	228479	233699	220662	0,002262	-0,00572
ES_AG_0023	154607	162426	156405	0,004946	-0,00377
ES_AG_0024	196567	183246	164573	-0,00699	-0,01069
ES_AG_0025	113472	128285	135922	0,012345	0,005799
ES_AG_0026	173017	177736	180387	0,002695	0,001482
ES_AG_0027	118181	124366	125652	0,005114	0,001029
ES_AG_0028	170797	176705	176166	0,003406	-0,00031
ES_AG_0029	169868	170311	167102	0,00026	-0,0019
ES_AG_0030	108561	107833	103663	-0,00067	-0,00394

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ES_AG_0031	167176	187384	195898	0,011477	0,004453
ES_AG_0032	181611	190953	188094	0,005029	-0,00151
ES_AG_0033	125592	144778	174530	0,014318	0,018865
ES_AG_0034	199916	212507	209943	0,006126	-0,00121
ES_AG_0035	188978	188469	194999	-0,00027	0,003412
ES_AG_0036	170428	232721	289696	0,031643	0,022141
ES_AG_0037	123727	121254	112085	-0,00202	-0,00783
ES_AG_0038	263266	288366	305006	0,009148	0,005626
ES_AG_0039	158984	165236	165653	0,003865	0,000252
ES_AG_0040	118375	123049	123983	0,00388	0,000756
ES_AG_0041	212688	230913	241540	0,008255	0,00451
ES_AG_0042	214533	258527	295410	0,018829	0,013426
ES_AG_0043	137809	136148	130961	-0,00121	-0,00388
ES_AG_0044	123235	111509	96415	-0,00995	-0,01444
ES_AG_0045	151051	153265	152287	0,001456	-0,00064
ES_AG_0046	148317	197049	239990	0,028817	0,01991
ES_AG_0047	113867	116763	115876	0,002515	-0,00076
ES_AG_0048	210337	208018	198034	-0,00111	-0,00491
ES_AG_0050	233980	224324	213981	-0,00421	-0,00471
ES_AG_0051	104857	98501	88135	-0,00623	-0,01106
ES_AG_0052	155057	151843	145089	-0,00209	-0,00454
ES_AG_0053	0	0	0	0,004327	0,000858
ES_AG_0054	204053	212498	220663	0,004064	0,003778
ES_AG_0055	176861	176894	173236	1,87E-05	-0,00209
ES_AG_0056	126782	122572	112074	-0,00337	-0,00891
ES_AG_0057	108600	102670	93774	-0,0056	-0,00902
ES_AG_0058	267087	300206	316143	0,011758	0,005186
ES_AG_0059	227051	251895	275770	0,010438	0,009097
ES_AG_0060	242059	226994	214101	-0,00641	-0,00583
ES_AG_0066	102341	111765	122143	0,008848	0,008919
ES_AG_0068	0	0	0	0,004327	0,000858
FI_AG_0001	630473	839624	918868	0,029063	0,00906
FI_AG_0002	261676	355724	418292	0,031181	0,016334
FI_AG_0003	221969	291598	323054	0,027659	0,010297
FI_AG_0004	237762	350230	435555	0,039492	0,022043
FI_AG_0005	169847	145550	107500	-0,01532	-0,02985
FI_AG_0006	157543	184692	206400	0,016026	0,011175
FI_AG_0007	97480	81121	57568	-0,0182	-0,03372
FI_AG_0008	14753	19423	21411	0,027883	0,009792
FI_AG_0009	130151	141991	131654	0,008745	-0,00753
FI_AG_0010	122185	138897	142812	0,012902	0,002784
FR_AG_0001	268144	287260	293552	0,00691	0,002169
FR_AG_0002	1035795	1369903	1454666	0,028352	0,006022
FR_AG_0003	328009	379289	377437	0,014632	-0,00049
FR_AG_0005	445840	495241	491720	0,010564	-0,00071
FR_AG_0006	1233372	1289240	1280859	0,00444	-0,00065

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FR_AG_0007	1510448	1807536	1943741	0,018118	0,007291
FR_AG_0008	2046245	2361542	2639500	0,014434	0,01119
FR_AG_0009	352128	382197	377724	0,008228	-0,00118
FR_AG_0010	470197	587622	628727	0,022544	0,006784
FR_AG_0011	251618	267925	259113	0,006299	-0,00334
FR_AG_0012	762843	947356	977564	0,021899	0,003144
FR_AG_0013	554787	574334	563903	0,003469	-0,00183
FR_AG_0014	322832	396921	416438	0,020875	0,004812
FR_AG_0015	7529214	8049708	8121095	0,006707	0,000883
FR_AG_0016	690994	1122767	1390148	0,049739	0,021591
FR_AG_0017	568879	645040	659467	0,012644	0,002214
FR_AG_0018	504375	554311	581593	0,009485	0,004816
FR_AG_0019	472829	518073	522315	0,00918	0,000816
FR_AG_0020	998924	1310933	1432554	0,027554	0,008911
FR_AG_0021	344129	382764	373203	0,010697	-0,00253
FR_AG_0022	385026	421237	439200	0,009029	0,004185
FR_AG_0023	301708	355137	383117	0,016438	0,007613
FR_AG_0024	455662	531783	566049	0,015568	0,006264
FR_AG_0025	150711	158808	152407	0,005247	-0,00411
FR_AG_0026	338957	443994	475824	0,027361	0,006948
FR_AG_0027	164288	248140	275017	0,042099	0,010337
FR_AG_0028	180198	211689	215207	0,016237	0,00165
FR_AG_0029	216976	227346	214637	0,00468	-0,00574
FR_AG_0030	158855	178304	175108	0,011617	-0,00181
FR_AG_0031	250977	275703	249992	0,009441	-0,00974
FR_AG_0032	388715	500541	517862	0,025607	0,003408
FR_AG_0033	110655	111578	107814	0,000831	-0,00343
FR_AG_0034	120572	144385	150670	0,018187	0,00427
FR_AG_0035	234431	254409	245503	0,008212	-0,00356
FR_AG_0036	212959	218991	214540	0,002797	-0,00205
FR_AG_0039	142955	189517	194781	0,028596	0,002743
FR_AG_0040	253915	256037	240917	0,000833	-0,00607
FR_AG_0041	268630	396580	489756	0,039723	0,021327
FR_AG_0042	252549	321092	324249	0,024303	0,000979
FR_AG_0043	155168	202673	206454	0,027068	0,00185
FR_AG_0044	89190	94991	96340	0,006321	0,001411
FR_AG_0045	118872	147544	152461	0,021843	0,003284
FR_AG_0046	272850	312668	327022	0,013715	0,004499
FR_AG_0047	230456	328963	403682	0,036229	0,020679
FR_AG_0048	229941	268159	269749	0,015495	0,000591
FR_AG_0049	234547	220242	200233	-0,00627	-0,00948
FR_AG_0051	161193	230965	259737	0,036621	0,01181
FR_AG_0052	312541	326625	318174	0,004417	-0,00262
FR_AG_0054	154897	171009	166430	0,009945	-0,00271
FR_AG_0056	151809	184855	195791	0,01989	0,005764
FR_AG_0057	132103	147300	146971	0,010948	-0,00022

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FR_AG_0058	150076	173376	174917	0,014537	0,000885
FR_AG_0059	118333	127949	127043	0,007844	-0,00071
FR_AG_0060	99869	106697	108978	0,006635	0,002118
FR_AG_0061	366810	373554	380416	0,001824	0,001822
FR_AG_0062	221846	254289	277370	0,013742	0,008726
FR_AG_0063	176625	199251	217206	0,012127	0,008665
FR_AG_0064	175821	209577	222795	0,017718	0,006135
FR_AG_0065	187272	190290	187019	0,0016	-0,00173
FR_AG_0066	302880	322901	336016	0,006421	0,003989
FR_AG_0067	135728	151885	156478	0,011311	0,002984
FR_AG_0068	323297	362330	389904	0,011464	0,007361
FR_AG_0069	218828	237294	242971	0,008134	0,002367
FR_AG_0070	158167	199364	238217	0,023418	0,017964
FR_AG_0071	251080	322967	404952	0,025497	0,02288
FR_AG_0072	375896	428940	512862	0,013288	0,01803
FR_AG_0073	179649	197581	211312	0,00956	0,006741
FR_AG_0074	214936	248939	288874	0,014795	0,01499
FR_AG_0075	239648	246510	247199	0,002827	0,000279
FR_AG_0076	275005	325444	383550	0,016983	0,016564
GR_AG_0001	818576	827385	790613	0,001071	-0,00454
GR_AG_0002	445468	549510	559092	0,021212	0,00173
GR_AG_0003	157475	160031	153314	0,001611	-0,00428
GR_AG_0004	253537	335501	352992	0,028408	0,005095
GR_AG_0005	215131	292201	236976	0,031093	-0,02073
GR_AG_0006	95806	121583	119491	0,024113	-0,00173
GR_AG_0007	102445	133676	132164	0,026966	-0,00114
GR_AG_0008	161054	200857	197646	0,022331	-0,00161
HR_AG_0001	924152	1136260	1135316	0,020877	-8,3E-05
HR_AG_0002	70130	96615	12216	0,032557	-0,18682
HR_AG_0003	72321	114186	12632	0,04673	-0,19761
HR_AG_0004	74809	114198	117909	0,043207	0,003203
HU_AG_0001	2026591	2442812	2589299	0,018855	0,005841
HU_AG_0002	172891	282627	327293	0,050374	0,014781
HU_AG_0003	100431	125525	127774	0,022554	0,001777
HU_AG_0004	95344	147747	171521	0,044774	0,015032
HU_AG_0005	106413	146883	160926	0,032756	0,009173
HU_AG_0006	70769	106902	120071	0,042112	0,011685
HU_AG_0007	68525	117540	136698	0,05544	0,015214
HU_AG_0008	58492	94247	104600	0,048859	0,010477
HU_AG_0009	86576	131785	154983	0,04291	0,016347
IE_AG_0001	1535098	2136343	2401700	0,033602	0,011777
IE_AG_0002	191287	165959	123581	-0,0141	-0,02905
IT_AG_0001	318623	374255	380059	0,016223	0,00154
IT_AG_0002	430784	480527	479253	0,010988	-0,00027
IT_AG_0003	311693	352369	353702	0,012342	0,000378
IT_AG_0004	420954	469177	453682	0,010905	-0,00335

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IT_AG_0005	645538	681361	672457	0,005415	-0,00131
IT_AG_0006	1440594	1537961	1518140	0,006562	-0,0013
IT_AG_0007	1076502	1105473	1026421	0,002659	-0,00739
IT_AG_0008	691693	745866	720346	0,007569	-0,00348
IT_AG_0009	2925651	3358436	3476029	0,013891	0,003447
IT_AG_0010	976158	1030376	978808	0,00542	-0,00512
IT_AG_0013	167330	185242	174310	0,010221	-0,00606
IT_AG_0015	123817	127891	123180	0,003243	-0,00375
IT_AG_0016	179148	174864	161871	-0,00242	-0,00769
IT_AG_0020	145333	163928	168319	0,012113	0,002647
IT_AG_0021	195700	244793	254512	0,022635	0,003901
IT_AG_0023	196685	248399	290063	0,023618	0,015627
IT_AG_0024	132908	153452	159914	0,014477	0,004133
IT_AG_0025	122770	157619	160950	0,025302	0,002093
IT_AG_0027	194003	231507	250526	0,017831	0,007927
IT_AG_0031	225646	282119	296598	0,022587	0,005017
IT_AG_0032	154496	167790	177244	0,008289	0,005496
IT_AG_0034	173743	221549	252045	0,024604	0,01298
IT_AG_0035	169232	217633	236442	0,025473	0,008324
IT_AG_0036	127872	126287	119301	-0,00125	-0,00567
IT_AG_0037	118218	151921	176024	0,0254	0,014835
IT_AG_0039	184941	199763	194108	0,007739	-0,00287
IT_AG_0041	209480	221857	212783	0,005757	-0,00417
IT_AG_0043	140377	173249	185472	0,021263	0,006841
IT_AG_0044	126659	122294	111522	-0,0035	-0,00918
IT_AG_0045	129899	160472	175274	0,021361	0,008862
IT_AG_0046	130256	175333	201666	0,030165	0,014091
IT_AG_0047	96968	99013	96547	0,002089	-0,00252
IT_AG_0048	156340	192257	207759	0,020895	0,007785
IT_AG_0049	177166	213392	228538	0,018779	0,006881
LT_AG_0001	633152	753388	721034	0,017539	-0,00438
LT_AG_0002	457530	554441	539555	0,019398	-0,00272
LT_AG_0003	233346	267581	243902	0,013784	-0,00922
LT_AG_0004	163216	198197	187888	0,019608	-0,00533
LT_AG_0005	130138	148142	135603	0,013042	-0,0088
LU_AG_0001	106996	141058	154524	0,028023	0,00916
LV_AG_0001	990494	1187911	1169102	0,018341	-0,00159
LV_AG_0002	139818	148014	131926	0,005713	-0,01144
MT_AG_0001	266441	266313	260296	-4,8E-05	-0,00228
NL_AG_0001	1606808	1751327	1825411	0,00865	0,004152
NL_AG_0002	1249156	1299018	1319241	0,003922	0,001546
NL_AG_0003	460199	524921	554269	0,013246	0,005455
NL_AG_0004	230045	217410	200069	-0,00563	-0,00828
NL_AG_0005	1341698	1467112	1536465	0,008976	0,00463
NL_AG_0006	499640	530276	543222	0,005969	0,002415
NL_AG_0007	227422	221882	216394	-0,00246	-0,0025

RLID	SUM_POP_10	SUM_POP_20	SUM_POP_30	CAGR10-20	CAGR20-30
NL_AG_0008	337041	390919	410259	0,01494	0,004841
NL_AG_0009	204353	208097	208288	0,001817	9,17E-05
NL_AG_0010	238987	286693	320325	0,018367	0,011154
NL_AG_0011	189234	218243	234653	0,014365	0,007276
NL_AG_0012	140878	149910	152260	0,006233	0,001557
NL_AG_0013	151697	139605	125969	-0,00827	-0,01023
NL_AG_0014	152301	172701	177114	0,01265	0,002526
NL_AG_0015	169457	163891	153852	-0,00333	-0,0063
NL_AG_0016	153408	173395	181347	0,012322	0,004494
NL_AG_0017	185205	191310	182014	0,003248	-0,00497
NL_AG_0018	122346	127083	123331	0,003806	-0,00299
NL_AG_0019	169178	187421	187928	0,010293	0,00027
NL_AG_0020	203674	199348	186908	-0,00214	-0,00642
NL_AG_0021	125502	146530	154262	0,015611	0,005155
PL_AG_0001	779870	816445	740957	0,004594	-0,00965
PL_AG_0002	309451	356693	336286	0,014309	-0,00587
PL_AG_0003	416864	531995	553986	0,024687	0,004059
PL_AG_0004	455148	517136	506916	0,01285	-0,00199
PL_AG_0005	268541	292487	275707	0,008578	-0,00589
PL_AG_0006	344843	389389	381579	0,012223	-0,00202
PL_AG_0007	901338	1061720	1025755	0,016511	-0,00344
PL_AG_0008	380570	466648	447110	0,0206	-0,00427
PL_AG_0009	675673	847816	846943	0,022955	-0,0001
PL_AG_0010	440414	520521	503535	0,016852	-0,00331
PL_AG_0011	1941154	2341333	2303767	0,018921	-0,00162
PL_AG_0012	698003	818258	816328	0,016022	-0,00024
PL_AG_0013	183961	186702	172655	0,00148	-0,00779
PL_AG_0014	183935	202929	195335	0,009876	-0,00381
PL_AG_0015	138945	154457	147947	0,01064	-0,0043
PL_AG_0016	261032	274718	258485	0,005123	-0,00607
PL_AG_0017	115747	108042	96598	-0,00687	-0,01113
PL_AG_0018	161718	222830	229045	0,032575	0,002755
PL_AG_0019	233789	279432	286442	0,017994	0,002481
PL_AG_0020	135574	172557	173052	0,024414	0,000286
PL_AG_0021	126850	193774	218794	0,043279	0,012218
PL_AG_0022	237827	296836	286490	0,022411	-0,00354
PL_AG_0023	120406	137954	129687	0,013698	-0,00616
PL_AG_0024	133347	182373	200420	0,031805	0,009481
PL_AG_0025	199193	243055	233901	0,020101	-0,00383
PL_AG_0026	149719	194613	195152	0,026572	0,000277
PL_AG_0027	133747	151939	143936	0,012835	-0,0054
PL_AG_0028	230938	247931	227609	0,007125	-0,00852
PL_AG_0029	161324	196716	206178	0,020033	0,004709
PL_AG_0030	139241	144605	137722	0,003787	-0,00487
PL_AG_0031	210860	271632	280629	0,025649	0,003264
PL_AG_0032	229118	251035	240499	0,009177	-0,00428

RLID	SUM_POP_10	SUM_POP_20	SUM_POP_30	CAGR10-20	CAGR20-30
PL_AG_0033	233086	273830	270270	0,01624	-0,00131
PL_AG_0035	137026	153836	151215	0,011639	-0,00172
PL_AG_0036	131050	143485	133392	0,009106	-0,00727
PL_AG_0037	144159	176500	177794	0,020447	0,000731
PL_AG_0038	206983	245299	249704	0,017129	0,001781
PL_AG_0039	130487	157801	150557	0,019188	-0,00469
PL_AG_0040	162158	214082	224328	0,028168	0,004686
PT_AG_0001	575733	599589	590211	0,004068	-0,00158
PT_AG_0002	318995	404883	410920	0,024129	0,001481
PT_AG_0003	166231	180005	184642	0,007992	0,002547
PT_AG_0004	207593	267235	283160	0,025577	0,005805
PT_AG_0005	162433	180961	192124	0,01086	0,006004
PT_AG_0006	173280	197933	215538	0,013391	0,008557
RO_AG_0001	325729	410895	440304	0,023499	0,006937
RO_AG_0002	1974473	2084939	1940039	0,005459	-0,00718
RO_AG_0003	336141	410299	413222	0,020136	0,00071
RO_AG_0004	322077	352473	333876	0,009059	-0,00541
RO_AG_0005	328602	397405	378109	0,019193	-0,00496
RO_AG_0006	312398	340571	321588	0,008672	-0,00572
RO_AG_0007	329505	391137	371899	0,017294	-0,00503
RO_AG_0008	247595	269068	252916	0,008352	-0,00617
RO_AG_0009	322292	360329	350419	0,011218	-0,00278
RO_AG_0010	183768	227511	238327	0,021582	0,004655
RO_AG_0011	178661	200784	188180	0,011742	-0,00646
RO_AG_0012	150567	166937	153824	0,010374	-0,00815
RO_AG_0013	127090	149774	141568	0,016559	-0,00562
RO_AG_0014	222119	243638	231105	0,00929	-0,00527
RO_AG_0015	146208	167804	164419	0,013872	-0,00204
RO_AG_0017	230556	298362	313254	0,026117	0,004883
RO_AG_0019	166776	170456	152935	0,002185	-0,01079
RO_AG_0022	162864	180522	166989	0,010347	-0,00776
RO_AG_0024	149309	165999	154602	0,010653	-0,00709
SE_AG_0001	784668	830511	828200	0,005694	-0,00028
SE_AG_0002	533051	616701	628759	0,014683	0,001938
SE_AG_0003	326653	406696	456089	0,022159	0,011528
SE_AG_0004	106871	118807	117617	0,010644	-0,00101
SE_AG_0005	134070	160317	166106	0,01804	0,003554
SE_AG_0006	135169	158543	179312	0,016078	0,012386
SE_AG_0007	145026	152565	148767	0,005081	-0,00252
SE_AG_0008	118199	143172	152588	0,019353	0,00639
SE_AG_0009	128739	137873	135823	0,006878	-0,0015
SE_AG_0010	132239	133466	126270	0,000924	-0,00553
SE_AG_0011	125963	170050	190686	0,030465	0,011519
SE_AG_0012	202815	233186	269502	0,014052	0,014579
SE_AG_0013	146184	179716	201379	0,020866	0,011446
SE_AG_0014	98891	115023	120719	0,015226	0,004845

RLID	SUM_POP_10	SUM_POP_20	SUM_POP_30	CAGR10-20	CAGR20-30
SE_AG_0015	103343	144143	181485	0,033835	0,023304
SI_AG_0001	317972	413910	453900	0,026719	0,009265
SI_AG_0002	180278	254394	284435	0,035038	0,011225
SK_AG_0001	546894	592918	599990	0,008113	0,001186
SK_AG_0002	249798	294645	304376	0,016649	0,003255
UK_AG_0001	601230	657334	662256	0,008961	0,000746
UK_AG_0002	274504	274947	270023	0,000161	-0,00181
UK_AG_0003	226690	221227	214390	-0,00244	-0,00313
UK_AG_0004	352922	379474	385058	0,00728	0,001462
UK_AG_0005	404129	401392	387288	-0,00068	-0,00357
UK_AG_0006	548106	581430	587450	0,00592	0,001031
UK_AG_0007	303792	309837	297313	0,001972	-0,00412
UK_AG_0008	286697	289170	286222	0,000859	-0,00102
UK_AG_0009	448556	445792	431906	-0,00062	-0,00316
UK_AG_0010	1101443	1153014	1158153	0,004586	0,000445
UK_AG_0011	8555626	8966574	9003355	0,004702	0,000409
UK_AG_0012	2105840	2311151	2407255	0,009347	0,004082
UK_AG_0013	282497	292661	290762	0,003541	-0,00065
UK_AG_0014	419348	425162	417207	0,001378	-0,00189
UK_AG_0015	703338	683851	655591	-0,00281	-0,00421
UK_AG_0016	590152	604750	604900	0,002446	2,48E-05
UK_AG_0017	346984	323042	297921	-0,00712	-0,00806
UK_AG_0018	204447	214874	218049	0,004987	0,001468
UK_AG_0019	323898	361594	378761	0,01107	0,004649
UK_AG_0020	572269	591187	592150	0,003258	0,000163
UK_AG_0021	284090	287930	282429	0,001344	-0,00193
UK_AG_0022	222720	222709	217993	-4,9E-06	-0,00214
UK_AG_0023	194224	210800	211337	0,008223	0,000254
UK_AG_0024	332604	353454	358303	0,006099	0,001363
UK_AG_0025	776454	811666	824555	0,004445	0,001577
UK_AG_0026	2220808	2313135	2318214	0,004082	0,000219
UK_AG_0027	1367077	1523095	1596293	0,010866	0,004705
UK_AG_0028	210360	245939	265293	0,015749	0,007604
UK_AG_0029	88327	88434	86579	0,000121	-0,00212
UK_AG_0030	99241	107107	109659	0,007657	0,002357
UK_AG_0031	117277	122571	123297	0,004425	0,000591
UK_AG_0032	120586	123733	123542	0,00258	-0,00015
UK_AG_0033	109841	112762	112007	0,002628	-0,00067
UK_AG_0034	106019	120018	125508	0,01248	0,004483
UK_AG_0035	78290	84307	87485	0,007432	0,003707
UK_AG_0036	93117	93705	92471	0,00063	-0,00132
UK_AG_0037	148309	167941	178953	0,012509	0,006371
UK_AG_0038	145391	158526	169639	0,008687	0,006798
UK_AG_0039	222834	241357	246106	0,008017	0,00195
UK_AG_0040	106273	121502	129781	0,013482	0,006614
UK_AG_0041	88671	86464	82709	-0,00252	-0,00443

RLID	SUM_POP_10	SUM_POP_20	SUM_POP_30	CAGR10-20	CAGR20-30
UK_AG_0042	111656	122152	127315	0,009025	0,004148
UK_AG_0043	116394	129532	135066	0,010752	0,004192
UK_AG_0044	122155	124548	123011	0,001942	-0,00124
UK_AG_0045	104731	103154	99699	-0,00152	-0,0034
UK_AG_0046	95401	114406	127470	0,018332	0,010871
UK_AG_0047	134315	145139	146097	0,007781	0,000658
UK_AG_0048	78179	88057	90077	0,011969	0,002271
UK_AG_0049	205260	224637	230152	0,009062	0,002428
UK_AG_0050	131689	145263	152663	0,009859	0,004981
UK_AG_0051	180049	206262	219483	0,013685	0,006232
UK_AG_0052	176328	195820	203334	0,01054	0,003773
UK_AG_0053	180627	192812	190680	0,00655	-0,00111
UK_AG_0054	87962	93327	95576	0,005938	0,002384
UK_AG_0055	111643	119902	122885	0,007162	0,00246
UK_AG_0056	139361	162570	170726	0,015523	0,004907
UK_AG_0057	241365	255615	253860	0,005753	-0,00069
UK_AG_0058	117801	125524	131805	0,00637	0,004895
UK_AG_0059	94616	94424	93901	-0,0002	-0,00056
UK_AG_0060	97369	112013	128888	0,014109	0,014132
UK_AG_0061	138433	138478	136111	3,25E-05	-0,00172
UK_AG_0062	152274	158903	158789	0,00427	-7,2E-05
UK_AG_0063	93573	100851	102967	0,007518	0,002079
UK_AG_0064	98582	95159	90731	-0,00353	-0,00475
UK_AG_0065	196934	194225	187664	-0,00138	-0,00343
UK_AG_0066	99253	108550	110758	0,008994	0,002016
UK_AG_0067	142280	158843	166958	0,011073	0,004995
UK_AG_0068	120284	128198	133512	0,006392	0,00407
UK_AG_0069	115734	120653	120140	0,004171	-0,00043
UK_AG_0070	89379	106064	115777	0,017263	0,008801
UK_AG_0071	153435	163899	164535	0,006619	0,000387
UK_AG_0072	188725	203174	205251	0,007404	0,001018
UK_AG_0073	110382	128574	134613	0,015373	0,0046
UK_AG_0074	282061	283365	279710	0,000461	-0,0013

Annex 3
Cumulative Average Growth Rate (CAGR) for EU-28 countries (extracting END urban agglomerations)

COUNTRY_ID	SUM_2010	SUM_2020	SUM_2030	CAGR10_20	CAGR20_30
AT	5772842	6289563	6709439	0,00861	0,006483
BE	8218580	8830697	9516827	0,00721	0,007511
BG	4879714	4270318	3934613	-0,01325	-0,00815
CY	416810	449020	668992	0,007471	0,040676
CZ	6749648	5714848	4998965	-0,0165	-0,01329
DE	54936130	51714876	50327392	-0,00602	-0,00272
DK	3432639	3341410	3333292	-0,00269	-0,00024
EE	710000	571623	539527	-0,02145	-0,00576
EL	8242827	8299171	7883533	0,000681	-0,00512
ES	23979321	25145961	26847957	0,004762	0,006571
FI	3060396	2760435	2634616	-0,01026	-0,00465
FR	31209562	29646120	30332647	-0,00513	0,002292
HR	2931173	2502770	1785820	-0,01568	-0,03319
HU	6950087	6050904	5463873	-0,01376	-0,01015
IE	2520709	2372195	2611344	-0,00605	0,009651
IT	45036816	46603752	48215365	0,003426	0,003405
LI	1525	1558	1596	0,002143	0,002413
LT	1541585	1161439	1080886	-0,02792	-0,00716
LU	385357	427000	468886	0,010314	0,009401
LV	1043098	741270	658270	-0,03358	-0,0118
NL	132367	134383	142187	0,001513	0,005661
PL	8193650	8227796	8364552	0,000416	0,00165
PT	24950982	23196565	22800307	-0,00726	-0,00172
RO	8104072	8105275	8157896	1,48E-05	0,000647
SE	14775256	13401185	12989498	-0,00971	-0,00312
SI	5773762	6025736	6312261	0,004281	0,004656
UK	1459775	1423753	1358634	-0,0025	-0,00467
MT	30408111	33044738	36726646	0,00835	0,01062
SK	4514399	4576528	4562247	0,001368	-0,00031

Annex 4
Decibel (dB) change at country level derived from the transport activity change, for 2020 and 2030

A4.1. Road noise exposure inside agglomerations

Country code	dB change 2010-2020	dB change 2020-2030
AT	0,2	0,3
BE	0,2	0,1
BG	0,3	0,2
CY	0,2	0,1
CZ	0,3	0,9
DE	0,2	0,0
DK	0,3	0,2
EE	0,4	0,2
ES	0,1	0,5
FI	0,1	0,0
FR	0,4	0,3
GR	0,1	-0,2
HR	0,3	0,4
HU	0,3	0,6
IE	0,2	0,8
IT	0,1	0,1
LT	0,2	0,0
LU	0,5	1,2
LV	0,2	0,2
MT	0,1	0,0
NL	0,2	0,2
PL	0,5	0,7
PT	0,1	0,7
RO	0,4	0,9
SE	0,2	0,5
SI	0,2	0,3
SK	0,6	1,7
UK	0,2	0,1

A4.2. Major road noise exposure outside agglomerations

Country code	dB change 2010-2020	dB change 2020-2030
AT	0,4	1,1
BE	0,4	1,2
BG	0,5	1,1
CY	0,3	0,9
CZ	0,4	1,9
DE	0,4	0,9
DK	0,6	1,1
EE	0,8	1,1
ES	0,2	1,4
FI	0,2	0,9
FR	0,6	1,5
GB	0,4	0,9
GR	0,2	0,5
HR	0,5	1,4
HU	0,4	1,6
IE	0,5	2,2
IT	0,2	0,9
LT	0,6	0,6
LU	1,0	2,2
LV	0,5	1,3
MT	0,3	1,0
NL	0,4	0,9
PL	0,9	2,0
PT	0,2	1,6
RO	0,9	2,3
SE	0,3	1,3
SI	0,6	1,5
SK	0,8	2,8

A4.3. Rail noise exposure inside agglomerations and major railways noise exposure outside agglomerations

Country code	dB change 2010-2020	dB change 2020-2030
AT	0,3	0,5
BE	0,3	1,5
BG	0,3	1,0
CY	0	0
CZ	0,5	0,8
DE	0,2	0,3
DK	0,3	0,9
EE	0,5	1,3
ES	0,5	1,5
FI	0,2	0,5
FR	0,5	1,3
GR	0,1	0,3
HR	0,2	0,1
HU	0,4	1,3
IE	0,1	0,3
IT	0,3	0,5
LT	0,6	0,4
LU	0,5	1,8
LV	0,4	1,4
MT	0	0
NL	0,3	0,5
PL	0,5	2,0
PT	0,2	1,1
RO	0,6	1,0
SE	0,3	0,8
SI	0,8	2,4
SK	0,5	1,7
UK	0,4	0,3

Annex 5
Results at country level for 2020 and 2030

A5.1. Road noise exposure inside agglomerations

	L_{den}		L_{night}	
Country	People exposed estimated at 2020	People exposed estimated at 2030	People exposed estimated at 2020	People exposed estimated at 2030
AT	2052544	1877172	1788339	1632326
BE	1635368	1566236	1301521	1242062
BG	2099099	1971271	1485351	1397302
CY	441519	279304	397368	250337
CZ	2002544	2363627	1216495	1488392
DE	6254992	5643791	4324538	3720203
DK	1143108	1225659	789510	839667
EE	323537	314523	214869	207674
ES	11794444	12310704	9479369	10091852
FI	526767	543885	284823	282931
FR	17042055	17470139	11507455	11684294
GR	901730	833661	577523	518080
HR	382147	313035	239234	197864
HU	1798500	2007691	1382891	1573041
IE	771448	917247	489838	627662
IT	8664885	8696954	7043810	7037121
LT	799885	752062	534818	497417
LU	158685	175915	128478	148411
LV	559897	551031	443621	436597
MT	105475	100952	78323	74077
NL	3497080	3582421	2077090	2127521
PL	4976066	5006301	3356379	3452219
PT	560246	644798	399708	424225
RO	2831883	2849863	2373046	2425280
SE	1330142	1481081	768932	905350
SI	225308	250804	150156	167701
SK	396728	447405	268013	332378
UK	10373846	10145796	7261600	6967804

A5.2. Rail noise exposure inside agglomerations

Country	L_{den}		L_{night}	
	People exposed estimated at 2020	People exposed estimated at 2030	People exposed estimated at 2020	People exposed estimated at 2030
AT	575631	535811	439275	409539
BE	124844	137017	96886	107266
BG	47455	53949	43038	48934
CY	0	0	0	0
CZ	91852	108226	65016	76959
DE	3218963	3174463	2502597	2470191
DK	32007	37047	19664	22925
EE	7030	7718	5373	6002
ES	521448	583601	361879	405373
FI	95206	105052	66566	73173
FR	2643654	2980504	2127636	2415436
GR	144573	143275	109956	109174
HR	28322	26393	21483	20307
HU	138726	164912	97336	116307
IE	32778	37535	19678	22663
IT	576136	594602	388341	401541
LT	13219	11908	9672	8724
LU	10224	12896	7520	9966
LV	42854	49140	33057	38217
MT	0	0	0	0
NL	233940	245846	129309	136011
PL	261253	304432	163728	192425
PT	37592	41842	23680	26031
RO	320109	316105	279850	276327
SE	308525	346534	235793	265729
SI	30584	42190	25539	35214
SK	142600	165051	115530	134951
UK	1319218	1315912	971761	968063

A5.3. Air noise exposure inside agglomerations

Country	L_{den}		L_{night}	
	People exposed estimated at 2020	People exposed estimated at 2030	People exposed estimated at 2020	People exposed estimated at 2030
AT	11898	11001	0	0
BE	69271	63972	8281	7676
BG	5276	4731	609	546
CY	7806	4781	2215	1357
CZ	10408	11149	4272	4575
DE	570471	529260	152054	140367
DK	3608	3758	637	663
EE	3332	3199	0	0
ES	79724	74455	44787	41150
FI	3449	3364	1033	991
FR	504717	520541	117959	120014
GB	986561	962856	307286	300250
GR	39310	36811	11080	10360
HR	0	0	0	0
HU	1083	1133	0	0
IE	30452	30018	7349	7988
IT	437132	401860	86203	78873
LT	11502	10603	3614	3341
LU	65620	69509	49078	51986
LV	532	507	426	405
MT	8670	8194	1008	953
NL	61448	61890	2583	2594
PL	55780	53346	6300	6009
PT	89852	85918	47679	45398
RO	45404	40852	28099	25276
SE	17342	17310	1196	1349
SK	1550	1516	310	303

A5.4. Major road noise exposure outside agglomerations

Country	L_{den}		L_{night}	
	People exposed estimated at 2020	People exposed estimated at 2030	People exposed estimated at 2020	People exposed estimated at 2030
AT	774552	893023	410877	505556
BE	1036772	1213043	820626	964762
BG	112466	116617	51630	53654
CY	42537	67636	21117	33750
CZ	734878	797644	447969	507581
DE	2809181	2886089	1700939	1755477
DK	305750	322561	182501	193293
EE	6882	6952	3108	3279
ES	2043274	2489979	1280359	1576294
FI	116581	120806	55078	57455
FR	6893543	7767939	4614144	5240331
GB	4469761	4717462	2859303	2890031
GR	16269	16823	4315	4250
HR	116356	91828	73132	58156
HU	174724	179297	125100	129859
IE	236770	312916	153431	205669
IT	7502371	8335403	5802106	6488141
LT	21732	20224	14356	13360
LU	75697	94750	52886	68980
LV	24166	24868	11344	12153
MT	17991	21452	12843	15409
NL	173100	193538	89013	100041
PL	2396413	2744175	1852285	2139579
PT	883843	1016462	497581	578785
RO	347446	407739	220203	261256
SE	331152	358243	199539	217909
SI	126827	152593	82528	99730
SK	173475	215021	106425	133932

A5.5. Major rail noise exposure outside agglomerations

Country	L_{den}		L_{night}	
	People exposed estimated at 2020	People exposed estimated at 2030	People exposed estimated at 2020	People exposed estimated at 2030
AT	533662	582432	423119	462585
BE	258652	317403	192471	238402
BG	0	0	0	0
CY	0	0	0	0
CZ	198776	181990	160511	147458
DE	3322282	3270876	2755472	2715221
DK	86641	92453	66760	71548
EE	0	0	0	0
ES	352089	419899	282066	339017
FI	31969	31586	22784	22580
FR	2684526	2997255	2345635	2636007
GB	468356	456937	357780	349697
GR	0	0	0	0
HR	646	583	434	397
HU	89536	82816	63471	58811
IE	13409	15090	6635	7489
IT	2152517	2181296	1871948	1893953
LT	970	1037	879	953
LU	20792	25404	16217	19682
LV	2603	2463	3884	3718
MT	0	0	0	0
NL	93988	109907	60712	71664
PL	206585	219469	155488	165736
PT	102333	106029	75871	78180
RO	27733	33388	11634	14177
SE	271731	300417	218244	243779
SI	24068	24904	20497	21197
SK	117464	142630	75475	93416

A5.6. Major air noise exposure outside agglomerations

Country	L_{den}		L_{night}	
	People exposed estimated at 2020	People exposed estimated at 2030	People exposed estimated at 2020	People exposed estimated at 2030
AT	11484	11846	517	534
BE	68720	71612	28539	29740
CZ	10072	8519	15443	13062
DE	282209	265561	91990	86564
DK	1000	965	800	772
ES	125702	129774	22808	23547
FI	22778	21021	2640	2436
FR	0	0	0	0
GB	146116	134825	137409	126791
GR	0	0	0	0
HU	30662	26773	5513	4814
IE	19604	20868	6535	6956
IT	183472	183543	50019	50039
LU	6759	7177	1664	1767
LV	1001	860	364	313
NL	912	933	0	0
PL	8077	7940	808	794
PT	134461	127796	73692	70039
RO	6756	6575	202	196
SE	14884	13950	392	367

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