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Proposal for a Limit Value Reduction Scenario for Road Vehicles compatible with the German National Traffic Noise Prevention

Package II

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Proposal for a Limit Value Reduction Scenario for Road Vehicles compatible with the German National Traffic Noise Prevention

Package II

by

Heinz Steven
Data Analysis and Consultancy, Heinsberg (Germany)

On behalf of the Federal Environment Agency (Germany)

UMWELTBUNDESAMT

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52525 Heinsberg

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Wörlitzer Platz 1
06844 Dessau-Roßlau
Germany
Phone: +49-340-2103-0
Fax: +49-340-2103 2285
Email: info@umweltbundesamt.de
Internet: http://www.umweltbundesamt.de
http://fuer-mensch-und-umwelt.de/

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Dr. Lars Schade

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1 Introduction

With COM(2011) 856 final from 09.12.2011 the EU Commission launched a proposal for a regulation of the European Parliament and of the Council on the sound level of motor vehicles. This proposal is related to motor vehicles having at least four wheels. Objective and aim are described as follows:

“The objective of the proposal is to ensure a high level of health and environmental protection and to safeguard the Internal Market for motor vehicles as regards their sound level. The proposal aims at reducing environmental noise by introducing a new test method for measuring noise emissions, by lowering the noise limit values, by including additional sound emission provisions in the type-approval procedure……” (see paragraph 1 of the explanatory memorandum).

Under the bullet point “- new limit values” of paragraph 1 of the explanatory memorandum the following statements are listed:

“On the basis of the results of the monitoring data an impact assessment has been prepared with different policy options for the noise test method and corresponding limit values. According to the most preferable option the limit values for light and medium size vehicles will be lowered in two steps of each 2 dB(A) and for heavy vehicles in a first step of 1 and a second step of 2 dB(A). This will result in a reduction of the noise impact of about 3 dB(A) for free flowing traffic and up to 4 dB(A) for intermittent traffic. The reduction of the number of highly annoyed people will be 25 %. The cost-benefit ratio for this measure is estimated to be around 20 times in favour of the noise reduction compared to no action taken.”

The forecast for the reduction of the noise impact in real traffic is far too optimistic. It is highly unlikely that the reduction of limit values by 3 to 4 dB will lead to a reduction of the noise impact in real traffic by the same amount without any deterioration factor. Own calculations with the TRANECAM model led to a significantly lower noise impact reduction of 1,5 dB for two reasons. The first reason is related to the fact that the limit value reduction will not affect the whole market. E.g., the reduced limit values as proposed in COM(2011) 856 final can already be fulfilled by 23% of the M1 vehicle types in the monitoring database. The corresponding percentages for N1 and N2 vehicles are even higher (32%, > 45%).

Another reason for the lower reduction forecast in the own calculations is related to the Regulation (EC) No 661/2009 of the European Parliament and of the Council of 13 July 2009 concerning type-approval requirements for the general safety of motor vehicles, their trailers and systems, components and separate technical units intended therefore, which introduced new stricter noise requirements for motor vehicle tyres.

In the Venoliva report which built the basis of the impact assessment accompanied to the EU Commission proposal it is forecasted that the effect of this regulation on the rolling noise reduction in real traffic will be more than 3 dB. Own estimates of the effect of the tyre noise reduction resulted in a reduction of the noise impact in the order of 1.1 dB. Further details will be shown in this report.

The aim of this study is to elaborate a reduction scenario which would most likely lead to a reduction of the noise impact in real traffic by 3 dB, by adding a 3rd reduction step. This possibility is left open in COM(2011) 856 final by article 7 (revision clause).

The limit values of COM(2011) 856 final are based on the existing vehicle categorisation with one exception, which is the definition of high powered M1 vehicles. Since this categorisation does no longer reflect the trends in the development of vehicle mass and rated engine power over the last 20 years, a proposal for an updated categorisation for all vehicle categories is included in this report.

2 Assessment of the vehicle categorisation and limit values of COM(2011) 856 final

The vehicle categorisation of COM(2011) 856 final is based on the vehicle categories as defined in Annex II of 2007/46/EC:

- Category M, Motor vehicles with at least four wheels designed and constructed for the carriage of passengers.
  - M1, Vehicles designed and constructed for the carriage of passengers and comprising no more than eight seats in addition to the driver's seat.
  - M2, Vehicles designed and constructed for the carriage of passengers, comprising more than eight seats in addition to the driver's seat, and having a maximum mass not exceeding 5 tonnes.,
  - M3, Vehicles designed and constructed for the carriage of passengers, comprising more than eight seats in addition to the driver's seat, and having a maximum mass exceeding 5 tonnes.
- Category N, Motor vehicles with at least four wheels designed and constructed for the carriage of goods.
  - N1, Vehicles designed and constructed for the carriage of goods and having a maximum mass not exceeding 3,5 tonnes.
  - N2, Vehicles designed and constructed for the carriage of goods and having a maximum mass exceeding 3,5 tonnes but not exceeding 12 tonnes.
  - N3, Vehicles designed and constructed for the carriage of goods and having a maximum mass exceeding 12 tonnes.

Concerning the limit values the assessment will focus on the limit values for the second stage (phase 2 and phase 3), because they determine the final effects on the noise impact in real traffic. In a first step the effects on the average Lurban will be assessed in the following chapters. The Calculation of the effective noise reduction for vehicle categories resulting from COM(2011) 856 final is based on the frequency distributions of Lurban in the monitoring database.

In cases where the German proposal (see [3]) would lead to an improvement with respect to the effectiveness of the reduction potential or would lead to a better balanced vehicle classifications, this proposal and its stage 3 limit values will be included in the assessment.

2.1 Subcategories of category M vehicles

2.1.1 M1 vehicles

Concerning the noise limit values the following subcategories for M1 vehicles are defined in COM(2011) 856 final:

1. M1 with power to mass ratio up to 150 kW/t (M1-a), stage 2 limit value 68 dB,
2. M1 with power to mass ratio higher than 150 kW/t (M1-b), stage 2 limit value 69 dB.

The power to mass ratio is the ratio between the rated power in kW and the mass in running order in tonnes. "mass of a vehicle in running order" (m_{ro}) means the mass of the vehicle including the mass of the driver, of the fuel and liquids, fitted with the standard equipment in accordance with the manufacturer's specifications.

In each vehicle category subclass COM(2011) 856 final specifies different limit values for on and off road vehicles. In a footnote (asterix) is stated that "Increased limit values shall only be valid if the vehicle complies with the relevant definition for off-road vehicles set out in point 4 of Section A of Annex II to EU Directive 2007/46/EC". A second footnote states that "For M1 vehicles the increased limit values for off-road vehicles are only valid if the maximum authorised mass > 2 tonnes".

The definition of off road vehicle in directive 2007/46/EC is as follows:

1. Vehicles in category N1 with a maximum mass not exceeding two tonnes and vehicles in category M1 are considered to be off-road vehicles if they have:

- at least one front axle and at least one rear axle designed to be driven simultaneously including vehicles where the drive to one axle can be disengaged,
- at least one differential locking mechanism or at least one mechanism having a similar effect and
- if they can climb a 30 % gradient calculated for a solo vehicle.
- In addition, they must satisfy at least five of the following six requirements:
    - ✓ the approach angle must be at least 25 degrees,
    - ✓ the departure angle must be at least 20 degrees,
    - ✓ the ramp angle must be at least 20 degrees,
    - ✓ the ground clearance under the front axle must be at least 180 mm,
    - ✓ the ground clearance under the rear axle must be at least 180 mm,
    - ✓ the ground clearance between the axles must be at least 200 mm.

An increased limit value by 1 dB for off road vehicles is only foreseen for M1-a with GVM > 2 tonnes. For the assessment of the Lurban reduction can be assumed that all M1 off road vehicles (M1-or) belong to this subclass.

The criteria for the high powered M1 class in the current directive are:

- fitted with a gear box having more than four forward gears
- equipped with an engine developing a maximum power greater than 140 kW (ECE),
- having a maximum-power/maximum-mass ratio greater than 75 kW/t
- and if the speed at which the rear of the vehicle passes the line BB' in third gear is greater than 61 km/h.

The trend to higher rated power values led to an increase of the percentage of high powered M1 vehicle types within the M1 vehicle class since the last limit value reduction. 23,3 % of the M1 vehicle types in the monitoring database belong to the high powered vehicle class as defined by the current directive.

With the updated definition of COM(2011) 856 final this percentage is decreased to 8,4 % , which means that this subgroup has been decreased by almost 2/3 (64%). Therefore the updated definition can be supported and is more appropriate for the state of the art. The importance of this vehicle subclass (> 150 kW/t) for the noise impact is far less than the share in the monitoring database, because the percentage of these vehicles on the production volume was only about 0,5% in 2007 (see [2]).

For the calculation of the average reduction of the noise emissions the Lurban distributions of the monitoring database were combined with the distribution of vehicle production in 2007 into power to mass ratio classes derived from the AAA database (see [2]). It was further assumed that M1-off road vehicles have a share of 5% on the whole M1 fleet. The resulting reduction schema for M1 vehicles is shown in Table 5.

More details can be found in the tables in chapter 6, Annex A. Figure 1 shows the shares for the necessary reduction in Lurban for the 2. stage of the limit values in COM(2011) 856 final for different power to mass ratio (pmr) classes. Figure 2 shows the resulting average reductions in Lurban. The stage 2 limits are less demanding for the pmr classes with the highest shares (pmr < 105 kW/t) and much more demanding for high powered vehicles. The reductions for the M1 subclasses are as follows:

1. M1-a: 2,05 dB,
2. M1-b: 4,37 dB,
3. M1-or: 2,67 dB

This results in an overall reduction for the average Lurban value of 2,1 dB for stage 2.

Monitoring database			fleet share	overall share	necessary Lurban reduction in dB		fleet share	
Category	Lurban in dB(A)	share			stage 1	stage 2	stage 1	stage 2
M1, pmr < 150 kW/t	64	0.21%	95%	0.20%				
	65	0.98%	95%	0.93%				
	66	2.48%	95%	2.35%				
	67	5.21%	95%	4.95%				
	68	16.49%	95%	15.66%				
	69	21.95%	95%	20.85%		-1		20.85%
	70	23.26%	95%	22.10%		-2		22.10%
	71	14.20%	95%	13.49%	-1	-3	13.49%	13.49%
	72	11.76%	95%	11.17%	-2	-4	11.17%	11.17%
	73	2.55%	95%	2.42%	-3	-5	2.42%	2.42%
	74	0.44%	95%	0.42%	-4	-6	0.42%	0.42%
	75	0.12%	95%	0.11%	-5	-7	0.11%	0.11%
M1, pmr > 150 kW/t	70	0.02%	95%	0.02%		-1		0.02%
	71	0.04%	95%	0.04%		-2		0.04%
	72	0.03%	95%	0.03%	-1	-3	0.03%	0.03%
	73	0.11%	95%	0.11%	-2	-4	0.11%	0.11%
	74	0.08%	95%	0.08%	-3	-5	0.08%	0.08%
	75	0.04%	95%	0.04%	-4	-6	0.04%	0.04%
	76	0.02%	95%	0.02%	-5	-7	0.02%	0.02%
M1, off road	67	1.69%	5.00%	0.08%				
	68	0.60%	5.00%	0.03%				
	69	11.10%	5.00%	0.55%				
	70	17.73%	5.00%	0.89%		-1		0.89%
	71	27.67%	5.00%	1.38%		-2		1.38%
	72	19.60%	5.00%	0.98%	-1	-3	0.98%	0.98%
	73	6.80%	5.00%	0.34%	-2	-4	0.34%	0.34%
	74	13.46%	5.00%	0.67%	-3	-5	0.67%	0.67%
	75	0.71%	5.00%	0.04%	-4	-6	0.04%	0.04%
	76	0.65%	5.00%	0.03%	-5	-7	0.03%	0.03%

Table 1: Reduction schema for M1 vehicles based on COM(2011) 856 final

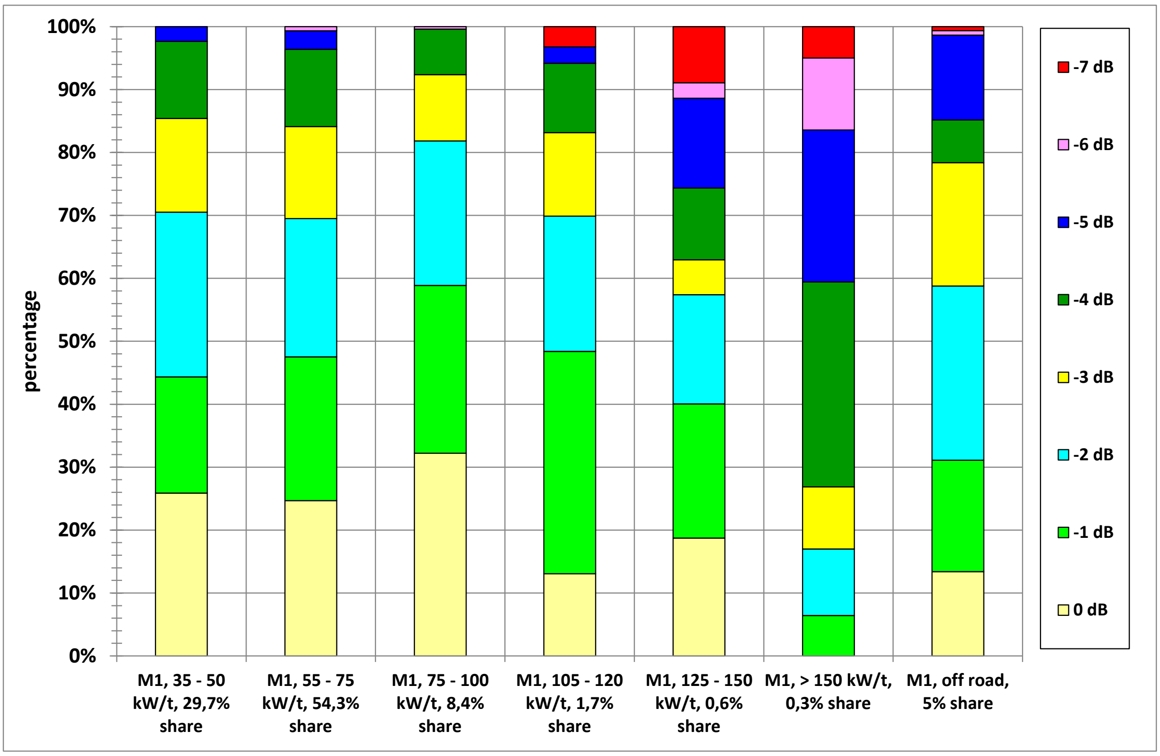

Figure 1: Shares for the necessary reduction in Lurban for the 2. stage of the limit values in COM(2011) 856 final for different power to mass ratio classes

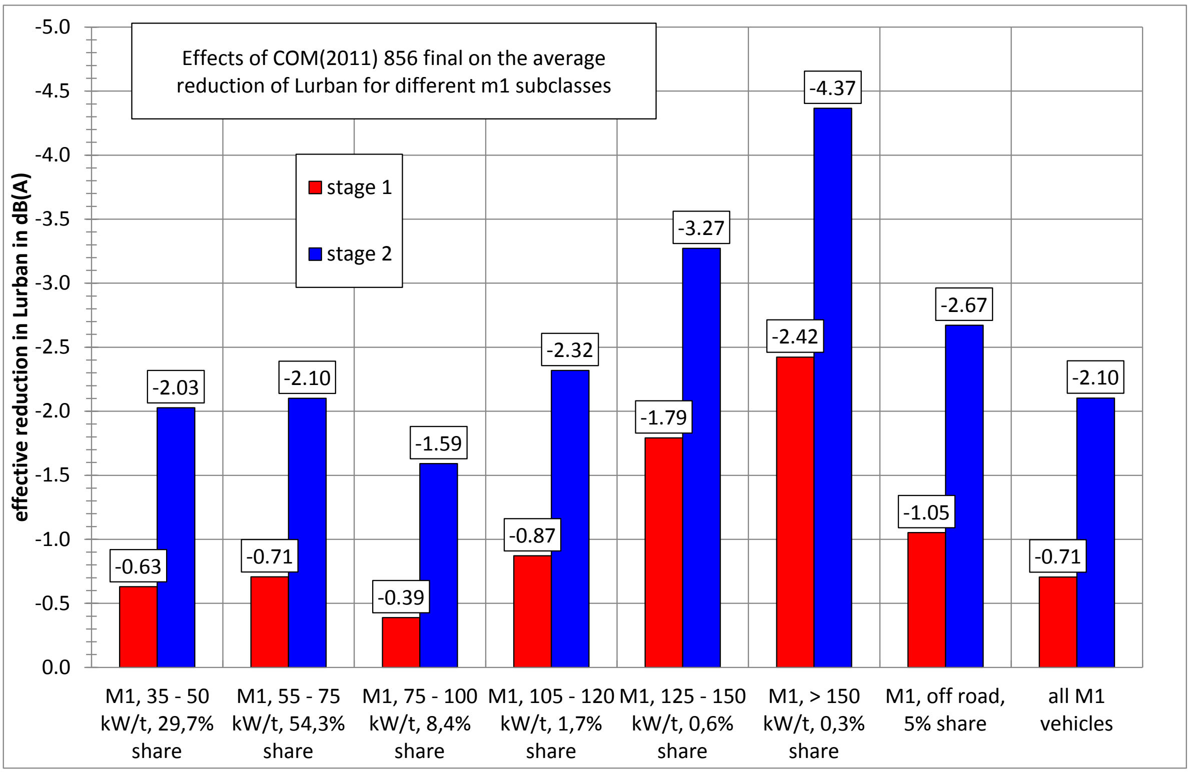

Figure 2: Effects of COM(2011) 856 final on the average reduction of Lurban for different m1 subclasses

COM(2011) 856 final contains 2 limit value stages. The German proposal as described in [3] consists of 3 limit value stages The 3rd stage of the German proposal is equivalent to the 2nd stage of COM(2011) 856 final and thus will be used for comparison.

The German proposal for M1 vehicles (see [3]) consists of the following subclasses:

1. M1 with pmr <= 120 kW/t (M1-a, DE), stage 3 limit value 68 dB,
2. M1 with 120 kW/t < pmr <= 160 kW/t (M1-b, DE), stage 3 limit value 70 dB,
3. M1-with pmr > 160 kW/t (M1-c, DE), stage 3 limit value 73 dB,
4. M1 off road vehicles (M1-d, DE), that fulfil the criteria described before but with the additional requirement of a wading depth >= 500 mm (see [3]).

The limit value increase for off road vehicles is also 1 dB for stage 3, but off road vehicles belonging to M1-b, DE have a 2 dB higher limit value than M1-a, DE vehicles. The reduction schema for the final reduction step (step 3) is shown in Table 2.

This results in the following reduction for the average Lurban:

1. M1-a, DE: 1,96 dB,
2. M1-b, DE: 1,70 dB,
3. M1-c, DE: 1,97 dB,
4. M1-or, DE: 2,70 dB

The weighted average reduction in Lurban for all M1 vehicles is 2,01 dB for stage 3.

In order to get a better insight into the differences between COM(2011) 856 final and the German proposal, the frequency distributions of Lurban for the several M1 subclasses are compared in Figure 3. The limit values are shown as vertical lines.

The following conclusions can be drawn from this figure: The limit values for the vast majority of M1 and M1 off road vehicles are identical and equally stringent for both subcategories (M1-a and M1-or). The frequency distributions for M1-b, Com and M1-c, De are close together but the corresponding limit values differ by 4 dB. The limit values of COM(2011) 856 final are much more stringent than for M1-a vehicles (4.37 dB vs 2.05 dB). This difference is counterproductive for the acceptance of the proposal as well as for the effects on noise emissions in real traffic, since M1-b, Com vehicles do not contribute significantly to the noise impact in real traffic because of their low fleet share.

The limit values of the German proposal are in contrast to that. They are less demanding for M1-b, DE and M1-c, DE vehicles than for M1-a and M1-or vehicles. They need to be decreased by 1 dB to make them equally demanding than the limits for M1-a and M1-or.

Since it can be expected that the reduction effect on the noise impact in real traffic will be less than the Lurban reduction and since M1 vehicles play an important role for the overall noise reduction in agglomerations, it can already here be concluded that the national targets of a noise impact reduction by 3 dB will not be reached, neither by COM(2011) 856 final nor by the German proposal.

Monitoring database			pmr share	overall share	stage 1	stage 2	stage 3	stage 1	stage 2	stage 3
Category	Lurban in dB(A)	share in DB								
M1, pmr <= 120 kW/t	64	0.44%	93.9%	0.41%						
	65	0.88%	93.9%	0.83%						
	66	2.42%	93.9%	2.28%						
	67	5.07%	93.9%	4.76%						
	68	15.42%	93.9%	14.48%						
	69	24.67%	93.9%	23.17%			-1			23.17%
	70	21.81%	93.9%	20.48%			-2			20.48%
	71	14.98%	93.9%	14.07%		-1	-3		14.07%	14.07%
	72	14.32%	93.9%	13.45%		-2	-4	13.45%	13.45%	13.45%
M1, 120 kW/t < pmr <= 160 kW/t	68	10.0%	0.9%	0.09%						
	69	16.0%	0.9%	0.14%						
	70	20.0%	0.9%	0.17%						
	71	14.0%	0.9%	0.12%			-1			0.12%
	72	12.0%	0.9%	0.10%		-1	-2		0.10%	0.10%
	73	16.0%	0.9%	0.14%		-2	-3		0.14%	0.14%
	74	12.0%	0.9%	0.10%	-1	-3	-4	0.10%	0.10%	0.10%
M1, pmr > 160 kW/t	70	2.9%	0.2%	0.01%						
	71	8.8%	0.2%	0.02%						
	72	5.9%	0.2%	0.01%						
	73	32.4%	0.2%	0.07%						
	74	20.6%	0.2%	0.05%			-1			0.05%
	75	17.6%	0.2%	0.04%		-1	-2		0.04%	0.04%
	76	11.8%	0.2%	0.03%		-2	-3		0.03%	0.03%
M1, pmr <= 120 kW/t, off road	67	1.9%	5.0%	0.09%						
	68	1.9%	5.0%	0.09%						
	69	17.0%	5.0%	0.85%						
	70	15.1%	5.0%	0.75%			-1			0.75%
	71	22.6%	5.0%	1.13%			-2			1.13%
	72	17.0%	5.0%	0.85%		-1	-3		0.85%	0.85%
	73	3.8%	5.0%	0.19%		-2	-4		0.19%	0.19%
	74	7.5%	5.0%	0.38%	-1	-3	-5	0.38%	0.38%	0.38%
	75	5.7%	5.0%	0.28%	-2	-4	-6	0.28%	0.28%	0.28%
	76	1.9%	5.0%	0.09%	-3	-5	-7	0.09%	0.09%	0.09%
M1, 120 kW/t < pmr <= 160 kW/t, off road	69	1.9%	5.0%	0.09%						
	71	1.9%	5.0%	0.09%						
	76	1.9%	5.0%	0.09%			-5			0.09%

Table 2: Reduction schema for M1 vehicles based on the German proposal (see [3])

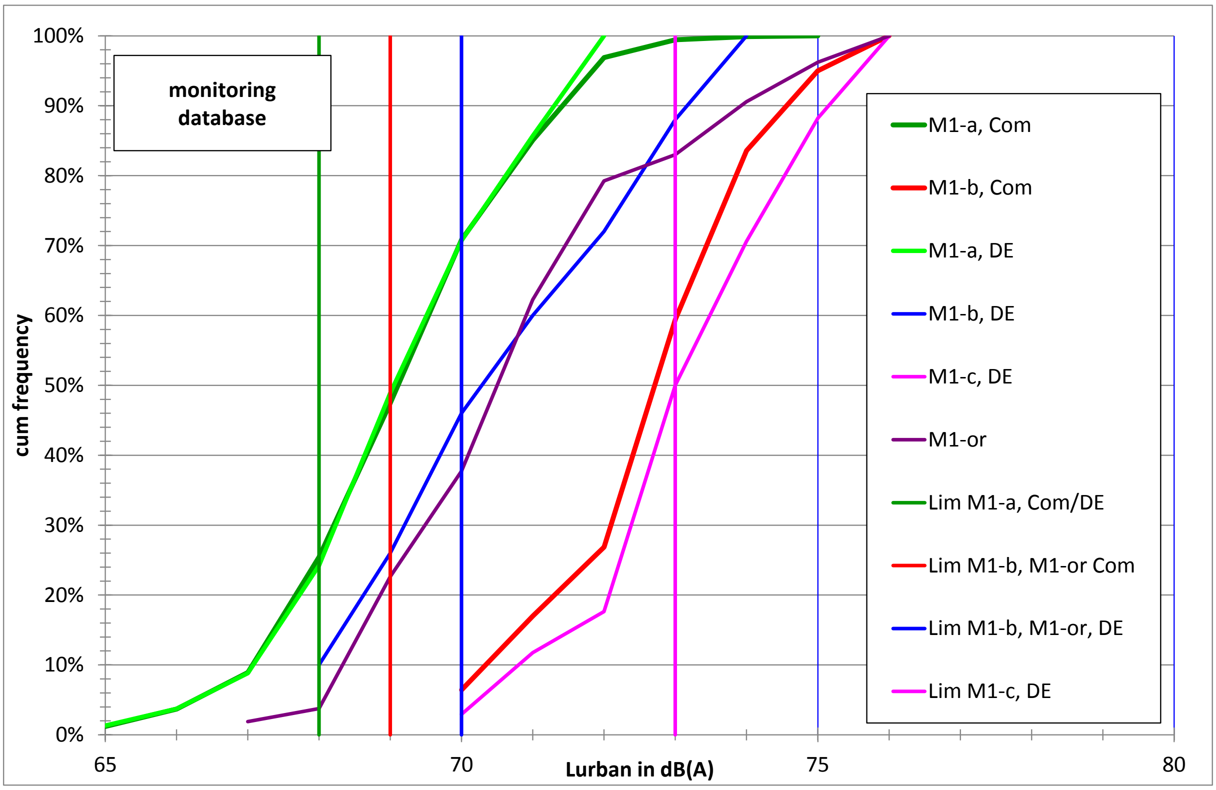

Figure 3: Comparison of Lurban frequency distributions for different M1 subclasses between COM(2011) 856 final and the German proposal

2.1.2 M2 vehicles

M2 vehicles are subcategorised with respect to their gross vehicle mass (GVM) and the rated power. The borderlines are 2 000 kg and 3 500 kg. The 4 M2 subclasses are defined as follows:

1. M2 vehicles with GVM <= 2 000 kg (M2-a), stage 2 limit value 70 dB,
2. M2 vehicles with 2 000 kg < GVM <= 3 500 kg (M2-b), stage 2 limit value 71 dB,
3. M2 vehicles with 3 500 kg < GVM <= 5 000 kg and rated power < 150 kW (M2-c), stage 2 limit value 72 dB,
4. M2 vehicles with 3 500 kg < GVM <= 5 000 kg and rated power >= 150 kW (M2-d), stage 2 limit value 74 dB.

Since M2 vehicles are designed and constructed for the carriage of passengers, comprising more than eight seats in addition to the driver's seat, the payload will be at least 900 kg and thus the GVM will be more than 2 000 kg in any case. **So, subclass 1 (M2-a) is redundant.**

Vehicles like the VW T5 (except for some very special versions with very low sales rates) or the Iveco Daily do not belong to the M2 category because the number of seats is lower than 10, so that the category is M1. Other vehicle types like Ford Transit or Mercedes Sprinter belong either to subclasses 2 (M2-b) or 3 (M2-c), depending on the number of seats and other configuration variances. Up to 12 seats the vehicles belong most probably to M2-b, with more than 14 seats M2-c is most probably appropriate. From 16 seats on the GVM values could even be higher than 5 000 kg, so that the appropriate vehicle category is M3.

Since no M2 vehicle was found in the monitoring database as well as in the current market production with rated power values above 150 kW, also subclass 4 is redundant.

The monitoring database contains 8 M2-b and 3 M2-c vehicles. The reduction schema is shown in Table 3. The resulting reduction of the average Lurban value is 2.30 dB for M2-b and 1.52 dB for M2-c vehicles. But the number of vehicles in the M2-c class is too small for the determination of a reliable reduction value.

On the other hand, M2-b and M2-c vehicles are all derivatives of N1 vehicles with GVM > 2000 kg. In this context it would be reasonable to merge both subclasses and apply the same limit value of 71 dB(A) for stage 2. Unfavourable for this approach is the fact, that the measurement methods are different. For M2-b vehicles the same method as for M1 vehicles is applied, for M2-c vehicles the N2 vehicle method with target engine speed at BB' is applied. Consequently it would be necessary to apply the M1 method also for M2-c vehicles if one would merge them with M2-b vehicles.

This discussion is not so important for the determination of the effects on the noise impact in real traffic, because M2 vehicles have not a significant percentage on the overall fleet share.

Monitoring database				**necessary Lurban reduction in dB**		**fleet share**	
Category	**Lurban in dB(A)**	**number of vehicles in DB**	**share**	**stage 1**	**stage 2**	**stage 1**	**stage 2**
M2-b, Pn < 150 kW	70	1	9.1%				
	71	2	18.2%				
	72		0.0%		-1		0.0%
	73	3	27.3%		-2		27.3%
	74		0.0%	-1	-3	0.0%	0.0%
	75	1	9.1%	-2	-4	9.1%	9.1%
	76	1	9.1%	-3	-5	9.1%	9.1%
	sum	**8**	**72.7%**				
M2-c, Pn < 150 kW	72	1	9.1%				
	73	1	9.1%		-1		9.1%
	74		0.0%		-2		0.0%
	75	1	9.1%	-1	-3	9.1%	9.1%
	sum	**3**	**27.3%**				

Table 3: Reduction schema for M2 vehicles based on COM(2011) 856 final

The German proposal contains the following M2 subclasses:

1. M2 vehicles with GVM <= 2 500 kg (M2-a, DE), stage 3 limit value 69 dB,
2. M2 vehicles with 2 500 kg < GVM <= 3 500 kg (M2-b, DE), stage 3 limit value 71 dB,
3. M2 vehicles with 3 500 kg < GVM <= 5 000 kg (M2-c, DE), stage 3 limit value 71 dB,

The stage 3 limit value for M2-b/c, DE is the same as for N1-b, DE (see chapter 3.2.1), but the stage 3 limit value for M2-a, DE is 1 dB higher than the corresponding value for N1-a, DE vehicles. Since the technical basis for both classes is the same, this difference is not justified and the M2-a, DE stage 3 limit value should be reduced by 1 dB for consistency reasons.

M2 off road vehicles are not considered because they are not relevant for the fleet share at all and because there are only a few examples (6 M2-b vehicles) in the monitoring database. Their average Lurban value is only 0,3 dB higher than the value for the M2-b vehicles.

2.1.3 M3 vehicles

M3 vehicles are subcategorised in COM(2011) 856 final with respect to their rated power values. The borderline is 150 kW:

1. M3 vehicles with rated power values < 150 kW (M3-a), stage 2 limit value 73 dB,
2. M3 vehicles with rated power values >= 150 kW (M3-b), stage 3 limit value 75 dB.

Concerning the use of the vehicles M3 vehicles can be subdivided into:

- Urban and inter city buses for public transport,
- Coaches.

Within these categories different GVM classes exist depending on the number of axles. Public transport buses with 2 axles have typically a GVM values of 19 000 kg, GVM values around 13 000 kg do also exist, but are of minor importance for the market share. Vehicles with 3 or 4 axles have GVM values of 29 000 up to 32 000 kg. The rated power values are highly correlated with the GVM values and the number of axles. Up to 19 000 kg the rated power values range from 180 to 220 kW, for higher GVMs or more than 2 axles the rated power values range from 220 to 260 kW.

Coaches have similar correlations between the number of axles, GVM and rated power: 2 axles up to 18 000 kg, 3 axles 24 000 kg, but the rated power values are typically higher than for public transport buses: 260 to 320 kW for 2 axle vehicles (210 kW for GVM of 13 000 kg), 320 to 350 kW for 3 axle vehicles.

This means that urban and inter-city buses as well as coaches belong exclusively to the rated power class M3-b.

In addition to these classes some M3 models exist with GVM values below 6 000 kg and rated power values below 150 kW and thus belonging to the rated power class M3-a, but these vehicles are of negligible importance for the market share.

The monitoring database contains 13 M3-a vehicles and 30 M3-b vehicles. The reduction schema is shown in Table 4. The resulting reduction in the average Lurban values is 1.25 dB for M3-a vehicles and 3.19 dB for M3-b vehicles. The first value is lower the second higher than for M1 vehicles. The second one is more important for the reduction of the noise impact in real traffic because M3-a vehicles have no relevance for the real traffic emissions.

Monitoring database				necessary Lurban reduction in dB		fleet share	
Category	**Lurban in dB(A)**	**number of vehicles in DB**	**share**	**stage 1**	**stage 2**	**stage 1**	**stage 2**
M3, Pn < 150 kW	72	2	15.4%				
	73	3	23.1%				
	74	4	30.8%		-1		30.8%
	75	2	15.4%		-2		15.4%
	76	2	15.4%	-1	-3	15.4%	15.4%
	sum	**13**	**100.0%**				
M3, Pn >= 150 kW	75	2	6.7%				
	76	3	10.0%		-1		10.0%
	77	4	13.3%		-2		13.3%
	78	14	46.7%	-1	-3	46.7%	46.7%
	79	2	6.7%	-2	-4	6.7%	6.7%
	80	3	10.0%	-3	-5	10.0%	10.0%
	81	2	6.7%	-4	-6	6.7%	6.7%
	sum	**30**	**100.0%**				

Table 4: Reduction schema for M3 vehicles based on COM(2011) 856 final

The German proposal (see [3]) contains the following updated proposal for rated power subclasses (German proposal):

1. M1-a, DE, Pn <= 180 kW, stage 3 limit value 73 dB,
2. M1-b, DE, 180 kW < Pn <= 250 kW, stage 3 limit value 76 dB,
3. M1-c, DE, Pn > 250 kW, stage 3 limit value 76 dB.

The corresponding reduction schema is shown in Table 5. The resulting reduction of the average Lurban values are also listed in Table 5. Since the German proposal contains the same limit value for M3-b and M3-c vehicles in stage 3, both subclasses could be merged and the only differences between this proposal and COM(2011) 856 final would be 1 dB difference in the limit values (75 dB vs 76 dB for M3-b) and the shifted rated power borderline from 150 kW to 180 kW.

That the German proposal still contains 3 different rated power classes for M3 vehicles results from a request of the vehicle manufacturers with respect to further future limit value reductions. The manufacturers argue that this might be possible for public transport buses (mainly belonging to M3-b, DE) but would be much more difficult and costly for coaches. Furthermore a limit value reduction for public transport buses would be much more important and effective for the reduction of the noise impact in real traffic than for coaches whose mileage focusses on rural roads and motorways rather than urban streets.

This request is reasonable but the rated power borderline between M3-b and M3-c should than be shifted to 260 kW.

Figure 4 shows a comparison of Lurban frequency distributions for different M3 subclasses between COM(2011) 856 final and the German proposal. This figure supports the merge of M3-b, DE and M3-c, DE and also the German limit value proposal for the resulting class. Figure 4 suggests on the other hand a reduction of the limit value for M3-a vehicles by 1 dB in order to be more consistent with the distributions for the other vehicle categories. This suggestion can also be justified by the fact, that these vehicles are N1/M2 derivatives.

M3 off road vehicles are not considered because they are not relevant for the fleet share at all. COM(2011) 856 final requires a 1 dB limit value increase for M3-a vehicles and a 2 dB increase for M3-b vehicles. The German proposal requires the 2 dB increase for all M3 vehicles.

Monitoring database				**necessary Lurban reduction in dB**	**fleet share**
Category	**Lurban in dB(A)**	**number of vehicles in DB**	**share**	**stage 3**	**stage 3**
M3, Pn <= 180 kW	72	2	15.4%		
	73	3	23.1%		23.1%
	74	4	30.8%	-1	30.8%
	75	2	15.4%	-2	15.4%
	76	2	15.4%	-3	15.4%
	sum	**13**	**100.0%**	D-Lurban in dB	**-1.25**
M3, 180 kW < Pn <= 250 kW	75	1	7.7%		
	76	1	7.7%		
	77	3	23.1%	-1	23.1%
	78	8	61.5%	-2	61.5%
	sum	**13**	**100.0%**	D-Lurban in dB	**-1.54**
M3, Pn > 250 kW	75	1	5.9%		
	76	2	11.8%		
	77	1	5.9%	-1	5.9%
	78	6	35.3%	-2	35.3%
	79	2	11.8%	-3	11.8%
	80	3	17.6%	-4	17.6%
	81	2	11.8%	-5	11.8%
	sum	**17**	**100.0%**	D-Lurban in dB	**-2.72**

Table 5: Reduction schema for M3 vehicles based on the German proposal

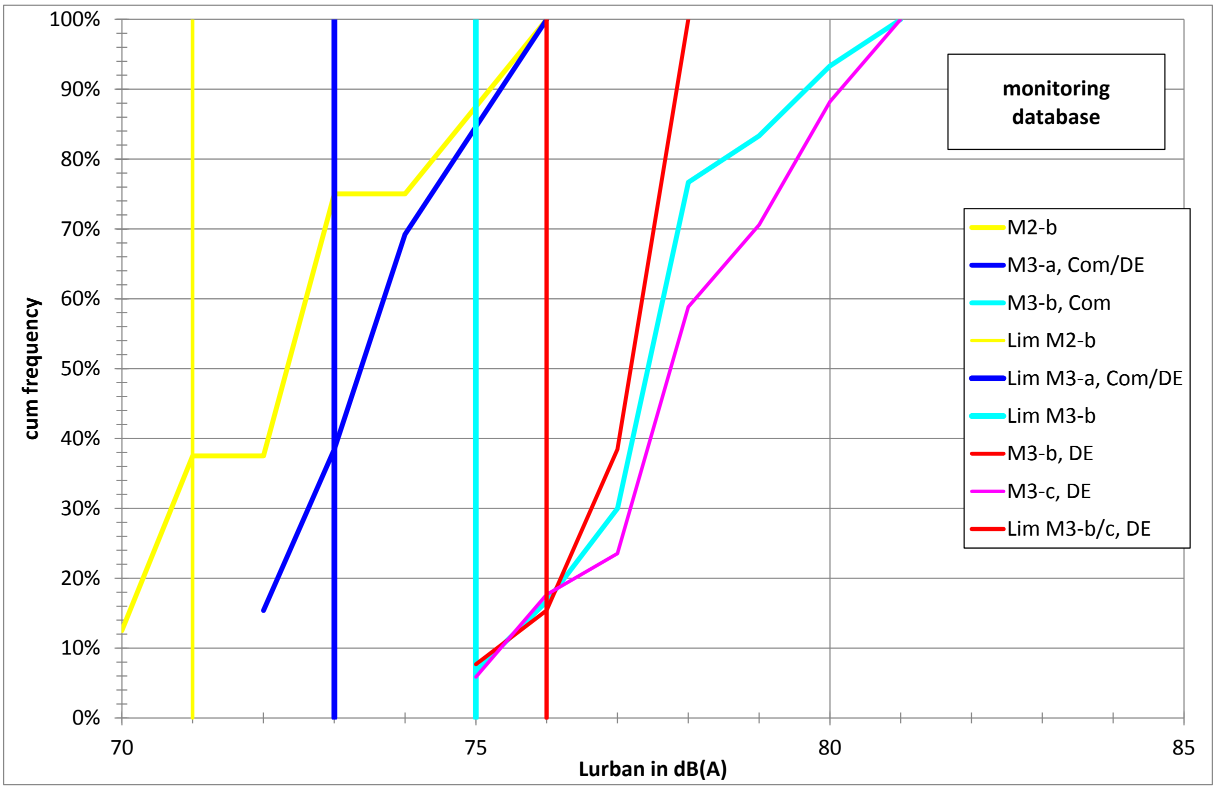

Figure 4: Comparison of Lurban frequency distributions for different M3 subclasses between COM(2011) 856 final and the German proposal

2.2 Subcategories of category N vehicles

2.2.1 N1 vehicles

The N1 vehicle category is subdivided in COM(2011) 856 final with respect to the GVM values with the borderline of 2 000 kg:

1. N1 vehicles with GVM <= 2 000 kg (N1-a), stage 2 limit value 69 dB,
2. N1 vehicles with 2 000 kg < GVM <= 3 500 kg N1-b), stage 2 limit value 70 dB.

These subclasses are intended to reflect the following 2 technical design classes:

- M1 derivatives like Renault Kangoo, Citroen Berlingo, VW Caddy, Ford Transit Connect and
- "real" N1 vehicles like Renault Trafic, VW Crafter, Ford Transit or MB Sprinter

In the meantime the M1 derivatives have GVM values between 1 900 and 2 400 kg, the "real" N1 vehicles have GVM values between 2 700 and 3 500 kg. A good example is the Renault Kangoo whose GVM values vary between 1 900 and 2 200 kg, depending on the variant.

These results show that the borderline of 2 000 kg between the 2 design classes is no longer state of the art. A borderline of 2 500 kg GVM as suggested in the German proposal would be much more appropriate.

Unfortunately, GVM values were not requested and delivered for the monitoring database. But values of the test mass (mass in running order or kerb mass plus drivers mass) are available instead. The correlation between both values could be calculated from data from previous research projects. On average a GVM of 2 000 kg is equivalent to a test mass of 1500 kg. This allowed the requested split of the N1 vehicles of the monitoring database into the two GVM classes.

For the estimation of the Lurban reduction was further assumed that 10% of the fleet belongs to the lower GVM class and 90% to the higher GVM class. This assumption is based on mileage data from the Handbook of emission factors. The resulting reduction schema is shown in Table 6. The average Lurban reduction for stage 2 is 1.90 dB (0.48 dB for N1 with test mass up to 1 500 kg and 1.99 dB for N1 with test mass > 1 500 kg).

The subclasses for N1 vehicles in the German proposal are:

1. N1 vehicles with GVM <= 2 500 kg (N1-a, DE), stage 3 limit value 68 dB,
2. N1 vehicles with 2 500 kg < GVM <= 3 500 kg N1-b, DE), stage 3 limit value 71 dB.

The reduction schema for the German proposal is shown in Table 7. The resulting reduction of the average Lurban values is 1.47 dB for N1-a, DE vehicles and 1.45 dB for N1-b, DE vehicles. This is better balanced between the 2 classes than for COM(2011) 856 final, but a bit less efficient for the whole N1 category (1.45 dB instead of 1.90 dB).

Figure 5 shows a comparison of Lurban frequency distributions for the 2 N1 subclasses between COM(2011) 856 final and the German proposal. The distribution for the N1-a, DE class is a bit more to the right compared to COM(2011) 856 final but still on the left side of the M1-a class, which means that the Lurban values are not higher than those for the M1-a class. This means that the 1 dB higher limit value in COM(2011) 856 final is incomprehensive.

Even more incomprehensive is the fact that COM(2011) 856 final allows a 1 dB higher limit value for M2 vehicles with GVM up to 2 000 kg compared to the limit values of the corresponding N1 subclass, although this does not harm, because M2 vehicles with GVM up to 2 000 kg do not exist. But the same 1 dB difference can be found between M2 vehicles and N1 with 2 000 kg < GVM <= 3 500 kg. This difference is also not justified.

On the other hand, the limit value of COM(2011) 856 final for N1-b, Com (70 dB) applied to the N1-b, DE distribution would lead to a 2 dB reduction of the average Lurban value and thus be more effective and more consistent than the current limit value of the German proposal.

Monitoring database			fleet share	overall share	necessary Lurban		fleet share	
Category	Lurban in dB(A)	share			stage 1	stage 2	stage 1	stage 2
N1, test mass <= 1500 kg	66	9.38%	10%	0.94%				
	67	6.25%	10%	0.63%				
	68	21.88%	10%	2.19%				
	69	34.38%	10%	3.44%				
	70	18.75%	10%	1.88%		-1		1.88%
	71	9.38%	10%	0.94%		-2		0.94%
	72	0.00%	10%	0.00%	-1	-3	0.00%	0.00%
N1, test mass > 1500 kg	67	2.82%	90%	2.54%				
	68	2.82%	90%	2.54%				
	69	11.27%	90%	10.14%				
	70	8.45%	90%	7.61%				
	71	23.94%	90%	21.55%		-1		21.55%
	72	28.17%	90%	25.35%		-2		25.35%
	73	11.27%	90%	10.14%	-1	-3	10.14%	10.14%
	74	4.23%	90%	3.80%	-2	-4	3.80%	3.80%
	75	7.04%	90%	6.34%	-3	-5	6.34%	6.34%

Table 6: Reduction schema for N1 vehicles based on the limit values in COM(2011) 856 final

Monitoring database					necessary Lurban reduction in dB			fleet share		
Category	Lurban in dB(A)	share	cat share	final share	stage 1	stage 2	stage 3	stage 1	stage 2	stage 3
N1, test mass <= 1800 kg	66	5.77%	30%	1.73%						
	67	7.69%	30%	2.31%						
	68	17.31%	30%	5.19%						
	69	32.69%	30%	9.81%			-1			9.81%
	70	19.23%	30%	5.77%			-2			5.77%
	71	13.46%	30%	4.04%		-1	-3		4.04%	4.04%
	72	3.85%	30%	1.15%		-2	-4		1.15%	1.15%
N1, test mass > 1800 kg	69	3.85%	70%	2.69%						
	70	3.85%	70%	2.69%						
	71	25.00%	70%	17.50%						
	72	36.54%	70%	25.58%			-1			25.58%
	73	15.38%	70%	10.77%		-1	-2		10.77%	10.77%
	74	5.77%	70%	4.04%		-2	-3		4.04%	4.04%
	75	9.62%	70%	6.73%	-1	-3	-4	6.73%	6.73%	6.73%

Table 7: Reduction schema for N1 vehicles based on the limit values of the German proposal

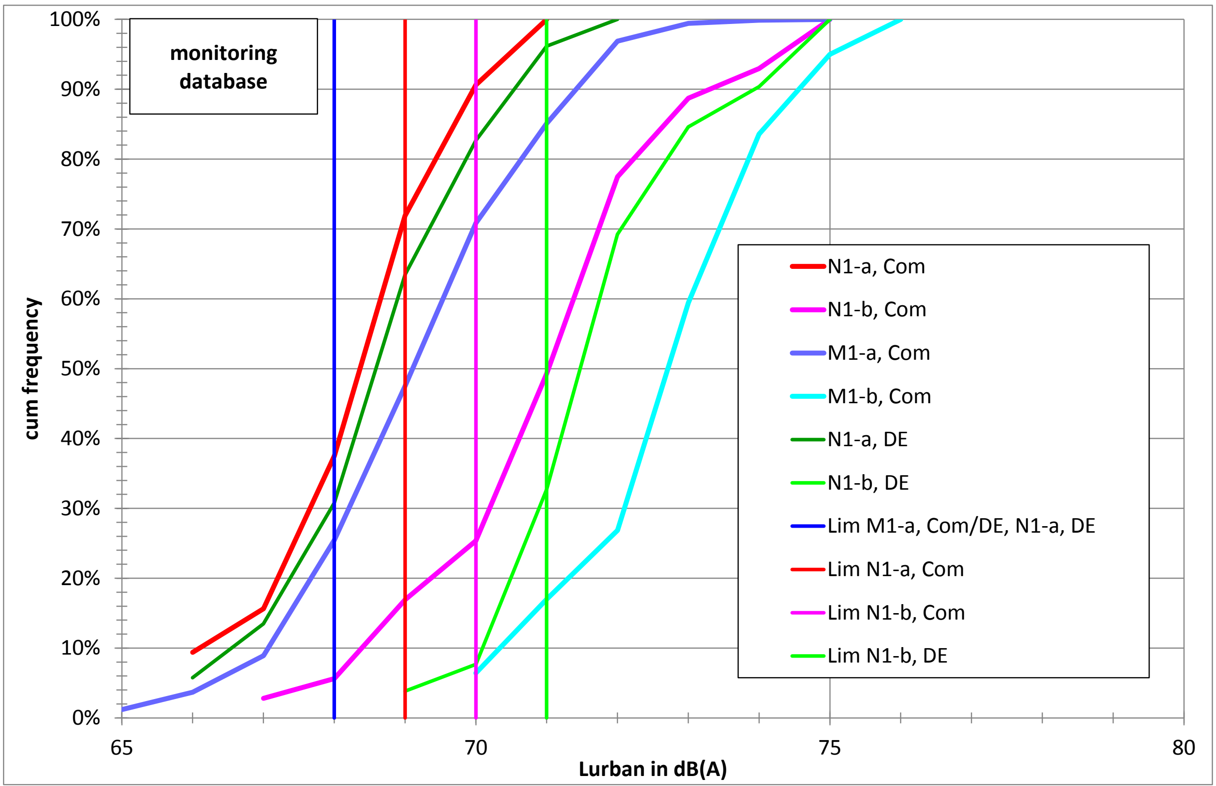

Figure 5: Comparison of Lurban frequency distributions for the 2 N1 subclasses between COM(2011) 856 final and the German proposal

The definition of N1 off road vehicles in directive 2007/46/EC is as follows:

1. Vehicles in category N1 with a maximum mass not exceeding two tonnes and vehicles in category M1 are considered to be off-road vehicles if they have:

- at least one front axle and at least one rear axle designed to be driven simultaneously including vehicles where the drive to one axle can be disengaged,
- at least one differential locking mechanism or at least one mechanism having a similar effect and
- if they can climb a 30 % gradient calculated for a solo vehicle.
- In addition, they must satisfy at least five of the following six requirements:
  - ✓ the approach angle must be at least 25 degrees,
  - ✓ the departure angle must be at least 20 degrees,
  - ✓ the ramp angle must be at least 20 degrees,
  - ✓ the ground clearance under the front axle must be at least 180 mm,
  - ✓ the ground clearance under the rear axle must be at least 180 mm,
  - ✓ the ground clearance between the axles must be at least 200 mm.

It is recommended to add the requirement of a wading depth >= 500 mm for M1 vehicles as done in [3].

2. Vehicles in category N 1 with a maximum mass exceeding two tonnes or in category N 2 , M 2 or M 3 with a maximum mass not exceeding 12 tonnes are considered to be off-road vehicles

- either if all their wheels are designed to be driven simultaneously, including vehicles where the drive to one axle can be disengaged,
- or if the following three requirements are satisfied:
  - ✓ at least one front and at least one rear axle are designed to be driven simultaneously, including vehicles where the drive to one axle can be disengaged,
  - ✓ there is at least one differential locking mechanism or at least one mechanism having a similar effect,
  - ✓ they can climb a 25 % gradient calculated for a solo vehicle.

The results in the monitoring database show that a 1 dB increase in the limit values for N1 off road vehicles as suggested in both proposals is justified.

2.2.2 N2 vehicles

The N2 vehicle category is subdivided in COM(2011) 856 final with respect to the rated power values into the following classes:

1. N2 vehicles with rated power < 75 kW (N2-a), stage 2 limit value 72 dB
2. N2 vehicles with 75 kW <= rated power < 150 kW (N2-b), stage 2 limit value 73 dB,
3. N2 vehicles with rated power >= 150 kW (N2-c), stage 2 limit value 75 dB.

With regard to the technical design 2 different subclasses can be distinguished:

- Vehicle models designed for GVM values between 3 000 kg to 7 000 kg,
- Vehicle models designed for GVM values between 7 000 kg to 18 000 kg.

The first subclass has model variants belonging to the N1 category. Examples are VW Crafter, MB Vario and Iveco Daily. The rated power values range from 80 kW to 150 kW. The second subclass has model variants belonging to the N3 category. Examples are the MB Atego and Volvo FL. The rated power values range from 100 kW to 210 kW.

The subclass with rated power values < 75 kW is an empty class, because the current market does not offer such vehicles. The 150 kW borderline is still appropriate, but the lower class should range up to 150 kW.

There are 52 N2 vehicles in the monitoring database. In the lowest rated power class (< 75 kW) is only 1 vehicle, so that this class cannot be considered. It can be expected to be empty in future. 31 N2 vehicles have rated power values between 75 kW and 149 kW, 20 vehicles have rated power values >= 150 kW. The reduction schema for N2 vehicles based on the limit values in COM(2011) 856 final is shown in Table 7. The average reduction in Lurban for N2 vehicles with rated power values below 150 kW for stage 2 is 1.90dB and for N2 vehicles with rated power values >= 150 kW is 1.79 dB. These reductions are comparable to the reductions for M1 vehicles.

The classification in the German proposal for N2 vehicles is almost the same as in COM(2011) 856 final, if the rated power class below 75 kW is disregarded or merged with the rated power class up to 150 kW. The only difference is that the lower rated power class in the German proposal ranges up to 150 kW and the higher rated power class starts above 150 kW. Since the monitoring database contains 2 vehicles with a rated power value of 150 kW, the number of vehicles in both classes is also slightly changed (34 vehicles up to 150 kW and 18 vehicles above 150 kW).

The limit values for the higher power class are identical, but the limit value for the lower rated power class is 1 dB lower in the German proposal compared to COM(2011) 856 final. This increases the reduction in the average Lurban value from 1.90 dB to 2.75 dB.

The definition for off road vehicles is already mentioned in the previous chapter. A 1 dB increase in the limit values for N2 off road vehicles as suggested in both proposals is justified.

Monitoring database				**necessary Lurban reduction in dB**		**fleet share**	
Category	**Lurban in dB(A)**	**number of vehicles in DB**	**share**	**stage 1**	**stage 2**	**stage 1**	**stage 2**
N2, Pn < 150 kW	70	1	3.33%				
	71	6	20.00%				
	72	2	6.67%				
	73	3	10.00%				
	74	7	20.00%		-1		20.00%
	75	4	13.33%		-2		13.33%
	76	5	16.67%	-1	-3	16.67%	16.67%
	77	1	3.33%	-2	-4	3.33%	3.33%
	78	2	6.67%	-3	-5	6.67%	6.67%
	sum	**31**	**100.0%**				
N2, Pn >= 150 kW	75	1	5.00%				
	76	7	35.00%		-1		35.00%
	77	10	50.00%		-2		50.00%
	78	1	5.00%	-1	-3	5.00%	5.00%
	79	1	5.00%	-2	-4	5.00%	5.00%
	sum	**20**	**100.0%**				

Table 8: Reduction schema for N2 vehicles based on the limit values in COM(2011) 856 final

2.2.3 N3 vehicles

The N3 vehicle category is subdivided in COM(2011) 856 final with respect to the rated power values into the following classes:

1. N3 vehicles with rated power < 150 kW (N3-a), stage 2 limit value 75 dB,
2. N3 vehicles with rated power >= 150 kW (N3-b), stage 2 limit value 78 dB.

Only 4 out of 152 N3 vehicles in the monitoring database have rated power values below 150 kW (see [2]). The percentage of all N3 vehicle sales in the EU in 2008 with rated power values up to 150 kW was less than 0,01%. It is most likely that this class will be empty in future. 90 vehicles (59%) in the database have rated power values > 250 kW. So, 150 kW rated power seems no longer to be an appropriate borderline, because it defines an empty class in future. It should therefore be shifted to 250 kW.

147 N3 vehicles have rated power values >= 150 kW. The reduction schema for N3 vehicles based on the limit values in COM(2011) 856 final is shown in Table 9. The average reduction in Lurban for N3 vehicles with rated power values below 150 kW for stage 2 is 3.33 dB (but based on 4 vehicle models only) and for N3 vehicles with rated power values >= 150 kW is 2.90 dB. These reductions show that the requirements of COM(2011) 856 final are much more stringent for N3 vehicles than for the other vehicle categories.

Monitoring database				**necessary Lurban reduction in dB**		**fleet share**	
Category	**Lurban in dB(A)**	**number of vehicles in DB**	**share**	**stage 1**	**stage 2**	**stage 1**	**stage 2**
N3, Pn < 150 kW	77	1	25.0%		-2		25.00%
	78	1	25.0%	-1	-3	25.0%	25.00%
	79	2	50.0%	-2	-4	50.0%	50.00%
	sum	**4**	**100.0%**	**Lurban reduction in dB**			**-3.33**
N3, Pn >= 150 kW	76	1	0.7%				
	77	3	2.0%				
	78	13	8.8%				
	79	15	10.2%		-1		10.2%
	80	30	20.4%		-2		20.4%
	81	43	29.3%	-1	-3	29.3%	29.3%
	82	31	21.1%	-2	-4	21.1%	21.1%
	83	6	4.1%	-3	-5	4.1%	4.1%
	84	5	3.4%	-4	-6	3.4%	3.4%
	sum	**147**	**100.0%**	**Lurban reduction in dB**			**-2.90**

Table 9: Reduction schema for N3 vehicles based on the limit values in COM(2011) 856 final

One reason is the outdated and no longer appropriate rated power classification.. The German proposal contains a rated power classification for N3 vehicles which takes into account that the rated power values have been significantly increased over the last decades:

1. N3 vehicles with rated power <= 250 kW (N3-a, DE), stage 3 limit value 77 dB,
2. N3 vehicles with rated power > 250 kW (N3-b, DE), stage 3 limit value 79 dB.

The reduction schema for N3 vehicles based on the limit values in this proposal is shown in Table 10. The achieved reduction in the average Lurban values are more demanding than for M1 vehicles also in this proposal. But it gives a better, more cost effective basis for further reductions.

A comparison of Lurban frequency distributions for the N3 subclasses between COM(2011) 856 final and the German proposal is shown in Figure 6. The results support the German classification proposal.

Monitoring database				**necessary Lurban reduction in dB**			**fleet share**		
Category	**Lurban in dB(A)**	**number of vehicles**	**share**	**stage 1**	**stage 2**	**stage 3**	**stage 1**	**stage 2**	**stage 3**
N3, Pn <= 250 kW	76	1	1.61%						
	77	5	8.06%						
	78	14	22.58%			-1			22.58%
	79	13	20.97%			-2			20.97%
	80	8	12.90%		-1	-3		12.90%	12.90%
	81	12	19.35%		-2	-4		19.35%	19.35%
	82	9	14.52%	-1	-3	-5	14.52%	14.52%	14.52%
	sum	**62**	**100.0%**		**average Lurban reduction in dB**				**-2.83**
N3, Pn > 250 kW	79	4	4.44%						
	80	22	24.44%			-1			24.44%
	81	31	34.44%			-2			34.44%
	82	22	24.44%		-1	-3		24.44%	24.44%
	83	6	6.67%	-1	-2	-4	6.67%	6.67%	6.67%
	84	5	5.56%	-2	-3	-5	5.56%	5.56%	5.56%
	sum	**90**	**100.0%**		**average Lurban reduction in dB**				**-2.38**

Table 10: Reduction schema for N3 vehicles based on the limit values of the German proposal

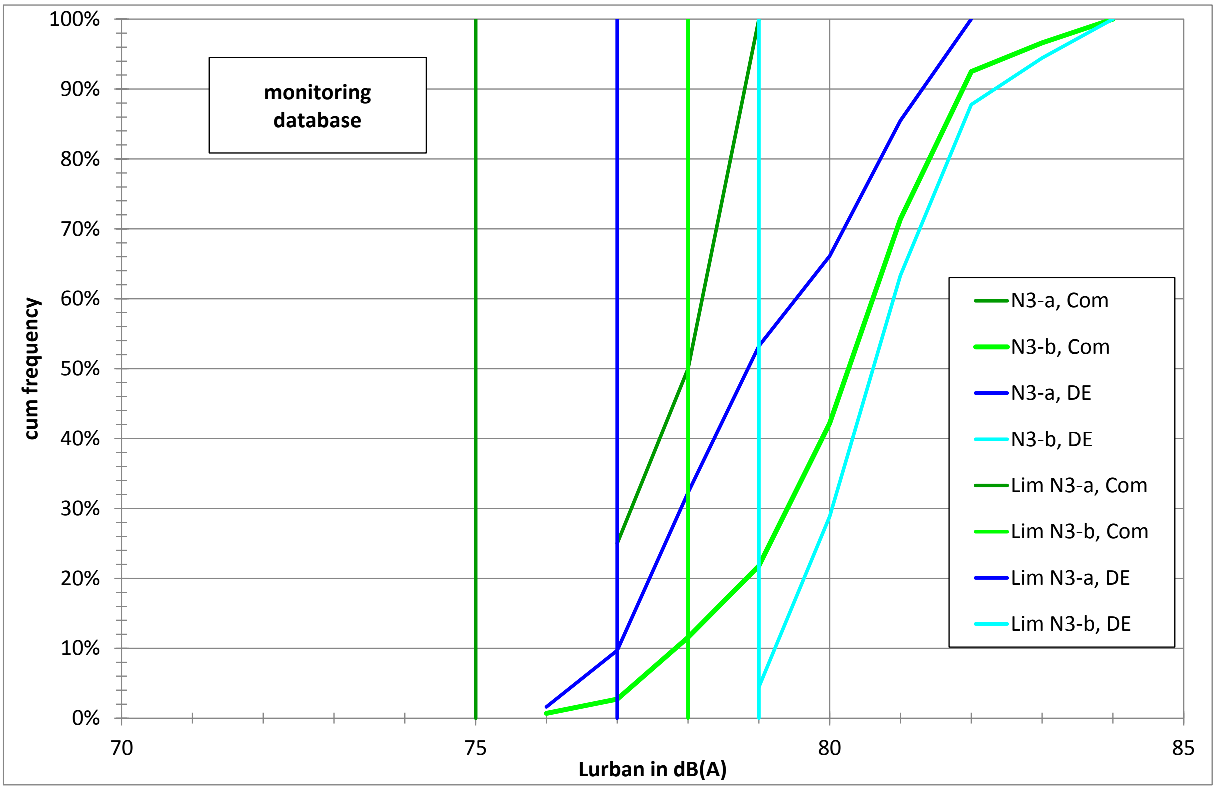

Figure 6: Comparison of Lurban frequency distributions for the N3 subclasses between COM(2011) 856 final and the German proposal

The definition of off road vehicles for N3 vehicles in directive 2007/46/EC is as follows:

Vehicles in category M 3 with a maximum mass exceeding 12 tonnes or in category N 3 are to be considered to be off-road vehicles

- either if the wheels are designed to be driven simultaneously, including vehicles where the drive to one axle can be disengaged,
- or if the following requirements are satisfied:
  - ✓ at least half the wheels are driven,
  - ✓ there is at least one differential locking mechanism or at least one mechanism having a similar effect,
  - ✓ they can climb a 25 % gradient calculated for a solo vehicle,
  - ✓ at least four of the following six requirements are satisfied:
  - ✓ the approach angle must be at least 25 degrees,
  - ✓ the departure angle must be at least 25 degrees,
  - ✓ the ramp angle must be at least 25 degrees,
  - ✓ the ground clearance under the front axle must be at least 250 mm,
  - ✓ the ground clearance between the axles must be at least 300 mm,
  - ✓ the ground clearance under the rear axle must be at least 250 mm.

COM(2011) 856 final requires a 1 dB limit value increase for N3-a vehicles and a 2 dB increase for N3-b vehicles. The German proposal requires the 2 dB increase for all N3 vehicles.

3 Influence of the reduction of the limit values for tyres on the noise impact in real traffic

The limitation of the rolling noise emission of tyres was introduced in the EU by regulation 2001/43/EC. This regulation was amended by regulation 2009/661/EC. The amendments are related to more stringent limit values and an updated tyre classification system (see Table 11).

The limit values of regulation2009/661/EC will become mandatory from 1 November 2012 for new types of tyres and from 1 November 2013 for new types of vehicles. From 1 November 2016 the stricter limit values will apply to all new vehicles and all new tyres.

Vehicle category	tyre class 2001/43/EC	tyre class 2009/661/EC	section width in mm	current limit value in dB(A)	limit 2009/661/EC in dB(A)
M1	C1a	C1a	145	72	70
	C1b	C1a	155 - 165	73	70
	C1c	C1a	175 - 185	74	70
	C1d	C1b	195 - 215	75	71
	C1e	C1c	225 - 245	76	71
	C1e	C1d	255 - 275	76	72
	C1e	C1e	>= 285	76	74
N1	C2, normal	C2, normal		75	72
	C2, Snow	C2, traction		77	73
N2/N3	C3, normal	C3, normal		76	73
	C3, Snow	C3, Snow		78	75

Table 11: Comparison of limit values and tyre classes in regulations 2001/43/EC and 2009/661/EC

In order to estimate the influence of regulation 2009/661/EC on the rolling noise levels in real traffic for M1 vehicles, the following approach was chosen for M1 vehicles. It was assumed that the constant speed test results Lcrs in the monitoring database are dominated by rolling noise. Consequently these values were used in a first (optimistic) scenario as rolling noise levels at 50 km/h. Since the tyre noise results according to 2001/43/EC and 2009/661/EC are related to a reference speed of 80 km/h, a value of 33,5*log(80/50) = 6,84 was added to the Lcrs results in order to get calculated rolling noise levels (L80_calc) according to the tyre regulations.

The slope of 33,5 dB/decade was derived as average of the slopes of the rolling noise measurements, performed during ACEA's first monitoring campaign in 2004 for 58 M1 vehicles. In cases where these values exceeded the current limit values in Table 11, the limit values were used for L80_calc instead, because all tyres used for vehicle type approval tests have to comply with these limits.

The calculation of the resulting rolling noise reduction was then based on a comparison with the future limit values for 2009/661/EC as shown in Table 11 and the frequency distribution of L80_calc in the new tyre width classes combined with a distribution of vehicle production in 2007 into power to mass ratio classes derived from the AAA database (AAA - Association Auxiliaire de l'Automobile). It is further assumed that the tyre manufacturers will only apply reduction measures to those tyre types that do not comply to the future limit values and keep the others unchanged. The same approach was used in [2] for the determination of the reduction potential for the overall noise levels.

A comparable less optimistic and thus more realistic scenario is assuming that the rolling noise contribution to Lcrs is 63% instead of 100%. Consequently L80_calc was calculated as L80_calc (SC2) = Lcrs - 2 dB + 6,84 dB.

These two scenarios determine the range for the reduction potential that can be expected by 2009/661/EC. The results of both scenarios are shown in Table 2. The average rolling noise reduction, whose full effect can be expected from 2018 on as consequence of the tighter rolling noise limit values of regulation 2009/661/EC, will be in the order of 1.5 to 2 dB. This is almost half as much as proposed in [1]. The reduction effects on the rolling noise levels for light and heavy duty vehicles will most probably be in the same order.

necessary rolling noise reduction in dB	**affected fleet share, L80_calc = Lcrs + 6.84 dB**	**affected fleet share, L80_calc = Lcrs - 2 dB + 6.84 dB**
-1	15.1%	17.4%
-2	18.6%	14.1%
-3	17.4%	11.0%
-4	28.5%	5.8%
-5	2.4%	0.0%
	82.0%	48.3%
resulting average rolling noise reduction in dB	**-2.6**	**-1.3**

Table 12: Effect of the tighter limit values of 2009/661/EC on the rolling noise levels of M1 vehicles

In an additional step an average rolling noise reduction of 1,5 dB was then implemented in the TRANECAM model for all vehicle categories and the effects on the Lden values were calculated for different road categories using typical traffic volume and fleet share values as shown in Table 13. A short description of the model is given in Annex B, Description of the TRANECAM model.

Stone mastic asphalt 0/11 was chosen as the road surface, since this surface has become a representative surface in many European regions in the meantime and it was assumed that the reduction of the rolling noise levels on this surface will be the same as on the ISO test track surface. The results of these calculations for the averages are shown in Table 4. The average reduction of L_den for urban streets is 1.1 dB(A) and a bit more 1.3 dB(A)) for rural roads and motorways.

Road category	no of lanes	ADT	percent LDV	percent HDV
residential streets, speed limit 30 km/h	2	250	3.3%	1.0%
residential streets, speed limit 50 km/h	2	500	3.3%	1.0%
urban, main streets, speed limit 50 km/h, right of way	2	2000	4.6%	3.0%
urban, city centre	2	20000	4.4%	4.0%
urban, main streets, speed limit 50 km/h, traffic lights	4	40000	4.5%	5.0%
urban, main streets, speed limit 60/70 km/h	4	40000	4.4%	5.0%
rural, speed limit 70 km/h	2	15000	4.3%	8.0%
rural, speed limit 80/90 km/h	2	15000	4.2%	8.0%
rural, speed limit 100 km/h	2	15000	4.0%	10.0%
motorway, speed limit 80 km/h	4	40000	4.2%	20.0%
motorway, speed limit 100 km/h	4	40000	4.2%	20.0%
motorway, speed limit 120 km/h	4	40000	4.2%	20.0%
motorway, without speed limit	4	40000	4.2%	20.0%

Table 13. Typical traffic load and fleet composition values for different road categories

Road category	Reduction in L_den due to rolling noise reduction in dB(A)
Urban, residential streets, speed limit 30	-0.8
Urban, residential streets, speed limit 50	-1.1
Urban main streets, right of way	-1.3
Urban, city centre	-0.9
Urban main streets, traffic lights, speed limit 50	-1.0
Urban main streets, speed limit > 50	-1.3
Rural, irregular curvatures	-1.2
Rural, primary, regular curvatures	-1.3
Rural, primary, straight	-1.3
Motorway, speed limit 80	-1.3
Motorway, speed limit 100	-1.3
Motorway, speed limit 120	-1.3
Motorway, no speed limit	-1.3

Table 14: Reduction potential of 2009/661/EC on L_den values in real traffic

4 Estimates of the effects on the noise impact in real traffic

4.1 Calculation of the effects on the reduction of the overall Lden in real traffic

4.1.1 COM(2011) 856 final

A similar approach as described in the previous chapter for the determination of the effects of the tyre noise emission limitation was used for the determination of the effects of COM(2011) 856 final on the overall noise impact in real traffic. The calculation is based on the following side conditions/assumptions:

- It is assumed that the average Lurban value reductions as described in chapter 2 will be fully effective for the noise emissions in real traffic. With the experiences gained so far over the last 3 decades, this is a very optimistic assumption. **A tolerance of at least 0.5 dB should be subtracted from the results.**

  The Lurban reduction will be used as reduction of the propulsion noise levels for all vehicle categories other than M1. In addition to that a rolling noise level reduction of

1.5 dB will be used in order to consider the effects of the tyre noise level limitation as described in the previous chapter for these vehicle categories.

For M1 vehicles the Lurban value reduction will be used for the propulsion noise reduction as well as for the rolling noise reduction because the resulting values are higher than 1.5 dB and because it will be most cost effective, if the emissions of both sources are reduced simultaneously.

- M2 and M3 vehicles and off road vehicles of categories other than M1 are not considered because of their low fleet shares.
- The TRANECAM model categorization for N2/N3 vehicles contains rigid trucks and trailer trucks. As a consequence the N2/N3 vehicle classes need to be distributed to these classes.

  It was assumed that rigid trucks consist of 1/3 of N2 vehicles with rated power up to 150 kW, 1/3 of N2 vehicles with rated power above 150 kW and 1/3 of N3 vehicles with rated power up to 250 kW.

  It was further assumed that the trailer and semitrailer truck category consists of N3 vehicles with rated power above 250 kW only.
- Stone mastic asphalt 0/11 (SMA 0/11) was chosen as road surface, since this surface has become a representative surface in many European regions in the meantime and it was assumed that the reduction of the rolling noise levels on this surface will be the same as on the ISO test track surface.

This results in the following reduction scenario for COM(2011) 856 final:

- M1 vehicles: -2.10 dB for propulsion noise levels and -1.5 dB for rolling noise levels,
- N1 vehicles: -1.9 dB for propulsion noise and -1.5 dB for rolling noise levels,
- Rigid trucks: -2.47 dB for propulsion noise levels as average of N2-a, N2-b and N3 vehicles up to 250 kW rated power and -1.5 dB for rolling noise levels,
- Trailer trucks: -3.38 dB for propulsion noise levels for N3 vehicles with rated power values above 250 kW and -1.5 dB for rolling noise levels.

The results of the corresponding calculations are shown in Table 15. The differences between the different road categories range from 1.6 dB to 1.8 dB.

Table 16 shows the contributions of the different vehicle categories on Lden. The most important road categories are highlighted in yellow. As expected, the contributions of M1 vehicles are most important (between 85% and 95% for urban streets and rural roads, between 70% to 80% for motorways), followed by rigid trucks and trailer trucks with similar contributions (between 2% and 6%) for urban streets. On rural roads and motorways the trailer trucks are more important than the rigid trucks due to the fleet share. On motorways the contribution of trailer trucks is about 7 times higher than the contribution of rigid trucks. N1 vehicles have the lowest contribution to Lden.

Table 17 shows the rolling noise contribution to the overall noise emission within the different vehicle categories. For M1 vehicles the rolling noise contribution is between 80% and 90% for the most important road categories. For the other vehicle categories the rolling noise influence is much lower in urban streets. But for roads with speed limits above 50 km/h the rolling noise contribution for trucks is also dominating (in the order of 66% to 86%).

Road category	Final reduction in L_den due to COM (2011) 856 final and 2009/661/EC in dB(A)
Urban, residential streets, speed limit 30	-1.78
Urban, residential streets, speed limit 50	-1.67
Urban main streets, right of way	-1.61
Urban, city centre	-1.80
Urban main streets, traffic lights, speed limit 50	-1.76
Urban main streets, speed limit > 50	-1.61
Rural, irregular curvatures	-1.66
Rural, primary, regular curvatures	-1.61
Rural, primary, straight	-1.62
Motorway, speed limit 80	-1.66
Motorway, speed limit 100	-1.64
Motorway, speed limit 120	-1.64
Motorway, no speed limit	-1.63

Table 15: Reduction potential of COM(2011) 856 final and 2009/661/EC on L_den values in real traffic

	Contribution to Lden				
Road category	M1	N1	rigid trucks	trailer trucks	sum
Urban, residential streets, speed limit 30	92.9%	3.4%	1.7%	1.9%	100.0%
Urban, residential streets, speed limit 50	95.5%	2.2%	1.1%	1.3%	100.0%
Urban main streets, right of way	94.2%	1.8%	1.8%	2.2%	100.0%
Urban, city centre	85.9%	3.5%	5.0%	5.6%	100.0%
Urban main streets, traffic lights, speed limit 50	86.4%	2.8%	5.0%	5.8%	100.0%
Urban main streets, speed limit > 50	92.7%	1.6%	2.6%	3.1%	100.0%
Rural, irregular curvatures	87.2%	1.5%	3.6%	7.7%	100.0%
Rural, primary, regular curvatures	89.2%	1.4%	2.9%	6.5%	100.0%
Rural, primary, straight	88.9%	1.2%	3.1%	6.8%	100.0%
Motorway, speed limit 80	69.4%	1.3%	3.4%	25.9%	100.0%
Motorway, speed limit 100	74.6%	1.4%	2.8%	21.3%	100.0%
Motorway, speed limit 120	78.1%	1.4%	2.4%	18.2%	100.0%
Motorway, no speed limit	80.7%	1.4%	2.1%	15.9%	100.0%

Table 16: Contribution of the different vehicle categories to Lden

	Rolling noise share on Lden			
Road category	M1	N1	rigid trucks	trailer trucks
Urban, residential streets, speed limit 30	66.5%	12.1%	9.9%	11.6%
Urban, residential streets, speed limit 50	79.7%	24.8%	21.9%	25.4%
Urban main streets, right of way	90.2%	55.3%	48.6%	56.0%
Urban, city centre	75.6%	20.6%	17.6%	20.5%
Urban main streets, traffic lights, speed limit 50	81.5%	29.3%	24.6%	28.5%
Urban main streets, speed limit > 50	91.1%	61.9%	56.7%	64.7%
Rural, irregular curvatures	90.5%	54.9%	52.3%	59.4%
Rural, primary, regular curvatures	91.9%	69.4%	68.8%	77.3%
Rural, primary, straight	90.9%	70.6%	66.2%	74.9%
Motorway, speed limit 80	91.7%	76.0%	75.6%	83.9%
Motorway, speed limit 100	88.6%	78.0%	78.2%	86.8%
Motorway, speed limit 120	88.3%	78.8%	78.2%	86.8%
Motorway, no speed limit	89.4%	79.8%	78.2%	86.8%

Table 17: Rolling noise share on Lden within the different vehicle categories

4.1.2 German proposal

The entry into force dates of the German proposal are significantly later than those of COM(2011) 856 final. The first step is foreseen 2 years after publication, but this step consists of equivalent limit values only and thus will have no effect on Lden. The further two steps have vehicle category dependent time schemes step two 4 to 6 years after step one and step three 4 to 6 years after step two.

The corresponding reduction scenario for the German proposal is as follows:

- M1 vehicles: -2.01 dB for propulsion noise levels and -1.5 dB for rolling noise levels,
- N1 vehicles: -145 dB for propulsion noise and -1.5 dB for rolling noise levels,
- Rigid trucks: -2.52 dB for propulsion noise levels as average of N2-a (-2.75 dB), DE, N2-b (-1.85 dB), DE and N3 vehicles up to 250 kW rated power (-2.83 dB)) and -1.5 dB for rolling noise levels,
- Trailer trucks: -2.38 dB for propulsion noise levels and -1.5 dB for rolling noise levels.

The results of the corresponding calculations are shown in Table 18. The differences between the different road categories are only 0.1 dB. The overall reduction in real traffic is 1.7 dB(A) and thus almost the same as for COM(2011) 856 final.

Table 19 shows the contributions of the different vehicle categories on Lden. The most important road categories are highlighted in yellow. The results are quite similar to the results for COM(2011) 856 final (see Table 16)

The same accounts for the rolling noise contribution to the overall noise emission within the different vehicle categories (Table 20).

The conclusion with respect to the target of a 3 dB(A) noise impact reduction in real traffic is obvious: Further limit value reductions will be necessary for COM(2011) 856 final as well as for the German proposal.

Road category	Final reduction in L_den due to German proposal and 2009/661/EC in dB(A)
Urban, residential streets, speed limit 30	-1.72
Urban, residential streets, speed limit 50	-1.64
Urban main streets, right of way	-1.59
Urban, city centre	-1.72
Urban main streets, traffic lights, speed limit 50	-1.69
Urban main streets, speed limit > 50	-1.59
Rural, irregular curvatures	-1.62
Rural, primary, regular curvatures	-1.58
Rural, primary, straight	-1.59
Motorway, speed limit 80	-1.61
Motorway, speed limit 100	-1.60
Motorway, speed limit 120	-1.60
Motorway, no speed limit	-1.60

Table 18: Reduction potential of the German proposal and 2009/661/EC on L_den values in real traffic

	Contribution to Lden				
Road category	M1	N1	rigid trucks	trailer trucks	sum
Urban, residential streets, speed limit 30	92.3%	3.7%	1.7%	2.3%	100.0%
Urban, residential streets, speed limit 50	95.1%	2.4%	1.1%	1.5%	100.0%
Urban main streets, right of way	93.9%	1.9%	1.8%	2.4%	100.0%
Urban, city centre	84.8%	3.7%	4.9%	6.6%	100.0%
Urban main streets, traffic lights, speed limit 50	85.4%	2.9%	4.9%	6.7%	100.0%
Urban main streets, speed limit > 50	92.4%	1.6%	2.6%	3.4%	100.0%
Rural, irregular curvatures	86.5%	1.6%	3.6%	8.4%	100.0%
Rural, primary, regular curvatures	88.8%	1.4%	2.9%	6.9%	100.0%
Rural, primary, straight	88.5%	1.3%	3.1%	7.2%	100.0%
Motorway, speed limit 80	68.7%	1.4%	3.3%	26.6%	100.0%
Motorway, speed limit 100	74.1%	1.4%	2.7%	21.8%	100.0%
Motorway, speed limit 120	77.6%	1.4%	2.3%	18.6%	100.0%
Motorway, no speed limit	80.2%	1.4%	2.1%	16.3%	100.0%

Table 19: Contribution of the different vehicle categories to Lden

	Rolling noise share on Lden			
Road category	M1	N1	rigid trucks	trailer trucks
Urban, residential streets, speed limit 30	66.0%	11.1%	10.0%	9.5%
Urban, residential streets, speed limit 50	79.4%	23.0%	22.1%	21.3%
Urban main streets, right of way	90.0%	52.8%	48.9%	50.3%
Urban, city centre	75.2%	18.9%	17.8%	17.0%
Urban main streets, traffic lights, speed limit 50	81.2%	27.2%	24.8%	24.0%
Urban main streets, speed limit > 50	90.9%	59.4%	56.9%	59.3%
Rural, irregular curvatures	90.3%	52.3%	52.6%	53.8%
Rural, primary, regular curvatures	91.8%	67.2%	69.1%	73.0%
Rural, primary, straight	90.8%	68.4%	66.5%	70.3%
Motorway, speed limit 80	91.5%	74.1%	75.8%	80.6%
Motorway, speed limit 100	88.4%	76.1%	78.4%	84.0%
Motorway, speed limit 120	88.1%	77.0%	78.4%	84.0%
Motorway, no speed limit	89.2%	78.1%	78.4%	84.0%

Table 20: Rolling noise share on Lden within the different vehicle categories

4.2 Proposal for additional limit reduction scenarios

4.2.1 Scenario 1, Further reduction of tyre noise limits of 2 dB for C1 tyres and 1 dB for C2/C3 tyres

Since the Lden values in real traffic are predominantly influenced by M1 vehicles and rolling noise is the dominant noise source for this vehicle category, a first scenario was calculated based on a further limit value reduction step for tyres, 2 dB for C1 and 1 dB for C2/C3 tyres without any reduction steps for Lurban. Calculations corresponding to those described in chapter 3 lead to a rolling noise reduction in real traffic of 3.1 dB for M1 vehicles and 2.15 dB for the other categories.

The resulting reduction for Lden in real traffic is shown in Table 21. The Lden reduction ranges between 1.5 dB to 2.5 dB, depending on the speed limit or the average speeds of the different road categories. **For the most important road categories this scenario is more effective than COM(2011) 856 final or the German proposal.**

Table 22 shows the contributions of the different vehicle categories on Lden. The most important road categories are highlighted in yellow. As expected, the importance of vehicle categories other than M1 is a bit higher than for the results of COM(2011) 856 final or the German proposal.

Table 23 shows the rolling noise contribution to the overall noise emission within the different vehicle categories. Since the rolling noise levels were reduced, the share on Lden is decreased accordingly.

The entry into force date for the additional step was assumed to be 2021.

Road category	Final reduction in L_den for scenario 1 in dB(A)
Urban, residential streets, speed limit 30	-1.54
Urban, residential streets, speed limit 50	-2.05
Urban main streets, right of way	-2.47
Urban, city centre	-1.67
Urban main streets, traffic lights, speed limit 50	-1.89
Urban main streets, speed limit > 50	-2.49
Rural, irregular curvatures	-2.33
Rural, primary, regular curvatures	-2.50
Rural, primary, straight	-2.45
Motorway, speed limit 80	-2.28
Motorway, speed limit 100	-2.28
Motorway, speed limit 120	-2.31
Motorway, no speed limit	-2.37

Table 21: Effect of a further limit value reduction step for tyres, 2 dB for C1 and 1 dB for C2/C3 tyres

Road category	M1	N1	rigid trucks	trailer trucks	sum
Urban, residential streets, speed limit 30	88.8%	4.8%	2.7%	3.7%	100.0%
Urban, residential streets, speed limit 50	92.3%	3.3%	1.9%	2.5%	100.0%
Urban main streets, right of way	90.7%	2.6%	2.9%	3.8%	100.0%
Urban, city centre	77.0%	4.8%	7.8%	10.4%	100.0%
Urban main streets, traffic lights, speed limit 50	77.5%	3.8%	8.0%	10.7%	100.0%
Urban main streets, speed limit > 50	88.8%	2.2%	4.0%	5.0%	100.0%
Rural, irregular curvatures	80.0%	2.1%	5.4%	12.5%	100.0%
Rural, primary, regular curvatures	84.8%	1.8%	4.1%	9.3%	100.0%
Rural, primary, straight	84.3%	1.6%	4.4%	9.7%	100.0%
Motorway, speed limit 80	62.2%	1.6%	4.2%	32.0%	100.0%
Motorway, speed limit 100	69.5%	1.6%	3.4%	25.5%	100.0%
Motorway, speed limit 120	73.5%	1.6%	2.9%	21.9%	100.0%
Motorway, no speed limit	76.3%	1.6%	2.6%	19.5%	100.0%

Table 22: Contribution of the different vehicle categories to Lden for scenario 1

	Rolling noise share on Lden			
Road category	M1	N1	rigid trucks	trailer trucks
Urban, residential streets, speed limit 30	46.1%	7.1%	5.1%	4.9%
Urban, residential streets, speed limit 50	62.9%	15.5%	12.0%	11.9%
Urban main streets, right of way	79.8%	40.8%	31.6%	33.5%
Urban, city centre	57.2%	12.6%	9.4%	9.3%
Urban main streets, traffic lights, speed limit 50	65.6%	18.7%	13.7%	13.6%
Urban main streets, speed limit > 50	81.5%	47.4%	38.9%	42.0%
Rural, irregular curvatures	80.5%	40.4%	34.9%	36.7%
Rural, primary, regular curvatures	83.1%	55.8%	51.9%	57.3%
Rural, primary, straight	81.2%	57.1%	48.9%	54.1%
Motorway, speed limit 80	82.6%	63.8%	60.2%	67.4%
Motorway, speed limit 100	77.1%	66.3%	63.6%	72.3%
Motorway, speed limit 120	76.5%	67.4%	63.6%	72.3%
Motorway, no speed limit	78.4%	68.7%	63.6%	72.3%

Table 23: Rolling noise share on Lden within the different vehicle categories for scenario 1

4.2.2 Scenario 2, a 3rd reduction step to a combination of COM(2011) 856 final and the German proposal for vehicle category classification

COM(2011) 856 final as well as the German limit value proposal lead to the same reduction of noise impact in real traffic. Since it could be shown that the vehicle category schema of the German proposal reflects much better the state of the art, this categorisation will be used as basis for the determination of an additional limit value reduction step intended to increase the reduction of noise impact in real traffic.

A corresponding proposal determining scenario 2 is shown in Table 24. It must be mentioned that this scenario would require tyres for M1 vehicles that would meet a further reduction of the tyre limits for C1 tyres by 1 dB and that the introduction year is tentative.

The resulting reduction for Lden in real traffic is shown in Table 25. **This scenario leads to Lden reductions between 1.7 dB and 2.0 dB and thus is better balanced between the road categories but on average less effective than scenario 1.**

Table 26 shows the contributions of the different vehicle categories on Lden. The results are similar as the results of COM(2011) 856 final or the German proposal.

The same accounts for Table 27 in which the rolling noise contribution to the overall noise emission within the different vehicle categories are shown.

Vehicle category	subclass	Limit value state of the art in dB(A)	stage 1, 2 years after publication	stage 2, 6 years after publication	reduction of average Lurban in dB(A)	stage 3, 10 years after publication	final limit value reduction in dB	reduction of average Lurban in dB(A)
M1	PMR ≤ 120 kW/t 1)	**72**	**70**	**68**	-1.96	**67**	-5	-2.89 2)
	120 < PMR ≤ 160 kW/t 1)	**73**	**71**	**70**	-1.7	**69**	-4	-2.48 2)
	PMR > 160 kW/t	**75**	**74**	**73**	-1.97	**71**	-4	-2.87
M2	GVM ≤ 2.5 to 1)	**72**	**70**	**68**		**67**	-5	
	2.5 to < GVM ≤ 3.5 to 1)	**74**	**72**	**71**	-2.3	**70**	-4	-3.18
	GVM > 3.5 to GVM 1)	**75**	**73**	**71**	-2.52	**71**	-4	-2.52
M3	Pn ≤ 180 kW 1)	**76**	**74**	**73**	-1.25	**72**	-4	-2.11
	180 < Pn ≤ 250 kW 2)	**78**	**76**	**75**	-2.47	**75**	-3	-2.47
	Pn > 250 kW 2)	**80**	**78**	**76**	-2.72	**76**	-4	-2.72
N1	GVM ≤ 2.5 to 1)	**72**	**70**	**68**	-1.47	**67**	-5	-2.36
	2.5 to < GVM ≤ 3.5 to 1)	**74**	**72**	**71**	-1.45	**70**	-4	-2.39
N2	Pn ≤ 150 kW 1)	**76**	**75**	**72**	-2.75	**71**	-5	-3.56
	Pn > 150 kW 1)	**78**	**77**	**75**	-1.85	**74**	-4	-2.85
N3	Pn ≤ 250 kW 2)	**81**	**79**	**77**	-2.83	**76**	-5	-3.82
	Pn > 250 kW 2)	**82**	**81**	**79**	-2.38	**78**	-4	-3.38
1) +1 dB for off road vehicles								
2) +2 dB for off road vehicles								
off road vehicles as defined in directive 2007/46/EC, for M1 vehicles with the								
additional requirement of a wading depth >= 500 mm								

Table 24: Proposal for an additional limit value reduction step aimed at an increase of the effect on noise impact in real traffic

Road category	Final reduction in L_den for scenario 2 in dB(A)
Urban, residential streets, speed limit 30	-2.03
Urban, residential streets, speed limit 50	-1.83
Urban main streets, right of way	-1.69
Urban, city centre	-2.01
Urban main streets, traffic lights, speed limit 50	-1.92
Urban main streets, speed limit > 50	-1.68
Rural, irregular curvatures	-1.74
Rural, primary, regular curvatures	-1.67
Rural, primary, straight	-1.69
Motorway, speed limit 80	-1.71
Motorway, speed limit 100	-1.71
Motorway, speed limit 120	-1.71
Motorway, no speed limit	-1.69

Table 25: Effect of a 3rd reduction step to a combination of COM(2011) 856 final and the German proposal for vehicle category classification

	Contribution to Lden				
Road category	M1	N1	rigid trucks	trailer trucks	sum
Urban, residential streets, speed limit 30	93.2%	3.3%	1.5%	2.1%	100.0%
Urban, residential streets, speed limit 50	95.6%	2.1%	1.0%	1.3%	100.0%
Urban main streets, right of way	94.4%	1.8%	1.7%	2.2%	100.0%
Urban, city centre	86.4%	3.3%	4.4%	5.9%	100.0%
Urban main streets, traffic lights, speed limit 50	87.0%	2.6%	4.4%	6.0%	100.0%
Urban main streets, speed limit > 50	92.9%	1.5%	2.4%	3.2%	100.0%
Rural, irregular curvatures	87.4%	1.5%	3.3%	7.8%	100.0%
Rural, primary, regular curvatures	89.2%	1.3%	2.8%	6.6%	100.0%
Rural, primary, straight	89.0%	1.2%	2.9%	6.9%	100.0%
Motorway, speed limit 80	69.2%	1.3%	3.3%	26.2%	100.0%
Motorway, speed limit 100	74.4%	1.4%	2.7%	21.6%	100.0%
Motorway, speed limit 120	77.8%	1.4%	2.3%	18.5%	100.0%
Motorway, no speed limit	80.5%	1.3%	2.0%	16.2%	100.0%

Table 26: Contribution of the different vehicle categories to Lden for scenario 2

Road category	Rolling noise share on Lden			
	M1	N1	rigid trucks	trailer trucks
Urban, residential streets, speed limit 30	70.3%	13.4%	12.2%	11.6%
Urban, residential streets, speed limit 50	82.5%	27.0%	26.1%	25.4%
Urban main streets, right of way	91.6%	58.0%	54.4%	56.0%
Urban, city centre	78.8%	22.4%	21.2%	20.5%
Urban main streets, traffic lights, speed limit 50	84.1%	31.7%	29.2%	28.5%
Urban main streets, speed limit > 50	92.4%	64.4%	62.3%	64.7%
Rural, irregular curvatures	91.9%	57.6%	58.1%	59.4%
Rural, primary, regular curvatures	93.2%	71.7%	73.6%	77.3%
Rural, primary, straight	92.3%	72.8%	71.2%	74.9%
Motorway, speed limit 80	92.9%	78.0%	79.7%	83.9%
Motorway, speed limit 100	90.3%	79.8%	81.9%	86.8%
Motorway, speed limit 120	90.0%	80.6%	81.9%	86.8%
Motorway, no speed limit	91.0%	81.5%	81.9%	86.8%

Table 27: Rolling noise share on Lden within the different vehicle categories for scenario 2

4.2.3 Scenario 3, combination of scenario 1 and scenario 2

The results of scenarios 1 and 2 suggest a combination as 3rd scenario. The results are shown in the following tables. The Lden reduction varies between 2.9 dB and 3.1 dB (see Table 28) and thus is pretty close to the required target. The contributions of the different categories to Lden are shown in Table 29, the rolling noise shares within the categories in Table 30.

Road category	Final reduction in L_den for scenario 3 in dB(A)
Urban, residential streets, speed limit 30	-3.02
Urban, residential streets, speed limit 50	-3.05
Urban main streets, right of way	-3.06
Urban, city centre	-3.05
Urban main streets, traffic lights, speed limit 50	-3.06
Urban main streets, speed limit > 50	-3.05
Rural, irregular curvatures	-3.04
Rural, primary, regular curvatures	-3.02
Rural, primary, straight	-3.02
Motorway, speed limit 80	-2.87
Motorway, speed limit 100	-2.89
Motorway, speed limit 120	-2.92
Motorway, no speed limit	-2.94

Table 28: Effect of a combination of scenarios 1 and 2

	Contribution to Lden				
Road category	M1	N1	rigid trucks	trailer trucks	sum
Urban, residential streets, speed limit 30	91.6%	4.1%	1.8%	2.5%	100.0%
Urban, residential streets, speed limit 50	94.4%	2.7%	1.2%	1.7%	100.0%
Urban main streets, right of way	92.9%	2.2%	2.1%	2.8%	100.0%
Urban, city centre	83.2%	4.1%	5.4%	7.3%	100.0%
Urban main streets, traffic lights, speed limit 50	83.8%	3.3%	5.5%	7.5%	100.0%
Urban main streets, speed limit > 50	91.1%	1.9%	3.0%	3.9%	100.0%
Rural, irregular curvatures	84.4%	1.9%	4.1%	9.6%	100.0%
Rural, primary, regular curvatures	86.8%	1.7%	3.4%	8.1%	100.0%
Rural, primary, straight	86.6%	1.5%	3.6%	8.4%	100.0%
Motorway, speed limit 80	64.5%	1.5%	3.8%	30.2%	100.0%
Motorway, speed limit 100	70.4%	1.6%	3.1%	24.9%	100.0%
Motorway, speed limit 120	74.2%	1.6%	2.7%	21.4%	100.0%
Motorway, no speed limit	77.1%	1.6%	2.4%	18.9%	100.0%

Table 29: Contribution of the different vehicle categories to Lden for scenario 3

	Rolling noise share on Lden			
Road category	M1	N1	rigid trucks	trailer trucks
Urban, residential streets, speed limit 30	62.1%	11.7%	10.7%	10.2%
Urban, residential streets, speed limit 50	76.5%	24.1%	23.3%	22.7%
Urban main streets, right of way	88.4%	54.4%	50.7%	52.3%
Urban, city centre	72.0%	19.9%	18.8%	18.2%
Urban main streets, traffic lights, speed limit 50	78.5%	28.5%	26.2%	25.5%
Urban main streets, speed limit > 50	89.4%	60.9%	58.7%	61.2%
Rural, irregular curvatures	88.8%	53.9%	54.4%	55.8%
Rural, primary, regular curvatures	90.4%	68.6%	70.6%	74.5%
Rural, primary, straight	89.2%	69.7%	68.0%	72.0%
Motorway, speed limit 80	90.1%	75.3%	77.1%	81.8%
Motorway, speed limit 100	86.6%	77.3%	79.5%	85.0%
Motorway, speed limit 120	86.2%	78.1%	79.5%	85.0%
Motorway, no speed limit	87.5%	79.2%	79.5%	85.0%

Table 30: Rolling noise share on Lden within the different vehicle categories for scenario 3

4.2.4 Scenario 4, a 3rd reduction step added to a combination of COM(2011) 856 final and the German proposal for vehicle category classification, restricted to M1 and N1 vehicles only

In order to further assess the influence of the different vehicle categories on Lden, the following 4th scenario was calculated: A 3rd reduction stage was foreseen as described in Table 24, but only for M1 and N1 vehicles.

The effects on Lden are shown in Table 32. The contributions of the different categories to Lden are shown in Table 33, the rolling noise shares within the categories in Table 34. This scenario is almost as effective as scenario 2. The average difference is less than 0.1 dB.

The contributions of the different categories to Lden are shown in Table 33 the rolling noise shares within the categories in Table 34.

Vehicle category	subclass	Limit value state of the art in dB(A)	stage 1, 2 years after publication	stage 2, 6 years after publication	reduction of average Lurban in dB(A)	stage 3, 10 years after publication	final limit value reduction in dB	reduction of average Lurban in dB(A)
M1	PMR ≤ 120 kW/t 1)	**72**	**70**	**68**	-1.96	**67**	-5	-2.89 2)
	120 < PMR ≤ 160 kW/t 1)	**73**	**71**	**70**	-1.7	**69**	-4	-2.48 2)
	PMR > 160 kW/t	**75**	**74**	**73**	-1.97	**71**	-4	-2.87
M2	GVM ≤ 2.5 to 1)	**72**	**70**	**68**		**67**	-5	
	2.5 to < GVM ≤ 3.5 to 1)	**74**	**72**	**71**	-2.3	**70**	-4	-3.18
	GVM > 3.5 to GVM 1)	**75**	**73**	**71**	-2.52			
M3	Pn ≤ 180 kW 1)	**76**	**74**	**73**	-1.25	**72**	-4	-2.11
	180 < Pn ≤ 250 kW 2)	**78**	**76**	**75**	-2.47			
	Pn > 250 kW 2)	**80**	**78**	**76**	-2.72			
N1	GVM ≤ 2.5 to 1)	**72**	**70**	**68**	-1.47	**67**	-5	-2.36
	2.5 to < GVM ≤ 3.5 to 1)	**74**	**72**	**71**	-1.45	**70**	-4	-2.39
N2	Pn ≤ 150 kW 1)	**76**	**75**	**72**	-2.75			
	Pn > 150 kW 1)	**78**	**77**	**75**	-1.85			
N3	Pn ≤ 250 kW 2)	**81**	**79**	**77**	-2.83			
	Pn > 250 kW 2)	**82**	**81**	**79**	-2.38			

1) +1 dB for off road vehicles

2) +2 dB for off road vehicles

off road vehicles as defined in directive 2007/46/EC, for M1 vehicles with the additional requirement of a wading depth >= 500 mm

Table 31: Proposal for an additional limit value reduction step mainly restricted to M1 and N1 vehicles

Road category	Final reduction in L_den for scenario 4 in dB(A)
Urban, residential streets, speed limit 30	-2.00
Urban, residential streets, speed limit 50	-1.81
Urban main streets, right of way	-1.67
Urban, city centre	-1.92
Urban main streets, traffic lights, speed limit 50	-1.84
Urban main streets, speed limit > 50	-1.66
Rural, irregular curvatures	-1.69
Rural, primary, regular curvatures	-1.65
Rural, primary, straight	-1.66
Motorway, speed limit 80	-1.66
Motorway, speed limit 100	-1.68
Motorway, speed limit 120	-1.68
Motorway, no speed limit	-1.67

Table 32: Effect of scenario 4 on Lden

Road category	Contribution to Lden				sum
	M1	N1	rigid trucks	trailer trucks	
Urban, residential streets, speed limit 30	92.4%	3.3%	1.8%	2.5%	100.0%
Urban, residential streets, speed limit 50	95.2%	2.1%	1.1%	1.6%	100.0%
Urban main streets, right of way	94.0%	1.8%	1.8%	2.4%	100.0%
Urban, city centre	84.7%	3.3%	5.1%	7.0%	100.0%
Urban main streets, traffic lights, speed limit 50	85.4%	2.6%	5.1%	6.9%	100.0%
Urban main streets, speed limit > 50	92.4%	1.5%	2.6%	3.4%	100.0%
Rural, irregular curvatures	86.4%	1.5%	3.6%	8.5%	100.0%
Rural, primary, regular curvatures	88.7%	1.3%	3.0%	7.0%	100.0%
Rural, primary, straight	88.4%	1.2%	3.1%	7.3%	100.0%
Motorway, speed limit 80	68.4%	1.3%	3.4%	26.9%	100.0%
Motorway, speed limit 100	73.7%	1.3%	2.8%	22.1%	100.0%
Motorway, speed limit 120	77.3%	1.4%	2.4%	19.0%	100.0%
Motorway, no speed limit	80.0%	1.3%	2.1%	16.6%	100.0%

Table 33: Contribution of the different vehicle categories to Lden for scenario 4

Road category	Rolling noise share on Lden			
	M1	N1	rigid trucks	trailer trucks
Urban, residential streets, speed limit 30	70.3%	13.4%	10.0%	9.5%
Urban, residential streets, speed limit 50	82.5%	27.0%	22.1%	21.3%
Urban main streets, right of way	91.6%	58.0%	48.9%	50.3%
Urban, city centre	78.8%	22.4%	17.8%	17.0%
Urban main streets, traffic lights, speed limit 50	84.1%	31.7%	24.8%	24.0%
Urban main streets, speed limit > 50	92.4%	64.4%	56.9%	59.3%
Rural, irregular curvatures	91.9%	57.6%	52.6%	53.8%
Rural, primary, regular curvatures	93.2%	71.7%	69.1%	73.0%
Rural, primary, straight	92.3%	72.8%	66.5%	70.3%
Motorway, speed limit 80	92.9%	78.0%	75.8%	80.6%
Motorway, speed limit 100	90.3%	79.8%	78.4%	84.0%
Motorway, speed limit 120	90.0%	80.6%	78.4%	84.0%
Motorway, no speed limit	91.0%	81.5%	78.4%	84.0%

Table 34: Rolling noise share on Lden within the different vehicle categories for scenario 4

4.2.5 Scenario 5, as scenario 4 but combined with a further limit value reduction of 2 dB for C1 tyres and 1 dB for C2/C3 tyres

As 5th scenario scenario 4 was combined with a further limit reduction of 2 dB for C1 tyres and 1 dB for C2 and C3 tyres. The effects on Lden are shown in Table 35. The contributions of the different categories to Lden are shown in Table 33, the rolling noise shares within the categories in Table 34. This scenario is almost as effective as scenario 3. The average difference for the most important road categories is 0.12 dB.

The contributions of the different categories to Lden are shown in Table 36 the rolling noise shares within the categories in Table 37.

Road category	Final reduction in L_den for scenario 5 in dB(A)
Urban, residential streets, speed limit 30	-2.92
Urban, residential streets, speed limit 50	-2.95
Urban main streets, right of way	-2.95
Urban, city centre	-2.88
Urban main streets, traffic lights, speed limit 50	-2.89
Urban main streets, speed limit > 50	-2.94
Rural, irregular curvatures	-2.89
Rural, primary, regular curvatures	-2.91
Rural, primary, straight	-2.91
Motorway, speed limit 80	-2.74
Motorway, speed limit 100	-2.78
Motorway, speed limit 120	-2.81
Motorway, no speed limit	-2.83

Table 35: Effect of scenario 5 on Lden

Road category	Contribution to Lden				sum
	M1	N1	rigid trucks	trailer trucks	
Urban, residential streets, speed limit 30	90.8%	4.0%	2.2%	3.1%	100.0%
Urban, residential streets, speed limit 50	94.0%	2.6%	1.4%	2.0%	100.0%
Urban main streets, right of way	92.5%	2.2%	2.3%	3.0%	100.0%
Urban, city centre	81.4%	4.0%	6.2%	8.5%	100.0%
Urban main streets, traffic lights, speed limit 50	82.0%	3.2%	6.3%	8.5%	100.0%
Urban main streets, speed limit > 50	90.6%	1.9%	3.2%	4.2%	100.0%
Rural, irregular curvatures	83.4%	1.8%	4.4%	10.4%	100.0%
Rural, primary, regular curvatures	86.4%	1.6%	3.6%	8.4%	100.0%
Rural, primary, straight	86.0%	1.4%	3.8%	8.7%	100.0%
Motorway, speed limit 80	63.9%	1.5%	3.9%	30.7%	100.0%
Motorway, speed limit 100	70.0%	1.5%	3.2%	25.2%	100.0%
Motorway, speed limit 120	73.9%	1.6%	2.8%	21.7%	100.0%
Motorway, no speed limit	76.8%	1.6%	2.4%	19.2%	100.0%

Table 36: Contribution of the different vehicle categories to Lden for scenario 5

Road category	Rolling noise share on Lden			
	M1	N1	rigid trucks	trailer trucks
Urban, residential streets, speed limit 30	62.7%	11.7%	8.7%	8.3%
Urban, residential streets, speed limit 50	76.9%	24.1%	19.6%	18.9%
Urban main streets, right of way	88.6%	54.4%	45.2%	46.6%
Urban, city centre	72.4%	19.9%	15.7%	15.0%
Urban main streets, traffic lights, speed limit 50	78.9%	28.5%	22.1%	21.4%
Urban main streets, speed limit > 50	89.6%	60.9%	53.2%	55.6%
Rural, irregular curvatures	89.0%	53.9%	48.9%	50.0%
Rural, primary, regular curvatures	90.6%	68.6%	65.8%	69.9%
Rural, primary, straight	89.5%	69.7%	63.1%	67.1%
Motorway, speed limit 80	90.3%	75.3%	73.0%	78.1%
Motorway, speed limit 100	86.8%	77.3%	75.7%	81.8%
Motorway, speed limit 120	86.5%	78.1%	75.7%	81.8%
Motorway, no speed limit	87.7%	79.2%	75.7%	81.8%

Table 37: Rolling noise share on Lden within the different vehicle categories for scenario 5

4.3 Comparison of the different scenarios

In order to make the comparison of the results of the different reduction scenarios, the Lden reductions are summarised in Table 38.

Number	Scenario	Description	reduction of Lden in dB(A)			
			urban	rural	motorway	overall
1	2009/661/EC, tyre noise limitation		-1.0	-1.3	-1.3	**-1.1**
2	COM(2011) 856 final		-1.7	-1.6	-1.6	**-1.7**
3	German proposal	see [3]	-1.7	-1.6	-1.6	**-1.7**
4	scenario 1	further limit value reduction step for tyres, 2 dB for C1 and 1 dB for C2/C3 tyres without any reduction steps for Lurban	-1.9	-2.5	-2.3	**-2.0**
5	scenario 2	3rd reduction step added to a combination of COM(2011) 856 final and the German proposal for vehicle category classification	-1.9	-1.7	-1.7	**-1.9**
6	scenario 3	combination of scenarios 1 and 2	-3.1	-3.0	-2.9	**-3.0**
7	scenario 4	3rd reduction step added to a combination of COM(2011) 856 final and the German proposal for vehicle category classification but only for M1 and N1 vehicles	-1.9	-1.7	-1.7	**-1.8**
8	scenario 5	scenario 4 but further limit value reduction step of 2 dB for C1 tyres and 1 dB for C2/C3 tyres	-2.9	-2.9	-2.8	**-2.9**

Table 38: Comparison of the effects of the different scenarios on the Lden reduction in real traffic

The following can be concluded from this table:

- The further reduction of the tyre noise limits will lead to a reduction of the noise impact of 1.1 dB.
- The Commission's proposal as well as the German proposal for further limit value reductions on the basis of the amended regulation R 51 will only add another 0.6 dB to the reduction resulting from the tyre noise limitation.
- A further reduction of the tyre noise limits by 2 dB for C1 tyres and 1 dB for C2/C3 tyres would be more effective (-2.0 dB).
- The target of a noise impact reduction in real traffic by 3 dB can only be achieved by adding a 3rd reduction step to a combination of COM(2011) 856 final and the German

proposal for vehicle category classification and a further reduction of the tyre noise limits by 2 dB for C1 tyres and 1 dB for C2/C3 tyres.

- A more cost effective scenario with nearly the same effect on the reduction of the noise impact in real traffic would be to restrict the 3rd reduction step added to a combination of COM(2011) 856 final and the German proposal for vehicle category classification to M1 and N1 vehicles only and to combine this with a further tyre noise limit reduction of 2 dB for C1 tyres and 1 dB for C2/C3 tyres.

In order to calculate the time schemes for the different noise impact reduction scenarios the following side conditions were assumed:

- The shares of new registered vehicles on the total vehicle fleet is 7.7%,
- The shares of vehicles with new tyres on the total vehicle fleet is 25%,
- Only 50% of the new registered vehicles have to comply with the new limits in the first year of a new limit stage, the percentage is 75% for the second year and 100% from the third year on.
- For 2009/661/EC the introduction year was set to 2016, because the new limit values for new tyre types and new vehicle types will already become mandatory from 2013/2014 on. The introduction year for a further limit value reduction step for tyres was set to 2021.
- For the German proposal the limit stage roadmap for M1/N1 vehicles was used for all categories for simplification reasons (step 2 from 2019 on and step 3 from 2023 on). This simplification will not influence the results significantly for urban and rural roads because the noise impact is dominated by M1 vehicles.

Figure 7 shows the time schemes of the noise impact reduction for several scenarios. The time schemes of the fleet shares of the different reduction steps for the different scenarios are tabled in Annex C. Scenario 4 is disregarded because it is almost the same as scenario 2.

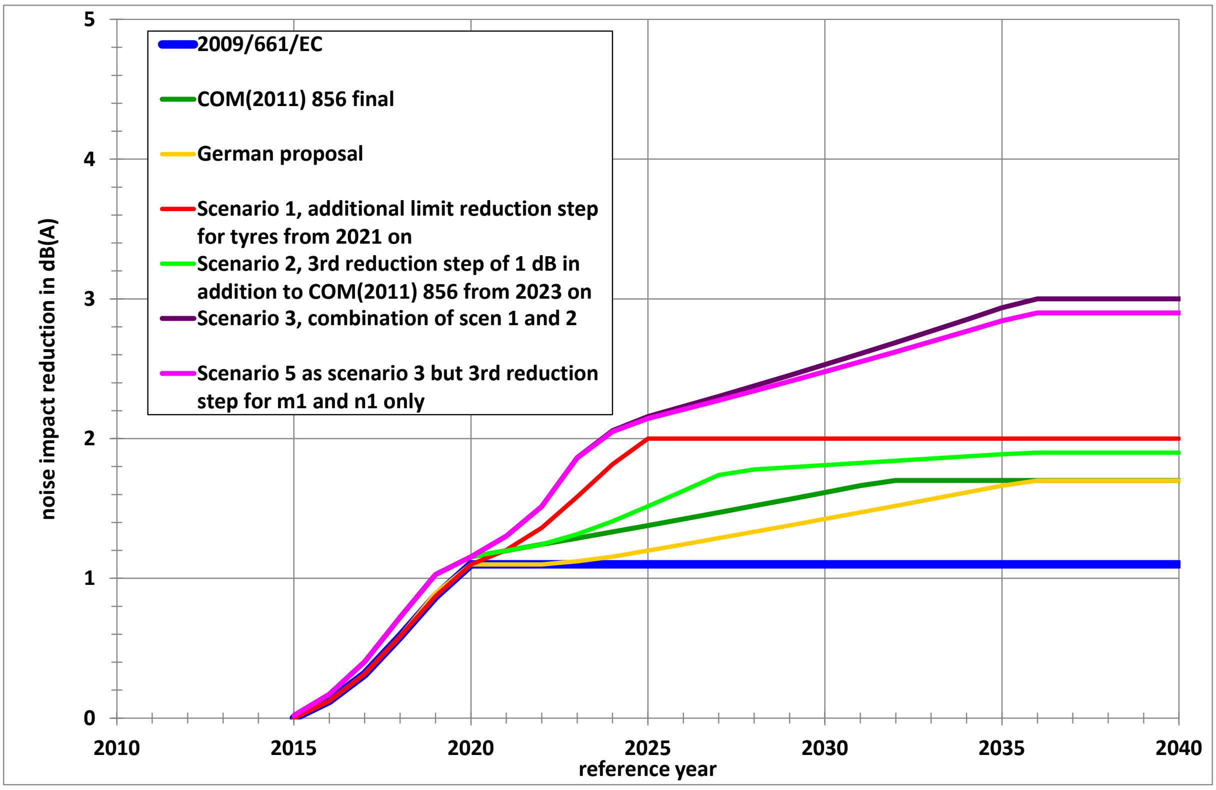

Figure 7: Time schemes of the noise impact reduction for several scenarios

5 Summary

With COM(2011) 856 final from 09.12.2011 the EU Commission launched a proposal for a regulation of the European Parliament and of the Council on the sound level of motor vehicles. This proposal is related to motor vehicles having at least four wheels. Objective and aim are described as follows:

“The objective of the proposal is to ensure a high level of health and environmental protection and to safeguard the Internal Market for motor vehicles as regards their sound level. The proposal aims at reducing environmental noise by introducing a new test method for measuring noise emissions, by lowering the noise limit values, by including additional sound emission provisions in the type-approval procedure……” (see paragraph 1 of the explanatory memorandum).

Under the bullet point “- new limit values” of paragraph 1 of the explanatory memorandum the following statements are listed:

“On the basis of the results of the monitoring data an impact assessment has been prepared with different policy options for the noise test method and corresponding limit values. According to the most preferable option the limit values for light and medium size vehicles will be lowered in two steps of each 2 dB(A) and for heavy vehicles in a first step of 1 and a second step of 2 dB(A). This will result in a reduction of the noise impact of about 3 dB(A) for free flowing traffic and up to 4 dB(A) for intermittent traffic. The reduction of the number of highly annoyed people will be 25 %. The cost-benefit ratio for this measure is estimated to be around 20 times in favour of the noise reduction compared to no action taken."

The forecast for the reduction of the noise impact in real traffic is far too optimistic. It is highly unlikely that the reduction of limit values by 3 to 4 dB will lead to a reduction of the noise impact in real traffic by the same amount without any deterioration factor. Own calculations with the TRANECAM model led to a significantly lower noise impact reduction of 1,5 dB for two reasons. The first reason is related to the fact that the limit value reduction will not affect the whole market. E.g., the reduced limit values as proposed in COM(2011) 856 final can already be fulfilled by 23% of the M1 vehicle types in the monitoring database. The corresponding percentages for N1 and N2 vehicles are even higher (32%, > 45%).

Another reason for the lower reduction forecast in the own calculations is related to the Regulation (EC) No 661/2009 of the European Parliament and of the Council of 13 July 2009 concerning type-approval requirements for the general safety of motor vehicles, their trailers and systems, components and separate technical units intended therefore, which introduced new stricter noise requirements for motor vehicle tyres.

In the Venoliva report which built the basis of the impact assessment accompanied to the EU Commission proposal it is forecasted that the effect of this regulation on the rolling noise reduction in real traffic will be more than 3 dB. Own estimates of the effect of the tyre noise reduction resulted in a reduction of the noise impact in the order of 1.1 dB.

The aim of this study is to elaborate a reduction scenario which would most likely lead to a reduction of the noise impact in real traffic by 3 dB, by adding a 3rd reduction step. This possibility is left open in COM(2011) 856 final by article 7 (revision clause).

The limit values of COM(2011) 856 final are based on the existing vehicle categorisation with one exception, which is the definition of high powered M1 vehicles. Since this categorisation does no longer reflect the trends in the development of vehicle mass and rated engine power over the last 20 years, a proposal for an updated categorisation for all vehicle categories is included in this report.

Concerning the limit values the assessment focusses on the limit values for the second stage (phase 2 and phase 3), because they determine the final effects on the noise impact in real traffic. In a first step the effects on the average Lurban was assessed. The Calculation of the effective noise reduction for vehicle categories resulting from COM(2011) 856 final is based on the frequency distributions of Lurban in the monitoring database.

In cases where the German proposal would lead to an improvement with respect to the effectiveness of the reduction potential or would lead to a better balanced vehicle classifications, this proposal and its stage 3 limit values were included in the assessment. An improvement for the vehicle classification of COM(2011) 856 final is necessary since it contains some empty classes, because such vehicles are no longer in the market.

The results of the different reduction scenarios discussed in this report are summarised in Table 39.

Number	Scenario	Description	reduction of Lden in dB(A)			
			urban	rural	motorway	overall
1	2009/661/EC, tyre noise limitation		-1.0	-1.3	-1.3	**-1.1**
2	COM(2011) 856 final		-1.7	-1.6	-1.6	**-1.7**
3	German proposal	see [3]	-1.7	-1.6	-1.6	**-1.7**
4	scenario 1	further limit value reduction step for tyres, 2 dB for C1 and 1 dB for C2/C3 tyres without any reduction steps for Lurban	-1.9	-2.5	-2.3	**-2.0**
5	scenario 2	3rd reduction step added to a combination of COM(2011) 856 final and the German proposal for vehicle category classification	-1.9	-1.7	-1.7	**-1.9**
6	scenario 3	combination of scenarios 1 and 2	-3.1	-3.0	-2.9	**-3.0**
7	scenario 4	3rd reduction step added to a combination of COM(2011) 856 final and the German proposal for vehicle category classification but only for M1 and N1 vehicles	-1.9	-1.7	-1.7	**-1.8**
8	scenario 5	scenario 4 but further limit value reduction step of 2 dB for C1 tyres and 1 dB for C2/C3 tyres	-2.9	-2.9	-2.8	**-2.9**

Table 39: Comparison of the effects of the different scenarios on the Lden reduction in real traffic (for scenario 2 see Table 40)

Vehicle category	subclass	Limit value state of the art in dB(A)	stage 1, 2 years after publication	stage 2, 6 years after publication	reduction of average Lurban in dB(A)	stage 3, 10 years after publication	final limit value reduction in dB	reduction of average Lurban in dB(A)
M1	PMR ≤ 120 kW/t [1)]	**72**	**70**	**68**	-1.96	**67**	-5	-2.89 [2)]
	120 < PMR ≤ 160 kW/t [1)]	**73**	**71**	**70**	-1.7	**69**	-4	-2.48 [2)]
	PMR > 160 kW/t	**75**	**74**	**73**	-1.97	**71**	-4	-2.87
M2	GVM ≤ 2.5 to [1)]	**72**	**70**	**68**		**67**	-5	
	2.5 to < GVM ≤ 3.5 to [1)]	**74**	**72**	**71**	-2.3	**70**	-4	-3.18
	GVM > 3.5 to GVM [1)]	**75**	**73**	**71**	-2.52	**71**	-4	-2.52
M3	Pn ≤ 180 kW [1)]	**76**	**74**	**73**	-1.25	**72**	-4	-2.11
	180 < Pn ≤ 250 kW [2)]	**78**	**76**	**75**	-2.47	**75**	-3	-2.47
	Pn > 250 kW [2)]	**80**	**78**	**76**	-2.72	**76**	-4	-2.72
N1	GVM ≤ 2.5 to [1)]	**72**	**70**	**68**	-1.47	**67**	-5	-2.36
	2.5 to < GVM ≤ 3.5 to [1)]	**74**	**72**	**71**	-1.45	**70**	-4	-2.39
N2	Pn ≤ 150 kW 1)	**76**	**75**	**72**	-2.75	**71**	-5	-3.56
	Pn > 150 kW [1)]	**78**	**77**	**75**	-1.85	**74**	-4	-2.85
N3	Pn ≤ 250 kW [2)]	**81**	**79**	**77**	-2.83	**76**	-5	-3.82
	Pn > 250 kW [2)]	**82**	**81**	**79**	-2.38	**78**	-4	-3.38

[1)] +1 dB for off road vehicles

[2)] +2 dB for off road vehicles

off road vehicles as defined in directive 2007/46/EC, for M1 vehicles with the additional requirement of a wading depth >= 500 mm

Table 40: Proposal for an additional limit value reduction step aimed at an increase of the effect on noise impact in real traffic

The following can be concluded from Table 39:

- The further reduction of the tyre noise limits will lead to a reduction of the noise impact of 1.1 dB.
- The Commission's proposal as well as the German proposal for further limit value reductions on the basis of the amended regulation R 51 will only add another 0.6 dB to the reduction resulting from the tyre noise limitation.
- A further reduction of the tyre noise limits by 2 dB for C1 tyres and 1 dB for C2/C3 tyres would be more effective (-2.0 dB).
- The target of a noise impact reduction in real traffic by 3 dB can only be achieved by adding a 3rd reduction step to a combination of COM(2011) 856 final and the German proposal for vehicle category classification and a further reduction of the tyre noise limits by 2 dB for C1 tyres and 1 dB for C2/C3 tyres.
- A more cost effective scenario with nearly the same effect on the reduction of the noise impact in real traffic would be to restrict the 3rd reduction step added to a combination of COM(2011) 856 final and the German proposal for vehicle category classification to M1 and N1 vehicles only and to combine this with a further tyre noise limit reduction of 2 dB for C1 tyres and 1 dB for C2/C3 tyres.

6 Literature

[1] VENOLIVA - Vehicle Noise Limit Values - Comparison of two noise emission test methods – Final Report, Specific Contract No SI2.545143 implementing Framework Contract No ENTR/05/18, by order of European Commission, Enterprise & Industry Directorate General, Unit Automotive Industry, March 2011

[2] MONITORING PROCEDURE IN THE VEHICLE NOISE REGULATION, ECE R 51 monitoring database and cost/benefit analyses, final report UTAC, TUEV Nord, by order of the European Automobile Manufacturers' Association (ACEA), August 2010

[3] German Position on new limit values for 03 series of amendments to Regulation No. 51, Informal document GRB-54-03, September 2011

[4] First ACEA monitoring study, 2004, no published report available

7 Annex A, Detailed reduction schema for M1 vehicles

veh cat	pmr	Lurban	number of models	DB weight	pmr weight	cat weight	overall weight	limit value in dB(A)		necessary reduction in dB		fleet percentage	
	kW/t	dB(A)						stage 1	stage 2	stage 1	stage 2	stage 1	stage 2
M1	35	66	1	14.29%	0.71%	95.00%	0.10%	70	68				
M1	35	67	1	14.29%	0.71%	95.00%	0.10%	70	68				
M1	35	69	1	14.29%	0.71%	95.00%	0.10%	70	68		-1		0.10%
M1	35	70	1	14.29%	0.71%	95.00%	0.10%	70	68		-2		0.10%
M1	35	71	1	14.29%	0.71%	95.00%	0.10%	70	68	-1	-3	0.10%	0.10%
M1	35	72	2	28.57%	0.71%	95.00%	0.19%	70	68	-2	-4	0.19%	0.19%
M1	40	67	1	11.11%	4.20%	95.00%	0.44%	70	68				
M1	40	69	1	11.11%	4.20%	95.00%	0.44%	70	68		-1		0.44%
M1	40	70	3	33.33%	4.20%	95.00%	1.33%	70	68		-2		1.33%
M1	40	71	1	11.11%	4.20%	95.00%	0.44%	70	68	-1	-3	0.44%	0.44%
M1	40	72	3	33.33%	4.20%	95.00%	1.33%	70	68	-2	-4	1.33%	1.33%
M1	45	66	1	3.45%	10.64%	95.00%	0.35%	70	68				
M1	45	68	8	27.59%	10.64%	95.00%	2.79%	70	68				
M1	45	69	4	13.79%	10.64%	95.00%	1.39%	70	68		-1		1.39%
M1	45	70	8	27.59%	10.64%	95.00%	2.79%	70	68		-2		2.79%
M1	45	71	4	13.79%	10.64%	95.00%	1.39%	70	68	-1	-3	1.39%	1.39%
M1	45	72	2	6.90%	10.64%	95.00%	0.70%	70	68	-2	-4	0.70%	0.70%
M1	45	73	2	6.90%	10.64%	95.00%	0.70%	70	68	-3	-5	0.70%	0.70%
M1	50	67	3	7.14%	15.74%	95.00%	1.07%	70	68				
M1	50	68	8	19.05%	15.74%	95.00%	2.85%	70	68				
M1	50	69	10	23.81%	15.74%	95.00%	3.56%	70	68		-1		3.56%
M1	50	70	10	23.81%	15.74%	95.00%	3.56%	70	68		-2		3.56%
M1	50	71	7	16.67%	15.74%	95.00%	2.49%	70	68	-1	-3	2.49%	2.49%
M1	50	72	4	9.52%	15.74%	95.00%	1.42%	70	68	-2	-4	1.42%	1.42%

Table A 1: Reduction schema for M1 vehicles with power to mass ratios up to 52,5 kW/t

veh cat	pmr	Lurban	number of models	DB weight	pmr weight	cat weight	overall weight	limit value in dB(A)		necessary reduction in dB		fleet percentage	
	kW/t	dB(A)						stage 1	stage 2	stage 1	stage 2	stage 1	stage 2
M1	55	66	3	4.48%	16.07%	95.00%	0.68%	70	68				
M1	55	67	6	8.96%	16.07%	95.00%	1.37%	70	68				
M1	55	68	10	14.93%	16.07%	95.00%	2.28%	70	68				
M1	55	69	13	19.40%	16.07%	95.00%	2.96%	70	68		-1		2.96%
M1	55	70	14	20.90%	16.07%	95.00%	3.19%	70	68		-2		3.19%
M1	55	71	14	20.90%	16.07%	95.00%	3.19%	70	68	-1	-3	3.19%	3.19%
M1	55	72	7	10.45%	16.07%	95.00%	1.60%	70	68	-2	-4	1.60%	1.60%
M1	60	65	2	4.55%	17.01%	95.00%	0.73%	70	68				
M1	60	66	1	2.27%	17.01%	95.00%	0.37%	70	68				
M1	60	67	2	4.55%	17.01%	95.00%	0.73%	70	68				
M1	60	68	6	13.64%	17.01%	95.00%	2.20%	70	68				
M1	60	69	9	20.45%	17.01%	95.00%	3.31%	70	68		-1		3.31%
M1	60	70	11	25.00%	17.01%	95.00%	4.04%	70	68		-2		4.04%
M1	60	71	6	13.64%	17.01%	95.00%	2.20%	70	68	-1	-3	2.20%	2.20%
M1	60	72	4	9.09%	17.01%	95.00%	1.47%	70	68	-2	-4	1.47%	1.47%
M1	60	73	2	4.55%	17.01%	95.00%	0.73%	70	68	-3	-5	0.73%	0.73%
M1	60	74	1	2.27%	17.01%	95.00%	0.37%	70	68	-4	-6	0.37%	0.37%
M1	65	66	1	2.50%	11.08%	95.00%	0.26%	70	68				
M1	65	67	1	2.50%	11.08%	95.00%	0.26%	70	68				
M1	65	68	9	22.50%	11.08%	95.00%	2.37%	70	68				
M1	65	69	10	25.00%	11.08%	95.00%	2.63%	70	68		-1		2.63%
M1	65	70	8	20.00%	11.08%	95.00%	2.10%	70	68		-2		2.10%
M1	65	71	2	5.00%	11.08%	95.00%	0.53%	70	68	-1	-3	0.53%	0.53%
M1	65	72	8	20.00%	11.08%	95.00%	2.10%	70	68	-2	-4	2.10%	2.10%
M1	65	73	1	2.50%	11.08%	95.00%	0.26%	70	68	-3	-5	0.26%	0.26%
M1	70	67	2	4.08%	7.90%	95.00%	0.31%	70	68				
M1	70	68	4	8.16%	7.90%	95.00%	0.61%	70	68				
M1	70	69	15	30.61%	7.90%	95.00%	2.30%	70	68		-1		2.30%
M1	70	70	10	20.41%	7.90%	95.00%	1.53%	70	68		-2		1.53%
M1	70	71	7	14.29%	7.90%	95.00%	1.07%	70	68	-1	-3	1.07%	1.07%
M1	70	72	8	16.33%	7.90%	95.00%	1.22%	70	68	-2	-4	1.22%	1.22%
M1	70	73	3	6.12%	7.90%	95.00%	0.46%	70	68	-3	-5	0.46%	0.46%
M1	75	64	1	2.78%	5.05%	95.00%	0.13%	70	68				
M1	75	65	1	2.78%	5.05%	95.00%	0.13%	70	68				
M1	75	66	3	8.33%	5.05%	95.00%	0.40%	70	68				
M1	75	67	1	2.78%	5.05%	95.00%	0.13%	70	68				
M1	75	68	3	8.33%	5.05%	95.00%	0.40%	70	68				
M1	75	69	9	25.00%	5.05%	95.00%	1.20%	70	68		-1		1.20%
M1	75	70	8	22.22%	5.05%	95.00%	1.07%	70	68		-2		1.07%
M1	75	71	7	19.44%	5.05%	95.00%	0.93%	70	68	-1	-3	0.93%	0.93%
M1	75	72	2	5.56%	5.05%	95.00%	0.27%	70	68	-2	-4	0.27%	0.27%
M1	75	73	1	2.78%	5.05%	95.00%	0.13%	70	68	-3	-5	0.13%	0.13%

Table A 2: Reduction schema for M1 vehicles with power to mass ratios from 52,5 kW/t to 77,5 kW/t

veh cat	pmr	Lurban	number of models	DB weight	pmr weight	cat weight	overall weight	limit value in dB(A)		necessary reduction in dB		fleet percentage	
	kW/t	dB(A)						stage 1	stage 2	stage 1	stage 2	stage 1	stage 2
M1	80	66	1	4.17%	4.07%	95.00%	0.16%	70	68				
M1	80	67	2	8.33%	4.07%	95.00%	0.32%	70	68				
M1	80	68	6	25.00%	4.07%	95.00%	0.97%	70	68				
M1	80	69	4	16.67%	4.07%	95.00%	0.64%	70	68		-1		0.64%
M1	80	70	7	29.17%	4.07%	95.00%	1.13%	70	68		-2		1.13%
M1	80	71	1	4.17%	4.07%	95.00%	0.16%	70	68	-1	-3	0.16%	0.16%
M1	80	72	3	12.50%	4.07%	95.00%	0.48%	70	68	-2	-4	0.48%	0.48%
M1	85	64	1	3.57%	1.91%	95.00%	0.06%	70	68				
M1	85	65	1	3.57%	1.91%	95.00%	0.06%	70	68				
M1	85	67	1	3.57%	1.91%	95.00%	0.06%	70	68				
M1	85	68	6	21.43%	1.91%	95.00%	0.39%	70	68				
M1	85	69	13	46.43%	1.91%	95.00%	0.84%	70	68		-1		0.84%
M1	85	70	3	10.71%	1.91%	95.00%	0.19%	70	68		-2		0.19%
M1	85	71	3	10.71%	1.91%	95.00%	0.19%	70	68	-1	-3	0.19%	0.19%
M1	90	67	1	5.00%	1.61%	95.00%	0.08%	70	68				
M1	90	68	5	25.00%	1.61%	95.00%	0.38%	70	68				
M1	90	69	5	25.00%	1.61%	95.00%	0.38%	70	68		-1		0.38%
M1	90	70	5	25.00%	1.61%	95.00%	0.38%	70	68		-2		0.38%
M1	90	71	4	20.00%	1.61%	95.00%	0.31%	70	68	-1	-3	0.31%	0.31%
M1	95	66	1	5.00%	0.71%	95.00%	0.03%	70	68				
M1	95	67	1	5.00%	0.71%	95.00%	0.03%	70	68				
M1	95	69	6	30.00%	0.71%	95.00%	0.20%	70	68		-1		0.20%
M1	95	70	4	20.00%	0.71%	95.00%	0.13%	70	68		-2		0.13%
M1	95	71	5	25.00%	0.71%	95.00%	0.17%	70	68	-1	-3	0.17%	0.17%
M1	95	72	2	10.00%	0.71%	95.00%	0.07%	70	68	-2	-4	0.07%	0.07%
M1	95	74	1	5.00%	0.71%	95.00%	0.03%	70	68	-4	-6	0.03%	0.03%
M1	100	68	5	27.78%	0.49%	95.00%	0.13%	70	68				
M1	100	69	6	33.33%	0.49%	95.00%	0.16%	70	68		-1		0.16%
M1	100	70	3	16.67%	0.49%	95.00%	0.08%	70	68		-2		0.08%
M1	100	71	2	11.11%	0.49%	95.00%	0.05%	70	68	-1	-3	0.05%	0.05%
M1	100	72	2	11.11%	0.49%	95.00%	0.05%	70	68	-2	-4	0.05%	0.05%

Table A 3: Reduction schema for M1 vehicles with power to mass ratios from 77,5 kW/t to 102,5 kW/t

veh cat	pmr	Lurban	number of models	DB weight	pmr weight	cat weight	overall weight	limit value in dB(A)		necessary reduction in dB		fleet percentage	
	kW/t	dB(A)						stage 1	stage 2	stage 1	stage 2	stage 1	stage 2
M1	105	67	1	6.25%	0.74%	95.00%	0.04%	70	68				
M1	105	68	1	6.25%	0.74%	95.00%	0.04%	70	68				
M1	105	69	5	31.25%	0.74%	95.00%	0.22%	70	68		-1		0.22%
M1	105	70	4	25.00%	0.74%	95.00%	0.18%	70	68		-2		0.18%
M1	105	71	1	6.25%	0.74%	95.00%	0.04%	70	68	-1	-3	0.04%	0.04%
M1	105	72	3	18.75%	0.74%	95.00%	0.13%	70	68	-2	-4	0.13%	0.13%
M1	105	73	1	6.25%	0.74%	95.00%	0.04%	70	68	-3	-5	0.04%	0.04%
M1	110	69	3	75.00%	0.53%	95.00%	0.38%	70	68		-1		0.38%
M1	110	71	1	25.00%	0.53%	95.00%	0.13%	70	68	-1	-3	0.13%	0.13%
M1	115	68	1	50.00%	0.28%	95.00%	0.13%	70	68				
M1	115	70	1	50.00%	0.28%	95.00%	0.13%	70	68		-2		0.13%
M1	120	70	1	25.00%	0.23%	95.00%	0.05%	70	68		-2		0.05%
M1	120	71	1	25.00%	0.23%	95.00%	0.05%	70	68	-1	-3	0.05%	0.05%
M1	120	72	1	25.00%	0.23%	95.00%	0.05%	70	68	-2	-4	0.05%	0.05%
M1	120	75	1	25.00%	0.23%	95.00%	0.05%	70	68	-5	-7	0.05%	0.05%

Table A 4: Reduction schema for M1 vehicles with power to mass ratios from 102,5 kW/t to 122,5 kW/t

veh cat	pmr	Lurban	number of models	DB weight	pmr weight	cat weight	overall weight	limit value in dB(A)		necessary reduction in dB		fleet percentage	
	kW/t	dB(A)						stage 1	stage 2	stage 1	stage 2	stage 1	stage 2
M1	125	68	3	37.50%	0.22%	95.00%	0.08%	70	68				
M1	125	69	1	12.50%	0.22%	95.00%	0.03%	70	68		-1		0.03%
M1	125	70	1	12.50%	0.22%	95.00%	0.03%	70	68		-2		0.03%
M1	125	72	2	25.00%	0.22%	95.00%	0.05%	70	68	-2	-4	0.05%	0.05%
M1	125	73	1	12.50%	0.22%	95.00%	0.03%	70	68	-3	-5	0.03%	0.03%
M1	130	68	1	16.67%	0.18%	95.00%	0.03%	70	68				
M1	130	69	2	33.33%	0.18%	95.00%	0.06%	70	68		-1		0.06%
M1	130	73	2	33.33%	0.18%	95.00%	0.06%	70	68	-3	-5	0.06%	0.06%
M1	130	75	1	16.67%	0.18%	95.00%	0.03%	70	68	-5	-7	0.03%	0.03%
M1	135	69	1	16.67%	0.05%	95.00%	0.01%	70	68		-1		0.01%
M1	135	70	3	50.00%	0.05%	95.00%	0.02%	70	68		-2		0.02%
M1	135	71	1	16.67%	0.05%	95.00%	0.01%	70	68	-1	-3	0.01%	0.01%
M1	135	72	1	16.67%	0.05%	95.00%	0.01%	70	68	-2	-4	0.01%	0.01%
M1	140	68	1	10.00%	0.13%	95.00%	0.01%	70	68				
M1	140	69	3	30.00%	0.13%	95.00%	0.04%	70	68		-1		0.04%
M1	140	70	3	30.00%	0.13%	95.00%	0.04%	70	68		-2		0.04%
M1	140	71	1	10.00%	0.13%	95.00%	0.01%	70	68	-1	-3	0.01%	0.01%
M1	140	72	1	10.00%	0.13%	95.00%	0.01%	70	68	-2	-4	0.01%	0.01%
M1	140	75	1	10.00%	0.13%	95.00%	0.01%	70	68	-5	-7	0.01%	0.01%
M1	145	70	1	33.33%	0.05%	95.00%	0.02%	70	68		-2		0.02%
M1	145	74	1	33.33%	0.05%	95.00%	0.02%	70	68	-4	-6	0.02%	0.02%
M1	145	75	1	33.33%	0.05%	95.00%	0.02%	70	68	-5	-7	0.02%	0.02%
M1	150	69	1	20.00%	0.04%	95.00%	0.01%	70	68		-1		0.01%
M1	150	70	1	20.00%	0.04%	95.00%	0.01%	70	68		-2		0.01%
M1	150	71	2	40.00%	0.04%	95.00%	0.02%	70	68	-1	-3	0.02%	0.02%
M1	150	73	1	20.00%	0.04%	95.00%	0.01%	70	68	-3	-5	0.01%	0.01%

Table A 5: Reduction schema for M1 vehicles with power to mass ratios from 122,5 kW/t to 152,5 kW/t

veh cat	pmr	Lurban	number of models	DB weight	pmr weight	cat weight	overall weight	limit value in dB(A)		necessary reduction in dB		fleet percentage	
	kW/t	dB(A)						stage 1	stage 2	stage 1	stage 2	stage 1	stage 2
M1	155	71	1	25.00%	0.09%	95.00%	0.02%	71	69		-2		0.02%
M1	155	72	1	25.00%	0.09%	95.00%	0.02%	71	69	-1	-3	0.02%	0.02%
M1	155	73	2	50.00%	0.09%	95.00%	0.04%	71	69	-2	-4	0.04%	0.04%
M1	160	70	1	20.00%	0.05%	95.00%	0.01%	71	69		-1		0.01%
M1	160	72	1	20.00%	0.05%	95.00%	0.01%	71	69	-1	-3	0.01%	0.01%
M1	160	73	2	40.00%	0.05%	95.00%	0.02%	71	69	-2	-4	0.02%	0.02%
M1	160	74	1	20.00%	0.05%	95.00%	0.01%	71	69	-3	-5	0.01%	0.01%
M1	165	73	1	33.33%	0.06%	95.00%	0.02%	71	69	-2	-4	0.02%	0.02%
M1	165	74	2	66.67%	0.06%	95.00%	0.04%	71	69	-3	-5	0.04%	0.04%
M1	170	74	1	50.00%	0.04%	95.00%	0.02%	71	69	-3	-5	0.02%	0.02%
M1	170	75	1	50.00%	0.04%	95.00%	0.02%	71	69	-4	-6	0.02%	0.02%
M1	175	70	1	25.00%	0.05%	95.00%	0.01%	71	69		-1		0.01%
M1	175	71	1	25.00%	0.05%	95.00%	0.01%	71	69		-2		0.01%
M1	175	74	1	25.00%	0.05%	95.00%	0.01%	71	69	-3	-5	0.01%	0.01%
M1	175	76	1	25.00%	0.05%	95.00%	0.01%	71	69	-5	-7	0.01%	0.01%
M1	180	71	1	20.00%	0.01%	95.00%	0.00%	71	69		-2		0.00%
M1	180	72	1	20.00%	0.01%	95.00%	0.00%	71	69	-1	-3	0.00%	0.00%
M1	180	73	2	40.00%	0.01%	95.00%	0.00%	71	69	-2	-4	0.00%	0.00%
M1	180	74	1	20.00%	0.01%	95.00%	0.00%	71	69	-3	-5	0.00%	0.00%
M1	185	73	1	50.00%	0.01%	95.00%	0.00%	71	69	-2	-4	0.00%	0.00%
M1	185	76	1	50.00%	0.01%	95.00%	0.00%	71	69	-5	-7	0.00%	0.00%
M1	190	73	1	50.00%	0.04%	95.00%	0.02%	71	69	-2	-4	0.02%	0.02%
M1	190	75	1	50.00%	0.04%	95.00%	0.02%	71	69	-4	-6	0.02%	0.02%
M1	195	72	1	50.00%	0.00%	95.00%	0.00%	71	69	-1	-3	0.00%	0.00%
M1	195	73	1	50.00%	0.00%	95.00%	0.00%	71	69	-2	-4	0.00%	0.00%
M1	200	73	1	100.00%	0.00%	95.00%	0.00%	71	69	-2	-4	0.00%	0.00%
M1	205	74	1	100.00%	0.00%	95.00%	0.00%	71	69	-3	-5	0.00%	0.00%
M1	215	75	3	100.00%	0.00%	95.00%	0.00%	71	69	-4	-6	0.00%	0.00%
M1	255	71	1	25.00%	0.00%	95.00%	0.00%	71	69		-2		0.00%
M1	255	73	3	75.00%	0.00%	95.00%	0.00%	71	69	-2	-4	0.00%	0.00%

Table A 6: Reduction schema for M1 vehicles with power to mass ratios above 152,5 kW/t

veh cat	pmr	Lurban	number of models	DB weight	pmr weight	cat weight	overall weight	limit value in dB(A)		necessary reduction in dB		fleet percentage	
	kW/t	dB(A)						stage 1	stage 2	stage 1	stage 2	stage 1	stage 2
M1or	50	70	2	33.33%	19.21%	5.00%	0.32%	71	69		-1		0.32%
M1or	50	72	4	66.67%	19.21%	5.00%	0.64%	71	69	-1	-3	0.64%	0.64%
M1or	55	70	2	22.22%	19.61%	5.00%	0.22%	71	69		-1		0.22%
M1or	55	71	5	55.56%	19.61%	5.00%	0.54%	71	69		-2		0.54%
M1or	55	72	1	11.11%	19.61%	5.00%	0.11%	71	69	-1	-3	0.11%	0.11%
M1or	55	74	1	11.11%	19.61%	5.00%	0.11%	71	69	-3	-5	0.11%	0.11%
M1or	60	71	1	25.00%	20.76%	5.00%	0.26%	71	69		-2		0.26%
M1or	60	73	1	25.00%	20.76%	5.00%	0.26%	71	69	-2	-4	0.26%	0.26%
M1or	60	74	2	50.00%	20.76%	5.00%	0.52%	71	69	-3	-5	0.52%	0.52%
M1or	65	67	1	12.50%	13.52%	5.00%	0.08%	71	69				
M1or	65	69	2	25.00%	13.52%	5.00%	0.17%	71	69				
M1or	65	70	1	12.50%	13.52%	5.00%	0.08%	71	69		-1		0.08%
M1or	65	71	3	37.50%	13.52%	5.00%	0.25%	71	69		-2		0.25%
M1or	65	72	1	12.50%	13.52%	5.00%	0.08%	71	69	-1	-3	0.08%	0.08%
M1or	70	69	2	33.33%	9.64%	5.00%	0.16%	71	69				
M1or	70	70	1	16.67%	9.64%	5.00%	0.08%	71	69		-1		0.08%
M1or	70	71	2	33.33%	9.64%	5.00%	0.16%	71	69		-2		0.16%
M1or	70	73	1	16.67%	9.64%	5.00%	0.08%	71	69	-2	-4	0.08%	0.08%
M1or	75	70	1	50.00%	6.17%	5.00%	0.15%	71	69		-1		0.15%
M1or	75	71	1	50.00%	6.17%	5.00%	0.15%	71	69		-2		0.15%
M1or	80	69	2	50.00%	4.97%	5.00%	0.12%	71	69				
M1or	80	72	2	50.00%	4.97%	5.00%	0.12%	71	69	-1	-3	0.12%	0.12%
M1or	85	69	3	75.00%	2.33%	5.00%	0.09%	71	69				
M1or	85	70	1	25.00%	2.33%	5.00%	0.03%	71	69		-1		0.03%
M1or	95	72	1	50.00%	0.87%	5.00%	0.02%	71	69	-1	-3	0.02%	0.02%
M1or	95	75	1	50.00%	0.87%	5.00%	0.02%	71	69	-4	-6	0.02%	0.02%
M1or	100	68	1	100.00%	0.60%	5.00%	0.03%	71	69				
M1or	105	74	1	100.00%	0.90%	5.00%	0.05%	71	69	-3	-5	0.05%	0.05%
M1or	110	76	1	100.00%	0.65%	5.00%	0.03%	71	69	-5	-7	0.03%	0.03%
M1or	120	75	1	100.00%	0.28%	5.00%	0.01%	71	69	-4	-6	0.01%	0.01%
M1or	125	69	1	100.00%	0.27%	5.00%	0.01%	71	69				
M1or	130	71	1	100.00%	0.22%	5.00%	0.01%	71	69		-2		0.01%

Table A 7: Reduction schema for M1 off road vehicles

8 Annex B, Description of the TRANECAM model

This description of the TRANECAM model is already given in [2]. The model was originally developed for the German Federal Environment agency and was updated with funding of the EU-commission and the Norwegian Pollution Control Authority. The model calculates the Leq for each hour of the day separately for a workday, a Saturday and a Sunday. Within a road category the traffic situation varies in relation to the actual hourly traffic volume.

The traffic volume is separated into different categories and subcategories and within these subcategories into different emission stages (related to different type approval limit values). The contributions of the different emission stages to the Leq are summarised for each hour of the day and afterwards summarised to Lday, Levening, Lnight and Lden. The calculation is carried out separately for propulsion noise, rolling noise and total noise. The user has the possibility to modify the databases and define/modify vehicle layers and modify the weighting factors.

The vehicle categories and subcategories are shown in table B 1, the emission stages are shown in Figure B 1.

Vehicle category	Sub-category	Vehicle category	Sub-category
Passenger car (M1)	Petrol, < 1400 cm^3	Rigid truck	≤ 7.5 tonnes Gross Vehicle Weight (GVW)
Passenger car (M1)	Petrol, 1400 – 2000 cm^3	Rigid truck	7.5 – 14 tonnes GVW
Passenger car (M1)	Petrol, > 2000 cm^3	Rigid truck	14 – 20 tonnes GVW
Passenger car (M1)	Diesel ≤ 2000 cm^3	Rigid truck	20 – 28 tonnes GVW
Passenger car (M1)	Diesel, 2000 cm^3	Rigid truck	< 7.5 tonnes, traction tyres
Passenger car (M1)	Petrol, > 2000 cm^3, high performance	Rigid truck	7.5 – 14 tonnes, traction tyres
Passenger car (M1)	Diesel > 2000 cm^3, high performance	Rigid truck	14 – 20 tonnes, traction tyres
Light duty vehicle (N1)	Petrol	Rigid truck	20 – 28 tonnes, traction tyres
Light duty vehicle (N1)	Diesel	Trailer truck	≤ 32 tonnes GVW
Public transport bus	≤ 20 tonnes GVW, standard	Trailer truck	> 32 tonnes GVW
Public transport bus	> 20 tonnes GVW, articulated	Trailer truck	≤ 32 tonnes, traction tyres
		Trailer truck	> 32 tonnes, traction tyres
Motorcycle	≤ 150 cm^3	Motorcycle	≤ 150 cm^3, rep/illegal silencers
Motorcycle	> 150 cm^3	Motorcycle	> 150 cm^3, rep/illegal silencers

Table B 1: The vehicle categories and subcategories of the Tranecam model

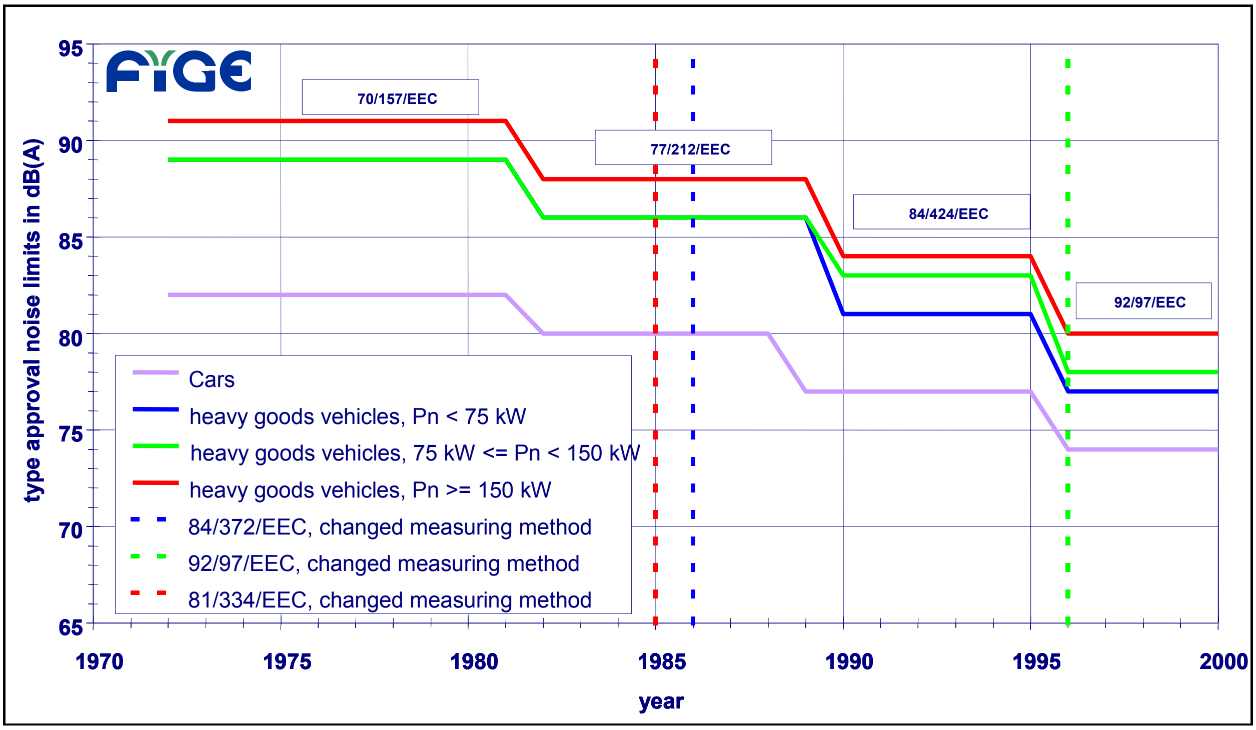

Figure B 1: The emission stages of the Tranecam model

The propulsion noise is depending on vehicle category, subcategory, emission stage, engine speed and engine load on a linear base. The tyre/road noise is depending on vehicle cat./subcat. (Tyre types and dimensions) road surface and vehicle speed on a logarithmic base.

The weighting factors for vehicle layers are reference year dependent and calculated from the following parameter:

- Percentage of vehicle subcategory on vehicle fleet ,
- Percentage of petrol/Diesel engines in the car and LDV fleet,
- Percentage of rigid trucks/trailer trucks for HDV,
- Percentage of rib/traction tyres for HDV,
- Percentage of motorcycles/scooters with tampered silencers.

The model contains noise emission factors for the different vehicle categories, subcategories and emission stages. For each of these combinations specific emission factors for different road categories and traffic situations have been calculated on the basis of representative driving pattern (second by second vehicle speed curves). The road categories and traffic situations per road category are shown in table B 2 and table B 3.

Further information can be get from the author (Heinz.Steven@t-online.de)

No	Road categories
1	motorway, without speed limit
2	motorway, speed limit 120 km/h
3	motorway, speed limit 100 km/h
4	motorway, speed limit 80 km/h
5	motorway, speed limit 60 km/h
6	rural, speed limit 100 km/h
7	rural, speed limit 80/90 km/h
8	rural, speed limit 70 km/h
9	urban, main streets, speed limit 60/70 km/h
10	urban, main streets, speed limit 50 km/h, right of way
11	urban, main streets, speed limit 50 km/h, traffic lights
12	urban, city centre
13	residential streets, speed limit 50 km/h
14	residential streets, speed limit 30 km/h

Table B 2: road categories of the Tranecam model

Road cat No	traffic situations
1 to 8	free
	dense
	stop & go
9 to 14	free
	small interactions
	medium interactions
	strong interactions
	stop & go

Table B 3: Traffic situations per road category

9 Annex C, Time schemes of the fleet shares of the different reduction steps for the different scenarios

year	step 0	step 1
2015	100.0%	0.0%
2016	87.5%	12.5%
2017	68.8%	31.3%
2018	43.8%	56.3%
2019	18.8%	81.3%
2020	0.0%	100.0%

Table C 1: Time schema for 2009/661/EC (tyre noise limitation

year	step 0	step 1	2009/661/EC	step 2
2015	96.2%	3.9%	0.0%	0.0%
2016	77.9%	9.6%	12.5%	0.0%
2017	51.4%	17.3%	31.3%	0.0%
2018	18.7%	25.0%	56.3%	0.0%
2019	0.0%	14.9%	81.3%	3.9%
2020	0.0%	0.0%	90.4%	9.6%
2021	0.0%	0.0%	82.7%	17.3%
2022	0.0%	0.0%	75.0%	25.0%
2023	0.0%	0.0%	67.3%	32.7%
2024	0.0%	0.0%	59.6%	40.4%
2025	0.0%	0.0%	51.9%	48.1%
2026	0.0%	0.0%	44.2%	55.8%
2027	0.0%	0.0%	36.5%	63.5%
2028	0.0%	0.0%	28.8%	71.2%
2029	0.0%	0.0%	21.1%	78.9%
2030	0.0%	0.0%	13.4%	86.6%
2031	0.0%	0.0%	5.7%	94.3%
2032	0.0%	0.0%	0.0%	100.0%

Table C 2: Time schema for COM(2011) 856 final

year	step 0	2009/661/EC	step 2	step 3
2015	100.0%	0.0%	0.0%	0.0%
2016	87.5%	12.5%	0.0%	0.0%
2017	68.8%	31.3%	0.0%	0.0%
2018	43.8%	56.3%	0.0%	0.0%
2019	14.9%	81.3%	3.9%	0.0%
2020	0.0%	100.0%	0.0%	0.0%
2021	0.0%	100.0%	0.0%	0.0%
2022	0.0%	100.0%	0.0%	0.0%
2023	0.0%	96.2%	0.0%	3.9%
2024	0.0%	90.4%	0.0%	9.6%
2025	0.0%	82.7%	0.0%	17.3%
2026	0.0%	75.0%	0.0%	25.0%
2027	0.0%	67.3%	0.0%	32.7%
2028	0.0%	59.6%	0.0%	40.4%
2029	0.0%	51.9%	0.0%	48.1%
2030	0.0%	44.2%	0.0%	55.8%
2031	0.0%	36.5%	0.0%	63.5%
2032	0.0%	28.8%	0.0%	71.2%
2033	0.0%	21.1%	0.0%	78.9%
2034	0.0%	13.4%	0.0%	86.6%
2035	0.0%	5.7%	0.0%	94.3%
2036	0.0%	0.0%	0.0%	100.0%

Table C 3: Time schema for the German proposal

year	step 0	2009/661/EC	step 2
2015	100.0%	0.0%	0.0%
2016	87.5%	12.5%	0.0%
2017	68.8%	31.3%	0.0%
2018	43.8%	56.3%	0.0%
2019	18.8%	81.3%	0.0%
2020	0.00%	100.0%	0.0%
2021	0.00%	87.5%	12.5%
2022	0.00%	68.8%	31.3%
2023	0.00%	43.8%	56.3%
2024	0.00%	18.8%	81.3%
2025	0.00%	0.0%	100.0%

Table C 4: Time schema for Scenario 1

year	step 0	step 1	2009/661/EC	step 2	step 3
2015	96.2%	3.9%	0.0%	0.0%	0.0%
2016	77.9%	9.6%	12.5%	0.0%	0.0%
2017	51.4%	17.3%	31.3%	0.0%	0.0%
2018	18.7%	25.0%	56.3%	0.0%	0.0%
2019	0.0%	14.9%	81.3%	3.9%	0.0%
2020	0.0%	0.0%	90.4%	9.6%	0.0%
2021	0.0%	0.0%	82.7%	17.3%	0.0%
2022	0.0%	0.0%	75.0%	25.0%	0.0%
2023	0.0%	0.0%	63.4%	32.7%	3.9%
2024	0.0%	0.0%	50.0%	40.4%	9.6%
2025	0.0%	0.0%	34.6%	48.1%	17.3%
2026	0.0%	0.0%	19.2%	55.8%	25.0%
2027	0.0%	0.0%	3.8%	63.5%	32.7%
2028	0.0%	0.0%	0.0%	59.6%	40.4%
2029	0.0%	0.0%	0.0%	51.9%	48.1%
2030	0.0%	0.0%	0.0%	44.2%	55.8%
2031	0.0%	0.0%	0.0%	36.5%	63.5%
2032	0.0%	0.0%	0.0%	28.8%	71.2%
2033	0.0%	0.0%	0.0%	21.1%	78.9%
2034	0.0%	0.0%	0.0%	13.4%	86.6%
2035	0.0%	0.0%	0.0%	5.7%	94.3%
2036	0.0%	0.0%	0.0%	0.0%	100.0%

Table C 5: Time schema for Scenario 2

year	step 0	step 1	2009/661/EC	step 2	2009/661/EC, step 2	step 3
2015	96.2%	3.9%	0.0%	0.0%	0.0%	0.0%
2016	77.9%	9.6%	12.5%	0.0%	0.0%	0.0%
2017	51.4%	17.3%	31.3%	0.0%	0.0%	0.0%
2018	18.7%	25.0%	56.3%	0.0%	0.0%	0.0%
2019	0.0%	14.9%	81.3%	3.9%	0.0%	0.0%
2020	0.0%	0.0%	90.4%	9.6%	0.0%	0.0%
2021	0.0%	0.0%	70.2%	17.3%	12.5%	0.0%
2022	0.0%	0.0%	43.7%	25.0%	31.3%	0.0%
2023	0.0%	0.0%	7.2%	32.7%	56.3%	3.9%
2024	0.0%	0.0%	0.0%	9.1%	81.3%	9.6%
2025	0.0%	0.0%	0.0%	0.0%	82.7%	17.3%
2026	0.0%	0.0%	0.0%	0.0%	75.0%	25.0%
2027	0.0%	0.0%	0.0%	0.0%	67.3%	32.7%
2028	0.0%	0.0%	0.0%	0.0%	59.6%	40.4%
2029	0.0%	0.0%	0.0%	0.0%	51.9%	48.1%
2030	0.0%	0.0%	0.0%	0.0%	44.2%	55.8%
2031	0.0%	0.0%	0.0%	0.0%	36.5%	63.5%
2032	0.0%	0.0%	0.0%	0.0%	28.8%	71.2%
2033	0.0%	0.0%	0.0%	0.0%	21.1%	78.9%
2034	0.0%	0.0%	0.0%	0.0%	13.4%	86.6%
2035	0.0%	0.0%	0.0%	0.0%	5.7%	94.3%
2036	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%

Table C 6: Time schema for Scenario 3

year	step 0	step 1	2009/661/EC	step 2	2009/661/EC, step 2	step 3
2015	96.2%	3.9%	0.0%	0.0%	0.0%	0.0%
2016	77.9%	9.6%	12.5%	0.0%	0.0%	0.0%
2017	51.4%	17.3%	31.3%	0.0%	0.0%	0.0%
2018	18.7%	25.0%	56.3%	0.0%	0.0%	0.0%
2019	0.0%	14.9%	81.3%	3.9%	0.0%	0.0%
2020	0.0%	0.0%	90.4%	9.6%	0.0%	0.0%
2021	0.0%	0.0%	70.2%	17.3%	12.5%	0.0%
2022	0.0%	0.0%	43.7%	25.0%	31.3%	0.0%
2023	0.0%	0.0%	7.2%	32.7%	56.3%	3.9%
2024	0.0%	0.0%	0.0%	9.1%	81.3%	9.6%
2025	0.0%	0.0%	0.0%	0.0%	82.7%	17.3%
2026	0.0%	0.0%	0.0%	0.0%	75.0%	25.0%
2027	0.0%	0.0%	0.0%	0.0%	67.3%	32.7%
2028	0.0%	0.0%	0.0%	0.0%	59.6%	40.4%
2029	0.0%	0.0%	0.0%	0.0%	51.9%	48.1%
2030	0.0%	0.0%	0.0%	0.0%	44.2%	55.8%
2031	0.0%	0.0%	0.0%	0.0%	36.5%	63.5%
2032	0.0%	0.0%	0.0%	0.0%	28.8%	71.2%
2033	0.0%	0.0%	0.0%	0.0%	21.1%	78.9%
2034	0.0%	0.0%	0.0%	0.0%	13.4%	86.6%
2035	0.0%	0.0%	0.0%	0.0%	5.7%	94.3%
2036	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%

Table C 7: Time schema for Scenario 5