EUROPEAN TYRE & RUBBER manufacturers' association

Tyre & Road traffic noise

Where we should look for road traffic noise improvements

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Introduction

The **European Tyre & Rubber Manufacturers Association (ETRMA)** represents nearly 4.400 companies in the EU, directly employing about 370.000 people. The global sales of ETRMA's tyre corporate members represent 70% of total global tyre sales and 7 out of 10 world leaders in the sector are ETRMA Members[1]. We have a strong manufacturing and research presence within the EU and candidate countries, with 86 tyre-producing plants and 16 tyre R&D centres.

As a key actor in road transport and mobility, we wish to share with policy makers and other relevant stakeholders an objective and focused analysis of the conditions and parameters that will best contribute to achieving the EU overall target of reducing traffic noise.

The European tyre industry recognises the need to contribute to the reduction of noise pollution and is committed to work with all the key stakeholders to make this transition a success.

The tyre industry is aware of its legal obligations under the EU as well as of the recent on going studies investigating the current sound emission levels of M and N category vehicles to propose possible improved sound level limits for the next phases of the Regulation (EU) No 540/2014 in the coming years.

Relevant progress has already been made over the last 15 years by the tyre industry to reduce the rolling noise by up to 5dB, more than halving sound emissions.

With this document, the European tyre industry intends to provide its views on the EC preliminary direction to achieve a further reduction of traffic noise, as well as to make feasible proposals, based on the analysis of technical facts.

Furthermore, the tyre industry would like to underline the importance of a holistic approach in effectively tackling traffic road noise, in the context of the balanced safety and environmental performances of tyres, and also committing to keep playing a key role in the achievement of the European Commission ambitions.

Industry key ask

The tyre industry asks that rather than focusing only on tightening rolling sound limits for tyres, attention should be paid to improving the accuracy of the noise measurement method, which is a crucial point for a reliable policy that benefits the entire noise ecosystem, as no requirements on road pavement noise exist at the moment.

We believe that the road system could bring relevant value in a truly holistic approach to mitigating traffic road noise.

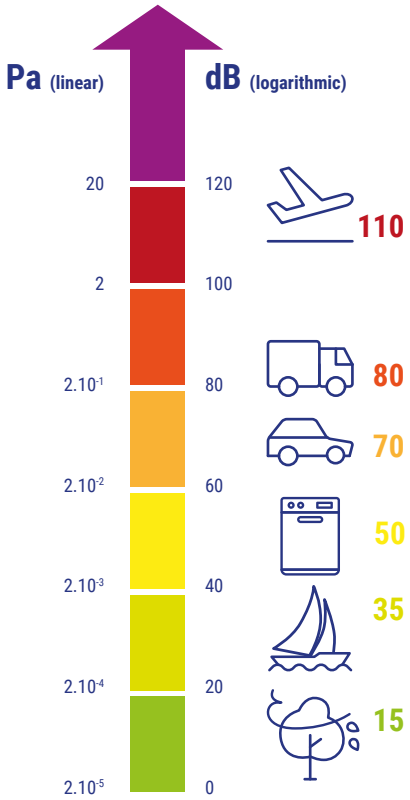
1 ETRMA's membership: APOLLO VREDESTEIN, BRIDGESTONE EUROPE, BRISA, CONTINENTAL, GOODYEAR, HANKOOK, MARANGONI, MICHELIN, NEXEN TIRE EUROPE, NOKIAN TYRES, PIRELLI, PROMETEON, SUMITOMO RUBBER INDUSTRIES AND TRELLEBORG WHEEL SYSTEMS. Furthermore, members include Associations in the following countries: Czech Republic, Finland, France, Germany, Hungary, Italy, the Netherlands, Poland, Slovak Republic, Spain and the UK (as of 1st January 2022).

How to measure noise

Road/tyre interaction generates noise emissions and, irrespective of the fact that cars have reduced the sound emitted, the tyres have become “quieter”, to the point that the tyre industry has already lowered noise emissions by far more than half over the past 15 years. However, no matter how quiet individual cars and tyres are today, the traffic noise continues to increase. The respective successes, of cars and tyres, on noise emissions reduction have been negatively compensated by bigger cars and higher traffic density as well as non-approved modifications by vehicle owners to increase engine noise. Noise reduction has also been achieved through technical advances in road surface construction, however this remains a solution that is too often overlooked.

When we speak about noise it becomes relevant to clarify the meaning of its measurement unit, decibel (dB).

Meaning of decibel



The sound pressure level (SPL) is a ratio between the sound emitted by a source and the reference human audibility.

This sound pressure level (SPL) is usually expressed in decibel (dB) – a **logarithmic**, not linear, **scale**.

This means for example that **reducing sound pressure level (SPL) by 3dB is the same as halving the sound energy.**

If one car emits 70dB, for instance, the sum of the sound emitted by two cars is not 140dB but 73dB.

Thus, noise reduction expressed in dB, may appear limited, but it has a major impact on sound energy and noise emission.

Noise is the result of vehicle, tyre and road interaction.

Tyres alone do not generate noise!

Road traffic noise is caused by a combination of rolling noise (linked to the interactions between the tyre on the vehicle and the road surface) and propulsion noise (originating from the engine itself). In general, above certain speeds the noise

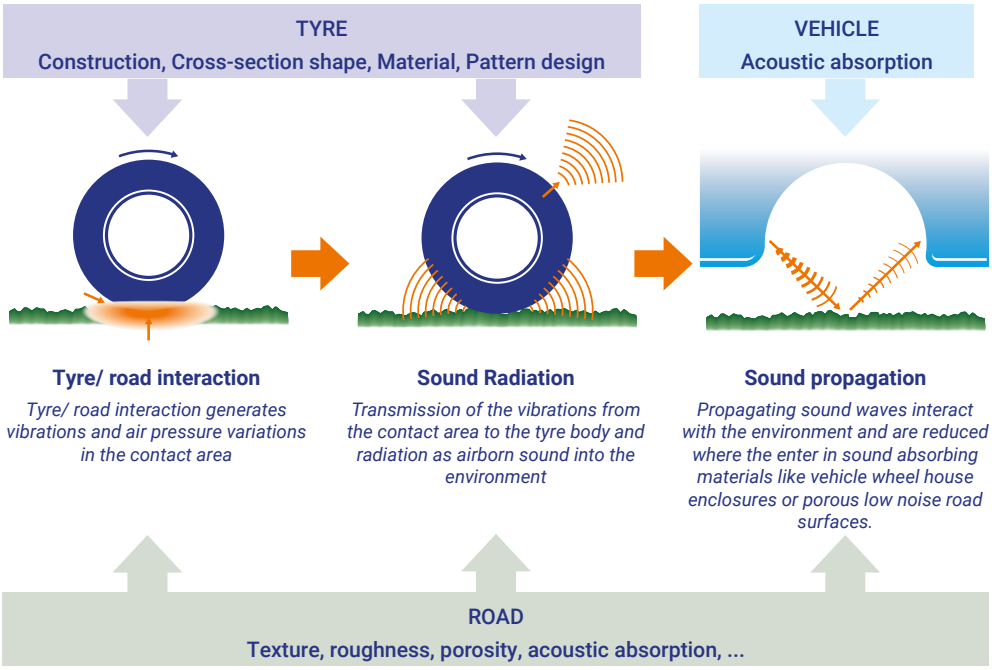
generated by tyre-road interaction becomes more relevant. Rolling noise dominates noise emissions when cars are travelling above approximately 30 kilometres per hour (km/h), while propulsion noise is the major source of noise below this speed or during high acceleration.[2]

The generation mechanism of tyre-road noise is made of several steps:

- Noise excitation
- Noise radiation
- Noise propagation

Each of them being influenced by several key factors like:

- **Tyres**' construction, cross section shape, material, pattern design;
- **Roads**' texture, roughness, porosity, surface damage, acoustic absorption;
- **Vehicles**' acoustic absorption and shielding.



As already specified in April 2017 in the European Commission report "*FUTURE BRIEF: Noise abatement approaches*"[3], road surfaces can have a significant influence on the sound produced by vehicles travelling on them and the benefits of low noise tyres are positively enhanced when applied on noise-reducing road surfaces.

Low-noise road surfaces are an optimal solution to reduce noise because they directly act on the source and therefore on all type of rolling tyres placed on the market and fitted to all travelling vehicles, and provide an acoustical benefit to the entire population living near those roads.

Important characteristics of road surfaces include their roughness, porosity and elasticity. These factors can be influenced by the amount and type of binder used (asphalt or cement concrete, for example), the mix (such as the shape and type of stones used in the mineral aggregate) and the surface treatment.[4]

2 https://ec.europa.eu/environment/integration/research/newsalert/pdf/noise_abatement_approaches_FB17_en.pdf
3 https://ec.europa.eu/environment/integration/research/newsalert/pdf/noise_abatement_approaches_FB17_en.pdf
4 Kropp et al., 2007

Some studies[5] also show that “rubberised asphalt layers provide a safe, cost effective road surface and environmentally friendly option of method of paving. Rubberized bituminous mixtures could be a good solution for the re-surfacing of any street which is in poor condition, since it reduces noise generation”.

It is important to note that low-noise road surfaces are more impactful where rolling noise dominates. Where engine noise is the main source of noise pollution, their value is limited.

Low-noise road surfaces also have advantages over other mitigation approaches as they reduce noise for all buildings near to roads, as opposed to sound insulation for example, which only benefits the protected building (Murphy and King, 2014).

Although many EU countries already use quiet road surfaces, the ultimate goal is to have minimum requirements on the noise characteristics of European road surfaces.

Moreover, the objective in the immediate future, is not to lay down in all the EU roads those low-noise road surfaces, but rather giving priority to the nosiest areas with the highest positive impact on citizens' lives.

5 Environmental Noise Performance of Rubberized Asphalt Mixtures: Lamia's case study https://www.sciencedirect.com/science/article/pii/S1878029617301767

Industry achievements and current status regarding noise reduction

Road/tyre interaction generates noise emissions. Tyres deployment has made a significant contribution to reducing vehicle noise emissions: the industry has lowered tyre noise emissions by more than half, whilst continuing to improve fuel efficiency and traffic safety. However, no matter how quiet individual cars and tyres are today, traffic noise continues to increase.

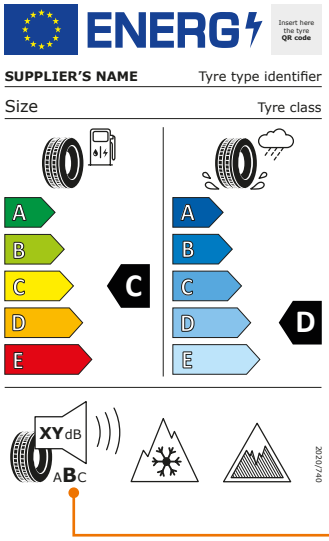
Bigger cars, higher traffic density and “unregulated” road surface construction have overwhelmed the individual improvements of cars and tyres.

The European tyre industry's commitment to contributing to the reduction of tyre/road noise emissions was accompanied by successive regulations **that have already reduced** by 3 to 5 dB the tyre rolling noise emissions, corresponding to a **sound energy reduction between 50% and 70%.**

As a result, **tyres have approached the physical limits for improved noise performance. Because tyre noise levels are currently already close to this limit, any further noise reduction will negatively impact other significant tyre performances, for instance rolling resistance, that contributes to fuel efficiency, and wet grip, that contributes to traffic safety.** These latter are the key priorities, if aiming at ambitious achievements on climate change and reducing road accidents and fatalities.

Before potentially tightening rolling sound limits for tyres, attention should be paid to **improving the accuracy of noise measurement method**, which is crucial for a reliable regulation that benefits the entire noise ecosystem (recall that no requirements on road pavement noise are existing).

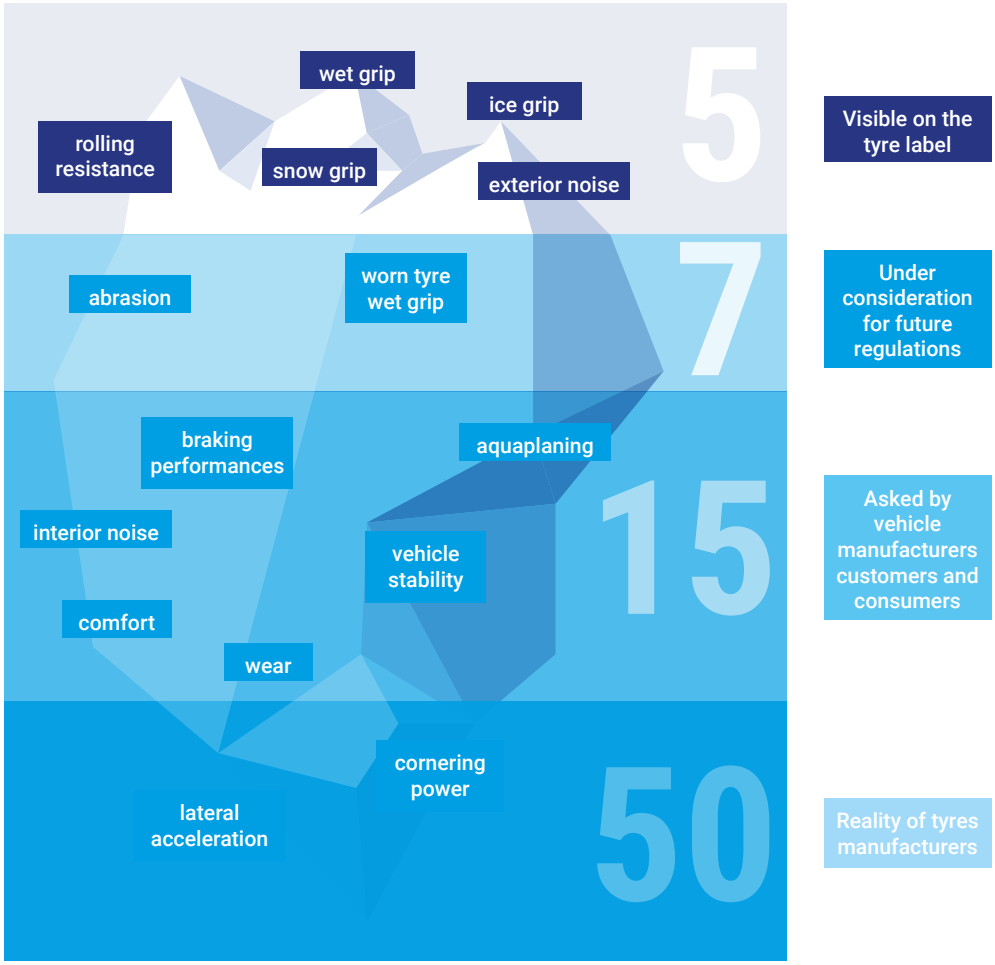
Some studies[6] claim that there is the possibility for noise limits improvements with no trade-off, however in reality **target conflicts do exist, especially among performances not visible on the label** like braking performance, aquaplaning, interior noise, vehicle stability, abrasion, wear, comfort, cornering power, lateral acceleration.



Tyre industry policy is to continue tyre-road noise reduction while maintaining and improving safety characteristics of the tyres.

A recent study[7], analysing EU market according to EU Label 1222/2009 applied until May 2021, shows that 78.8% of the C1 summer market presents moderate noise rating (2 waves), while only 8,7 % of the market presents quiet (1 wave) noise rating.

6 Phenomena.
7 https://www.etrma.org/wp-content/uploads/2021/04/ETRMA-UPDATED-LIZEO-REPORT-2021.pdf



Source: ETRMA

We always consider three tyre performances (rolling resistance, exterior noise, wet grip), which are those regulated under the existing Tyre label Regulation and General Safety Regulation.[8] Recently also Snow and Ice Grip performances have been added and two others performances are under consideration: tyre abrasion and worn tyre wet grip.

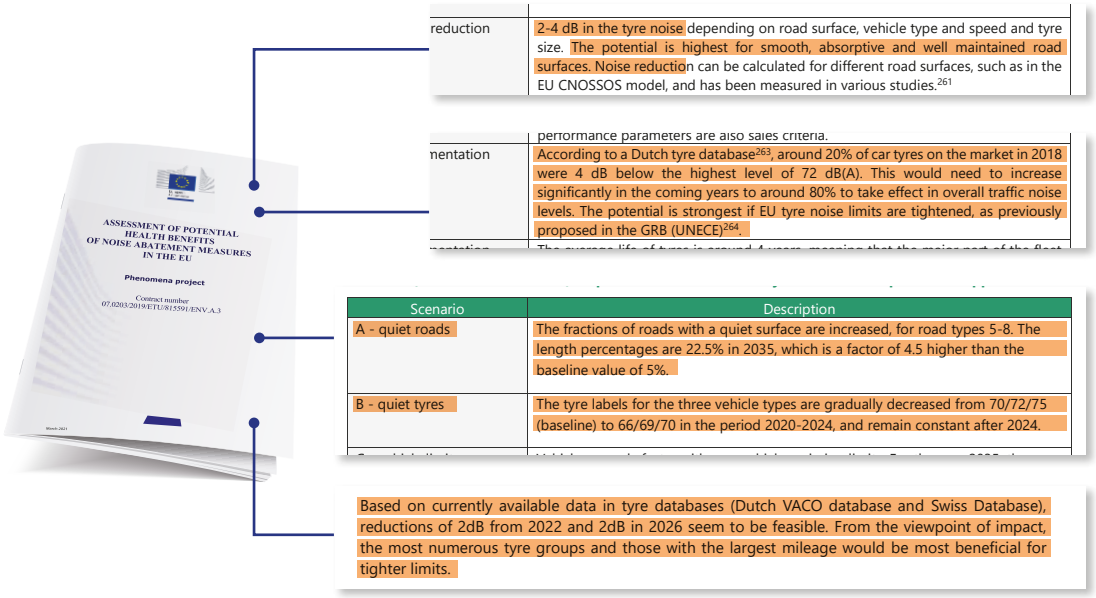
However, the vehicle manufactures already take into consideration about 15 tyre performances, and in reality, the tyre manufacturers are looking at around 50 tyre performances that need to be evaluated and balanced to optimise comprehensive tyre performance.

Existing trade-offs are largely linked to currently non-regulated tyre performances, that are part of the forthcoming regulatory approach, which the tyre industry supports. Hence, trade-offs linked to **non-regulated performances are being overlooked by the majority of studies,** which were all based on the tyre label assessment.

8 Other tyre performances and characteristics are regulated by the following UN regulations: UN R30, R54, R117.

Trade-offs linked to non-regulated performances are being overlooked by the majority of studies:

- Referring to available data-sets and not collecting new measurement data vs non-regulated performances.
- Often referring to old data sets.
- Assessments of potential noise improvements by the tyre are based just on evaluations of label databases, which refer only to regulated performances.
- **Effect of quiet roads is mentioned, but often underrated** because it is assumed that it will be high cost (not quantified in detail). A quiet road will however benefit immediately all the vehicles and all surrounding citizens, without the need to wait for the market renovation at critical locations.



Source: Phenomena Study[9].

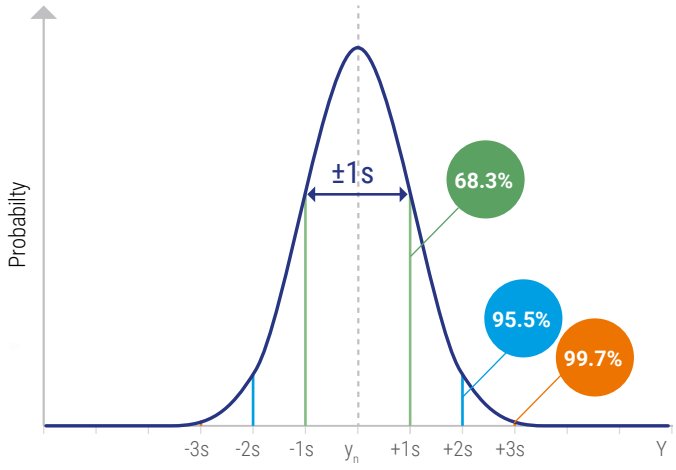
Examples that illustrate how key trade-offs are largely linked to currently non – regulated performances, can be found in the Appendix.

9 https://circabc.europa.eu/ui/group/7ee2560e-7a0d-4e16-8c61-f3a05ee2dd6f/library/4d217fe9-5fab-48f5-ae6d-cf38657b596e

The central role of noise measurement accuracy

The tyre industry believes that margins for improvement of noise reduction could be found deeply analysing the **noise measurement uncertainty. The tyre industry has been engaged in a process to improve the noise measurement method, in order to allow lower sound emissions.**

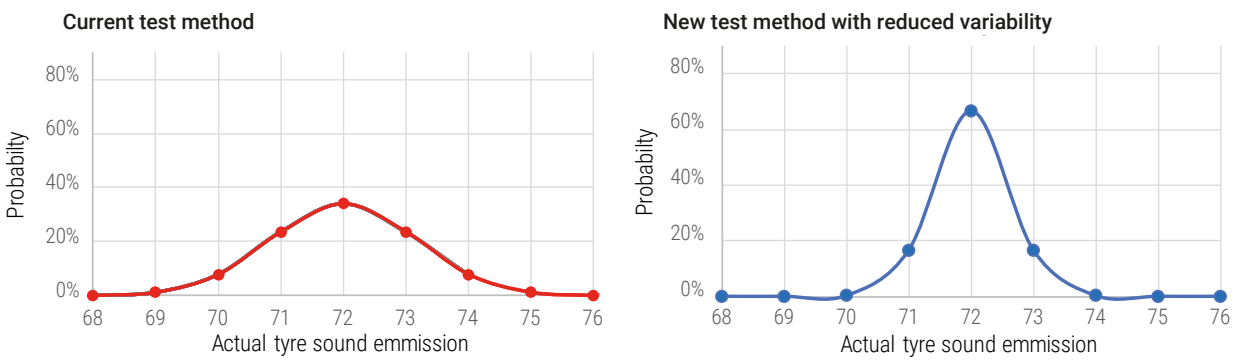
Each measurement method has a certain measurement uncertainty. This means that when a noise test is repeated multiple times, different noise values will be found. The "true" or "actual" noise value of a tyre corresponds to the average value of all noise measurements for this tyre. All measured values for this tyre will be distributed around the true noise value. The standard deviation is a measure for how large is the spread around the true noise value. The standard deviation for the current test method is 1.17 dB(A). This means that 95% of all measured values will be in the range of -2.3 dB to +2.3 dB around the true noise level of the tyre (so-called 95% confidence interval).



Source: ETRMA

Due to the variability of the current test method, it is possible that tyres are homologated even if they have a true noise level above the limit. For instance, if the noise limit is 72 dB(A), there is approximately a 20% probability that a tyre with a true noise level of 73 dB(A) will be measured at a noise level of 72dB or below. Obviously, the higher the true noise level of the tyre, the less likely it becomes that the measured noise value will be below 72 dB. For a tyre with a true noise level of 76 dB this probability is close to 0%.

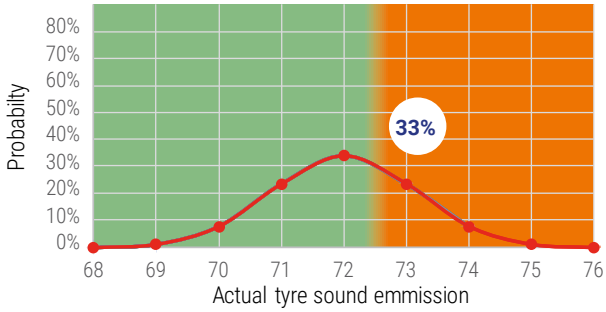
Probability of the true value for a 72 dB measured value



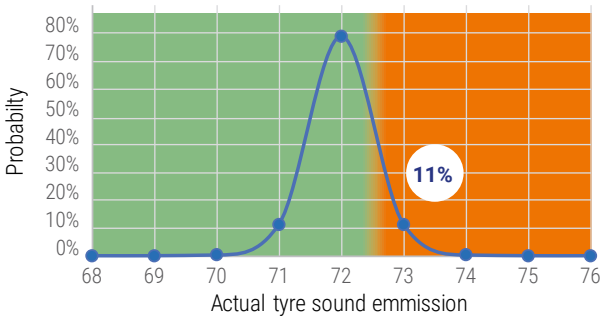
Once a **new method** will be available, with lower uncertainty, this will not be possible anymore. Tyres "in the range of more than 2 dB above the current limits", which today can benefit from the variability, could not be homologated anymore.

To quantify the potential, we need to consider that with current measurement uncertainty, there is a statistical probability that **1 out of 3 tyres measured at the limit value is approved as compliant with the limit although its noise emissions are actually above the limits.**

Actual sound vs measured value measured value: 72 dB, threshold 72 with existing std deviation 1.17 dB



Actual sound vs measured value measured value: 72 dB, threshold 72 with standard deviation 0.5 dB



Assuming a strong improvement of measurement uncertainties (standard deviation from current 1.17 dB(A) to 0.7-0.5 dB(A)), the proportion of tyres in this category will be reduced by **potentially up to 10%, so that tyres 2dB(A) above the threshold will be eliminated.**

Although tyre manufacturers type approve a tyre based on a measured value below the limit value, the tyre industry would like to draw attention to the fact that the uncertainty of the measurement is so high that statistically we cannot assure that all the tyres on the market have a true noise value which is below the limit.

The tyre industry strongly recommends the implementation of a new accurate methodology, which will have two immediate positive effects:

- **Introduce certainty in the tyre type approval system;**
- **Force all the tyre makers to adapt or re-design the tyres in order to be in compliance with the regulation, according to the new measurement procedure.**

Detailed plan on noise measurement uncertainty

The standard deviation for the current test method is 1.17 dB(A). This means that 95% of all measured values will be in the range of -2.3 dB to +2.3 dB around the true noise level of the tyre.

The Tyre industry proposal to reduce uncertainty is made of the concrete following steps:

1. A first reduction of 0,4 dB, bringing the current 2,3dB to future 1,9 dB will be realised thanks to noise measurement method improvement of uncertainty factors stated in the UN regulation R117;[10]

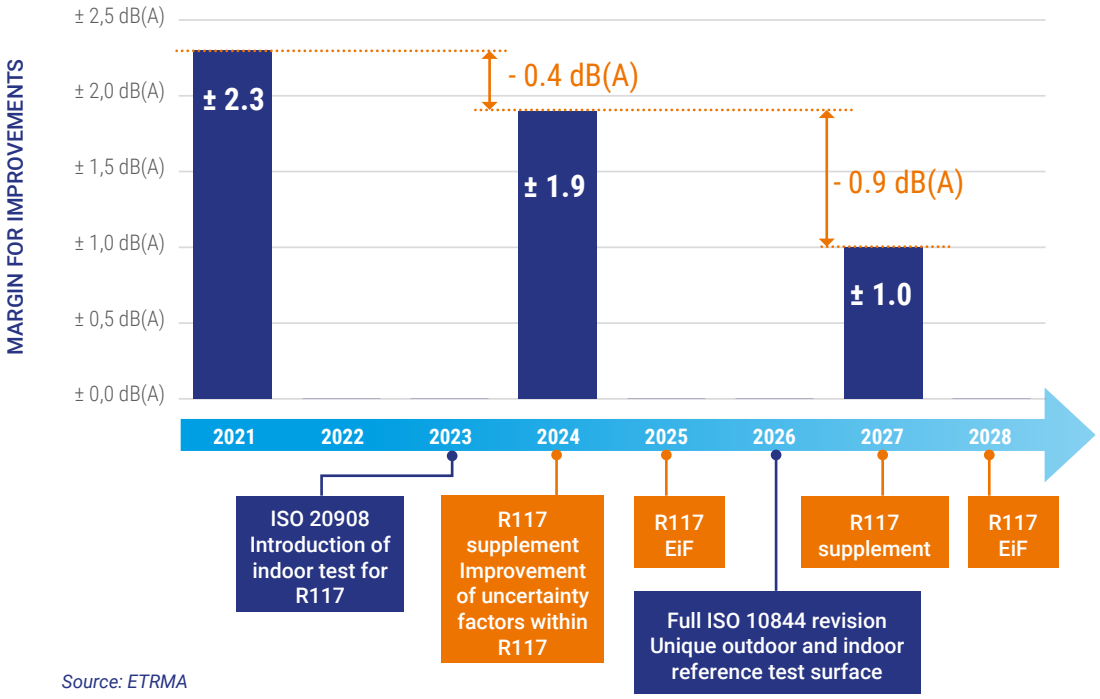
2. An additional 0,9 dB reduction will be implemented by 2027 with the revision of ISO10844 test tracks with the main focus on measurement uncertainty.

The above-mentioned steps can result in an important 1.3 dB improvement of tyre noise in the environment.

10 https://unece.org/transport/documents/2021/02/standards/un-regulation-no-117-rev4-amend4

The roadmap here illustrated, specifies in details the steps the industry plans to take, while investigating further methodologies to accelerate the process.

Proposed targets (with a 95% confidence interval) to achieve in order to reduce uncertainly in R117



Source: ETRMA

The tyre industry is looking for concrete solutions to reduce the measurement uncertainty by 1,3 dB. This will allow to remove from the roads a significant amount of noisy tyres, which due to the test uncertainty, are now allowed in the market.

Exploring the potential for transport noise reduction

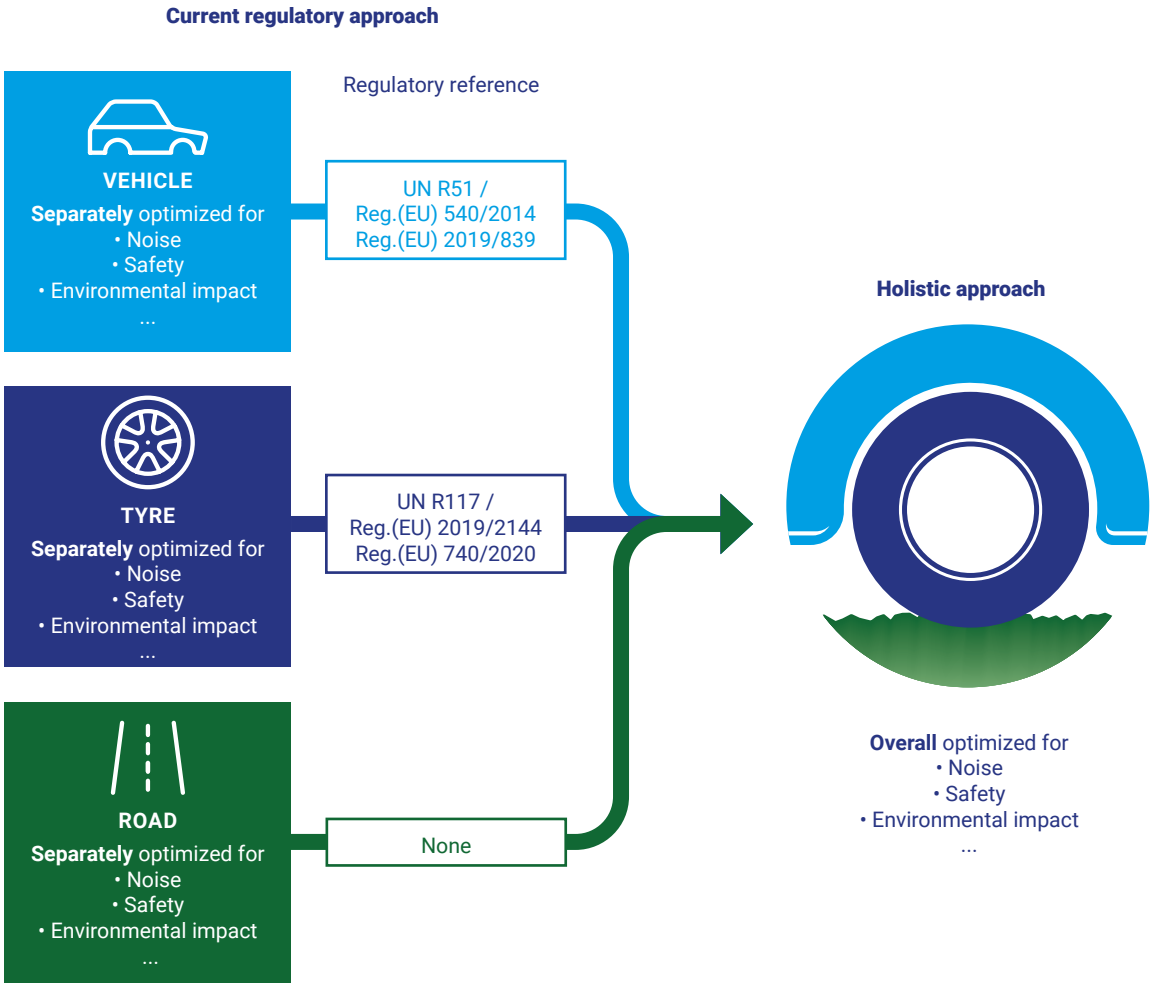
The tyre industry strongly supports a holistic approach able to optimise overall safety and environmental impact while improving the tyre and road noise. Balanced requirements could deliver even higher noise reduction with lower trade-offs on overall system performance.

The current regulatory approach is ruling separately the:

- **vehicle** via UNR51, Reg.(EU) 540/2014 and Reg.(EU) 2019/839
- **tyre** via UNR117, Reg.(EU) 2019/2144 and Reg. (EU) 2020/740
- **road**, with a regulation that could be introduced.

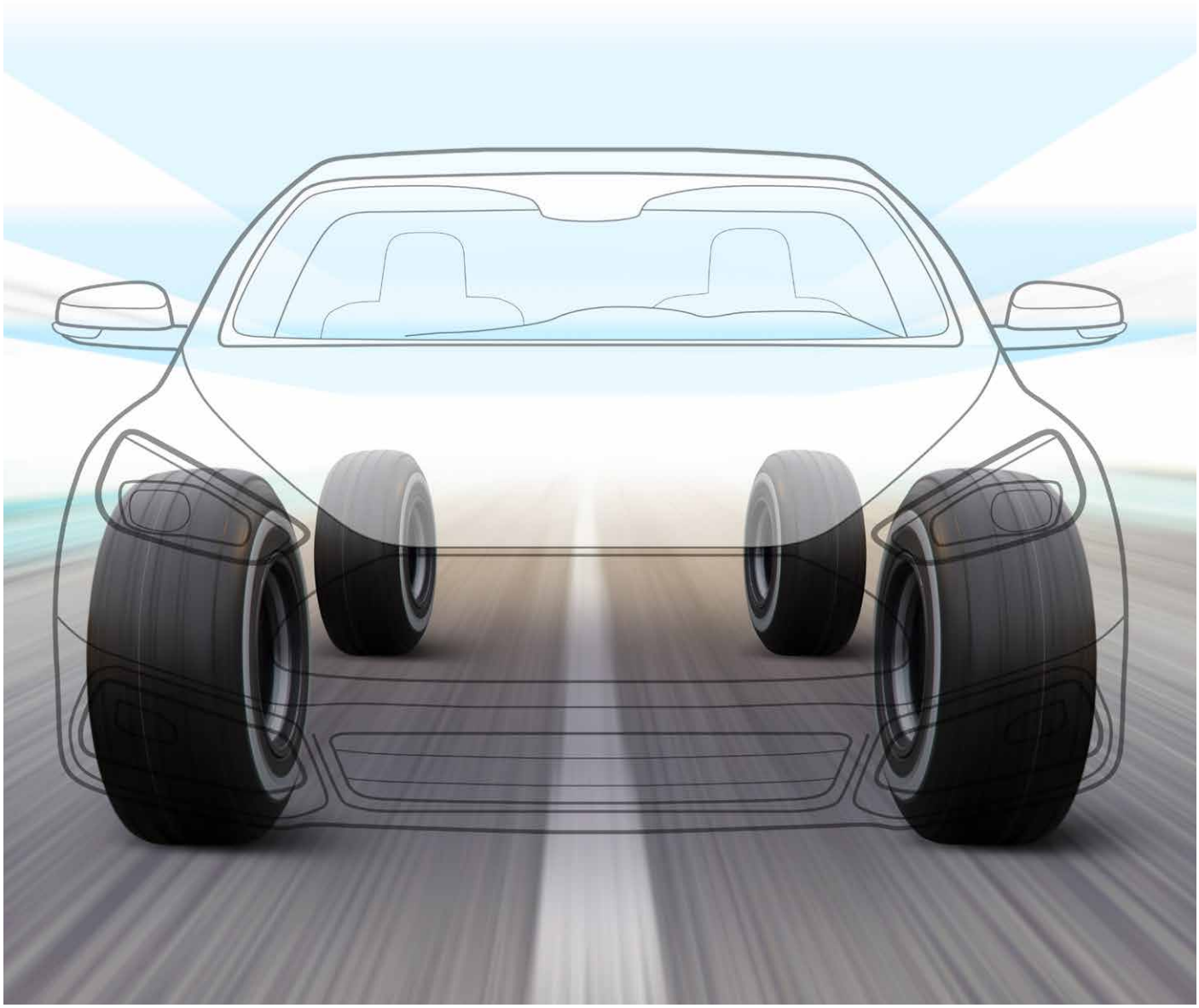
In so doing the regulator aims at noise reduction with the lowest trade-off respectively on vehicle performances and tyre performances, in a context where there is **separate optimisation of noise, safety, environmental impact** and other key parameters.

The suggested holistic approach, which integrates vehicle, tyre and road, aims instead at an overall optimisation for noise, safety and environmental impact.



The main reason why the tyre industry strongly believes in the holistic approach is also linked to the fact that addressing tyre noise limits only, will not address the major disturbances of noise peaks that would remain out of scope. Taking into account the masking effect of the peak (see Appendix, page 18), the progress made on threshold will not be perceived by citizens.

For further explanations on masking effect and peaks, please refer to the Appendix.



The tyre industry vision and proposal for real-world time effective noise improvements, safeguarding other ambitious sustainability and safety priorities

The tyre industry target is to continue tyre-road noise reduction, while maintaining and improving safety characteristics of the tyres. In order to obtain relevant results the following points must be addressed.

Measurement Uncertainty

There is a potential to address a part of the market that may result in non-compliance when tested with a more accurate method and thus require re-design for noise reduction and improvements.

Industry is working on very clear deadlines to achieve these improvements.

Trade-offs

Key trade-offs concern parameters that are now under consideration for future regulation, and, as already explained, non regulated tyre performances are in clear trade-off with noise performance. For instance, hydroplaning has evident trade-off with worn tyre wet grip, as well as abrasion has with tyre wear.

The tyre industry is fully committed to working on performances that meet the climate and circular economy ambitions of the Green Deal, while improving safety performance.

To ensure this ambition, physics must be taken into account: both trade-offs and physical limits reduce the possibility of tyre noise tightening.

At the same time, solutions to improve road noise exist. The tyre industry is already working on improving the accuracy of the measurement method, in order to ensure concrete progress.

Conclusions

Renewing its strong commitment to reduce traffic noise, the tyre industry asks to prioritise improvement of measurement uncertainty over further tighntening of limits. The industry is committed to investing in the:

- Planning and progress of test method development;
- Significant improvement of measurement uncertainty, which is connected to the introduction of indoor tyre noise test ISO 20908 and especially a completely revised concept with a worldwide unique test track surface within ISO 10844.

In order to achieve the European Commission targets in terms of traffic noise reduction, it will be key **to support the assessment of methodologies necessary to evaluate the whole mobility ecosystem**, e.g. road surface, peak noise, traffic regulations, etc. **and stimulate its improvement regarding noise, launching project calls on road/tyre interaction optimisation for noise and developing a road labelling approach.**

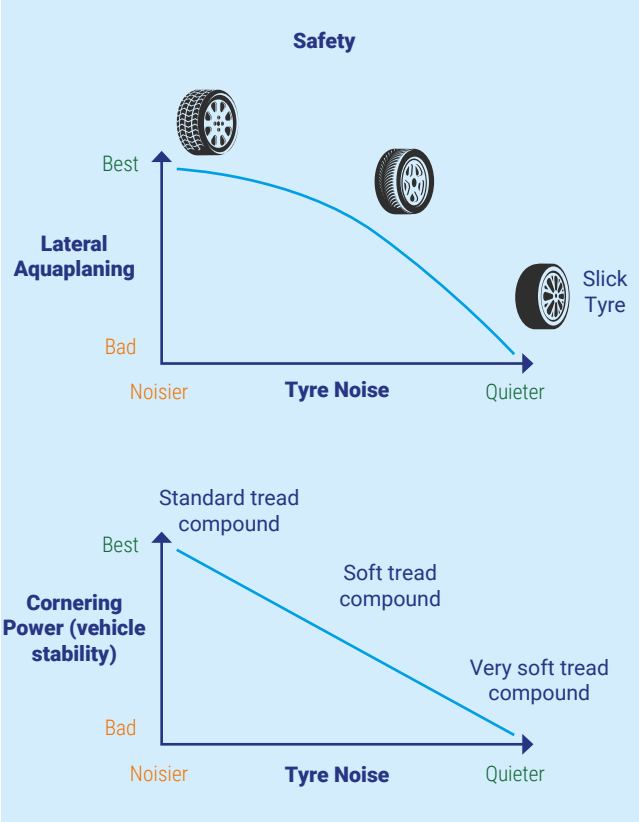
We need an integrated approach, where all the concerned actors join forces to reduce the acoustic burden weighing on the society, bringing together all the stakeholders –central governments, local governments/municipalities, tyre manufacturers, car manufacturers, road makers and drivers.

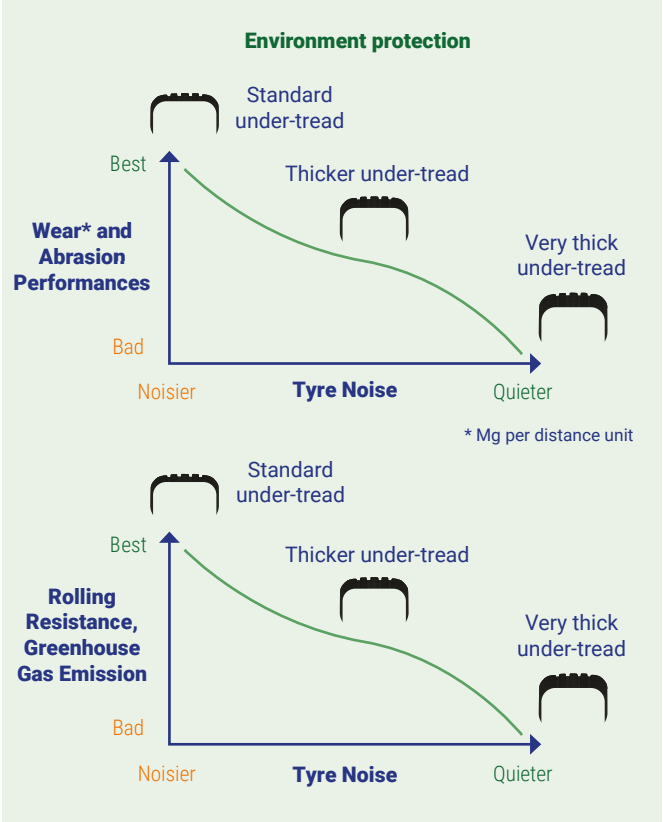
Appendix

General tyre technology trade-offs

Trade-offs are often correlated to currently not-regulated tyre performances, which are part of the upcoming regulation, fully supported by the tyre industry.

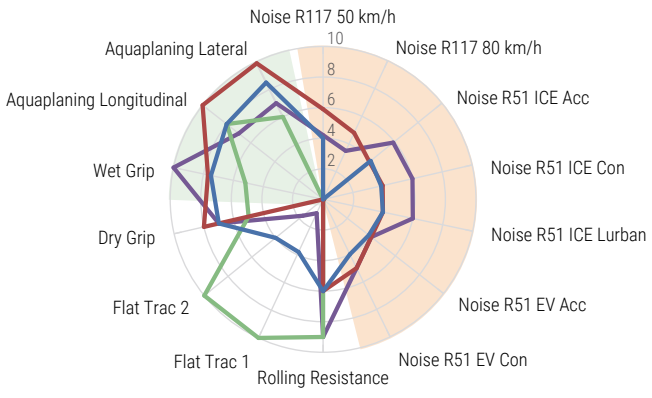
The following examples have an illustrative purpose, to show the actual design trade-offs that tyre manufactures face.





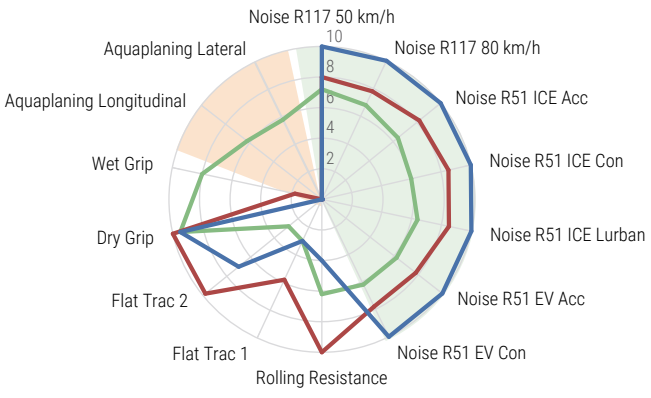
The following graphs reflect real data for different tyres sets.

Best tyres for wet safety
→ Worse for Rolling Sound Emission



Flat Trac 1 and Flat Trac 2 are a measurement of the tyre cornering stiffness of the tyre measured on a Flat Trac machine in two different load conditions and represent here the dry handling performance.

Best tyres for Rolling Sound Emission
→ Worse for Aquaplaning



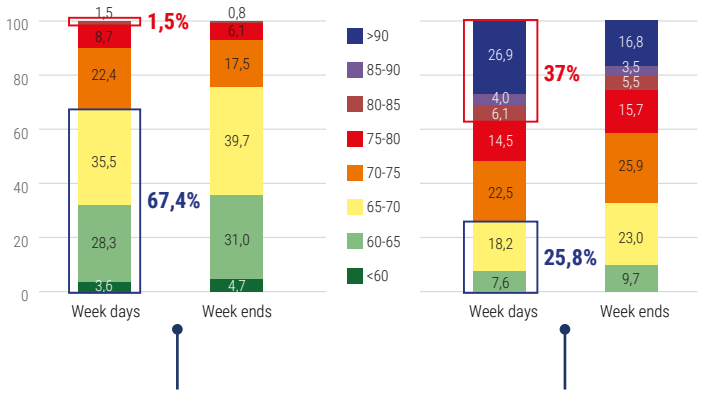
acc = acceleration
con = constant speed (=km/h)
L urban = reported vehicle sound pressure level representing urban operation

Focus on effects: Local peaks disturbance

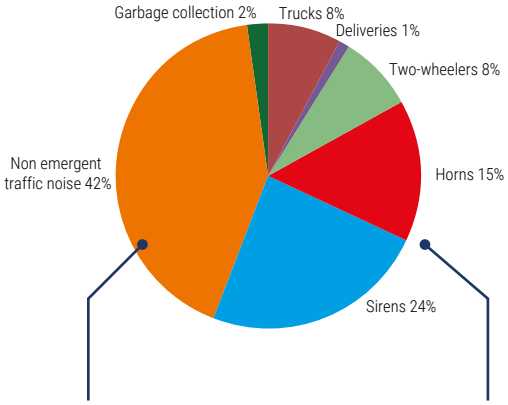
L_{den} does not consider local peaks, which have a strong impact

L_{den} - Day-evening-night level - is a descriptor of noise level based on energy equivalent noise level (Leq) over a whole day with a penalty of 10 dB (A) for night time noise (23.00-7.00) and an additional penalty of 5 dB (A) for evening noise (i.e. 19.00-23.00).

Proportion of events per range of sound level (Site: rue Frémicourt, Paris 15)



Case Study[10] City center road (Site: rue des Haudriettes, Paris 3)



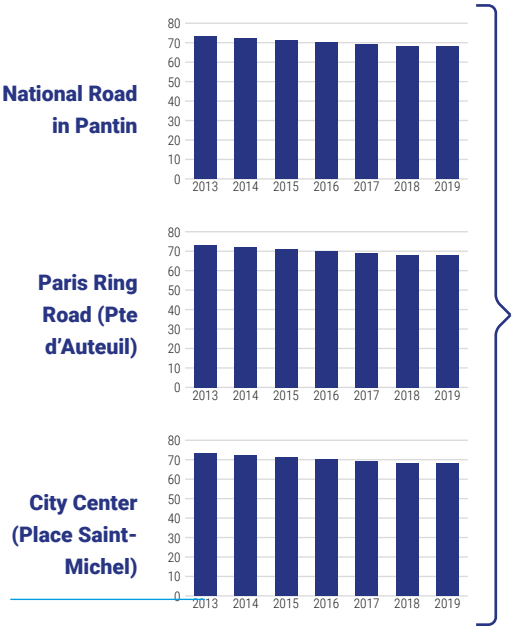
However Lden calculation does not consider them: regulatory limits on tyres and vehicles does not address the major disturbance as it is measured and felt by citizen.

Local peaks represent a major part of local (not only traffic) sound emission.

Vehicles and tyres non emergent sound only taken in consideration

Main local peaks sources are
- Horns and sirens
- 2 wheels
- Trucks

Addressing tyre noise limits will not address the major disturbances that would remain out of scope. Taking into account the masking effect of the peak, the progress made on threshold will not be perceived by citizens.



Gradual improvements, made thanks to regulations implementation, remain neglectable in the reduction of noise.

Since masking effects and peaks persist and tend to invalidate them.

Masking effect : vehicle at 68 dB + motorbike at 80.3 dB equivalent to a total of 80.6 dB : no impact of the vehicle sound emission, nor of vehicle sound emission reduction.

10 https://wiki.unece.org/download/attachments/128421111/TFSL-03-05%20%28France-Bruitparif%29%2020210712_Bruitparif%20VF.pdf?api=v2

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