Bernd Lange

Member of the European Parliament

Born in 1955 in Varel/Friesland Bernd Lange studied **Politics and Protestant Theology** in **Göttingen** and worked as a teacher at the secondary school in Burgdorf for 11 years.

From 1994 to 2004, Bernd Lange represented the **German Social Democratic Party** (SPD) of Lower Saxony as a **Member of the European Parliament in Brussels**. During this time, he was significantly involved in the introduction of the European Emission Control legislation. He was awarded the Federal Cross of Merit of the Federal Republic of Germany.

From 1999 to 2004 Bernd Lange worked as the **head of the "Economy, Environment and Europe"**- department at the **German Trade Union Federation in Lower Saxony**.

Since 2009, Bernd Lange is again **Member of the European Parliament**. He is a full member of the **INTA-Committee for International Trade** and a substitute member in the **ITRE Committee for Industry, Research and Energy**. He is also a member of the Delegation for Relations with South Africa and Co-Chairman of the Forum for the Automobile and Society in Brussels.

BERND LANGE
MITGLIED DES EUROPÄISCHEN PARLAMENTS

Bernd Lange became a member of the **SPD** in 1974 when he was a High School student.
Five years later he entered the Trade Union. During his time at university, he was president of the Students' Assembly and chairman of the Students' Union Executive Committee.
Among many positions within the SPD, he is chairman of the SPD Burgdorf since 1992 continuously.

Memberships:
Bernd Lange is a member of the Industrial Union of Metalworkers in Germany (IG Metall), the German Workers' Welfare Organisation (AWO), the Europa-Union, the Auto Club Europa (ACE), the German Life Saving Association (DLRG), the Association for Transport and

Beautification Burgdorf (VVV Burgdorf) and the Forum for Politics and Culture in Hannover.

Pierre Caussade
Vice-president Environment and Sustainable Development
Air-France KLM

A graduate of the French *Ecole Polytechnique* and the French *Civil Aviation National School*, Pierre Caussade started out with **DGAC, the French Civil Aviation Authority**, which is part of the Ministry of Transport, before moving to the "**Aéroports de Paris", ,** Paris Airports authority.

After joining **Air France** in 1979, he occupied a range of Company executive positions in Operations and the General Management.
He was VP Technical Flight Operations from 1996 to 2006, and in October of that year he was appointed senior VP Environment and Sustainable Development.

At international level he represents Air France-KLM on the Environment Committee of the International Air Transport Association (IATA).

Aircraft noise and mitigation strategy

Noise at source

Two “families” of noise contribute to the overall noise made by an aircraft: engine noise, and aerodynamic noise. Engine noise, of course, is closely linked to the revolutions and thrust it delivers. Aerodynamic noise is generated by all the components that contribute to keeping the aircraft in flight – its wings, stabilizers, rudders and flaps, air brakes, and high-lift leading edge slats and flaps, not to mention the noise of the landing gear when it is lowered. The amount of aerodynamic noise depends both on the speed of the aircraft and the position of these various components, as, for example, when the slats and flaps are extended, the rudder is moved, the landing gear deployed, and so on.
The engines are operated at a very high regime on take-off, so the noise they generate predominates during this phase.

During landing, the engine regime is close to idling, whereas the slats and flaps are generally fully extended, and, of course, the landing gear is lowered. So it is aerodynamic noise that predominates during this particular phase.

The noise generated on take-off and landing, the two phases during which the aircraft is most audible differ in their nature and intensity. Consequently, the acoustic certification of aircraft involves a specific procedure for each phase.

Certification, an aid to qualifying and limiting noise at source

Acoustic certification standards and procedures are drawn up by the International Civil Aviation Organization (ICAO), the UN organization in charge of international air transport regulation. Starting from the observation that aircraft noise can trigger fierce rejection on the part of the general public, and for that very reason can constitute a threat to the development of commercial aviation, the ICAO started taking measures designed to limit noise hindrance as of early 1970s. Aircraft acoustic certification was the first measure to be implemented. It is still used as the main aid to managing the noise environment.

The ICAO structured its certification around two aspects:

- measure characteristic noise at take-off and landing using a procedure common to all commercial aircraft
- set certified noise limits that must not be exceeded

An aircraft whose certified noise levels exceed the limits set by the ICAO cannot be granted an airworthiness certificate.

However to ensure that noise certification does not disadvantage or exclude one market segment relative to another (eg, medium-haul commercial aircraft in relation to business aviation aircraft, which are lighter), the limits are adjusted according to the mass of the aircraft and its propulsion mode.

The difference between the noise limits and the certified noise of an aircraft is known as the cumulative noise margin. The cumulative noise margin is thus a marker for the acoustic quality of an aircraft independently of its mass, and hence of its market segment.

The continuous raising of certification standards

Down the years, the ICAO has lowered its noise levels to encourage manufacturers to build-in the best acoustic technology, and to encourage operators to retire their noisiest aircraft.

Each increase in certification requirements gives rise to the publication of a new “Chapter” included in the ICAO’s Annex 16.

Chapter 2 concerns aircraft types certified before 1977. “Chapter 2” aircraft have been banned from operating in Europe and in many other countries since 2002.

Chapter 3 concerns aircraft types certified after 1977. The vast majority of aircraft in operation today falls under Chapter 3. But numerous airports have placed restrictions on Chapter 3 aircraft with very small cumulative noise margins. For example, Chapter 3 aircraft with less than 5dB of margin have been banned from operating at CDG since 2008.

Chapter 4 aircraft are certified according to the same protocol as those of Chapter 3, but they must have a cumulative noise margin greater than 10dB. Since 2006, only aircraft falling within Chapter 4 can obtain its type certification.

The certification chapter, the noise certification, and the cumulative noise margin are the basic criteria used to draw up the operating restrictions under the so called "ICAO’s balanced approach".

A pertinent concept: the ICAO’s Balanced Approach

The ICAO has developed the concept of the “Balanced Approach” to maximize the effect of noise reduction at source resulting from the raising of certification standards. The Balanced

Approach is a shared programme to combat perceived noise. Every stakeholder contributes to developing a comprehensive solution to improve the noise environment:

- Use by aircraft operators of less noisy aircraft on the basis of certified noise utilisation,
- Deployment of noise mitigation procedures by air traffic control and airlines,
- Adoption of land-use rules by the government and local communities,
- Implementation of operating restrictions as a last resort.

The transposition of the Balanced Approach into European Union law

The European community adopted the recommendations of the Balanced Approach in its Directive 2002/30/EC. This directive is a set of guidelines, one of whose key objectives as set out in Article 1c is to "promote development of airport capacity in harmony with the environment." This text is therefore entirely in line with sustainability principles.

Application of the Balanced Approach at French airports

France has adopted exhaustive use of the Balanced Approach. Continuous fleet renewal by airlines and improved procedures have considerably reduced noise at source and limited perceived noise. The French State has also developed an original, consistent system to protect people living near airports. Land use depends on their exposure to noise, as shown by their location on the Noise Exposure Map (PEB: *Plan d'exposition au Bruit*): the greater the noise, the more stringent the land-use rules. In parallel, residents exposed to a certain level of noise, as shown by the position of their homes on the Noise Hindrance Map (PGS: *Plan de Gêne Sonore*) receive grants to help soundproof their homes. Oversight of PEBs and PGSs, along with the deployment of restrictions and any modifications to procedures, are presented, assessed and discussed by all stakeholders in the airport's Environmental Advisory Committee.

Claude Cham

Chairman

Union Routière de France (URF)

Employment history:

2008-2009: Chairman "Union Routière de France" (French Road Federation)

2007 August: Retirement from Goodyear-Dunlop Tires Europe

2000-2007: Vice-Chairman Goodyear-Dunlop Tires Europe (Joint-venture between Goodyear and Sumitomo Rubber)

1987-2000: President & CEO Dunlop South Europe, Middle East and Africa (subsidiary of Sumitomo Rubber Industries Ltd.)

1990-1999: Board member Sumitomo Rubber Europe

1987-1999: President Dunlopillo-France (bedding and car seat)

1990-1999: President TRECA (bedding and car seat)

1991-1999: President ONIRIS, the second largest European bedding company for foam, latex end spring mattress, result of the merger between Dunlopillo and Treca companies.

1986-1987: Managing Director Dunlop France (Subsidiary of Sumitomo Rubber Industries Ltd.)

1984-1986: General Secretary Dunlop France (Sumitomo Rubber Industries took over Dunlop activities in USA & Europe in 1984-1985)

1978-1984: Managing Director SAMOR/SAPSER (Paris Airports' subcontractor for luggage handling, airplanes cleaning and technical maintenance)

1974-1978: Chrysler-France & Europe: Vice-President Industrial Training and Human Resources Department

1970-1974: Chrysler-France: Manager Production and Industrial Engineering

1966-1970: Teacher in French Public Junior High School.

Additional Information:

2008-2009: Board member of: International Road Federation
World Road Federation, French Committee
French Road Safety Association

2000-2006: President of S.I.A (French Automotive Engineers' Association); Honorary President since 2006
1999-2009: Board member of F.I.E.V (French Vehicle Equipment Industries' Federation)
1997-2009: Board member of Magnetto Wheels Company
2001-2007: Board member of E.T.R.M.A (European Tyre and Rubber Manufacturers' Association)
1997-1999: Board member of CLEPA (European Federation representing the Automotive Supply Industry)
1981-1987: Judge at the Paris Labor and Social Court

1999: Honored by the French Government with the "Légion d'honneur".

Reducing road noise: an approach to sustainable mobility

The problem of noise emissions in relation to the road has been a major subject of concern for the industries representing the road sector for many years. Whilst huge progress has already been made, there is still a lot to do. This is why all the stakeholders of the road sector have decided to take concerted action to fight against noise pollution via prevention, education and various technical means of reducing noise emissions at the source.

Too much noise? Too little noise?

Noise can be useful, in particular to pedestrians in the street for whom it represents an important source of information. On the contrary, the absence of noise can lead to a lack of reference points and generate anxiety. This concept will require thoughtful consideration in the perspective of the development of electric vehicles which are much more silent than the conventional vehicles.

What is road noise made of? How is it measured?

Two sources of noise can be identified:

- "individual" noise resulting from both the vehicle itself and the driver's behavior: this noise generates a temporary pollution;
- "collective" noise resulting from the flow of vehicles on the road and depending on various parameters (vehicle type and speed, infrastructures, tyres…).

Logically enough the characteristics of the road flow (traffic jam, road work, etc.) have an influence on the level of noise emitted by the vehicle alone.

Several methods are used to assess road noise. In France, compliance with the ISO standards is mandatory.

The road users' behavior is the first cause of noise!

Everybody can mitigate noise pollution by adopting a socially-aware attitude in their everyday life. This civic-mindedness can also apply when you drive your car. People must become aware of how much noise they make either deliberately (subject to penalties) or unwillingly (subject to education).

Education, then, is the key word: driving "peacefully" is not only an efficient way to reduce noise emissions, but also to save on fuel and to increase road safety in general.

What about vehicle noise?

Reducing vehicle noise is a priority concern for all the industries: bodybuilders, component manufacturers and carmakers have made considerable technological progress through significant R&D investments.

According to the carmakers, the engine noise is predominant between 20 km/h and 40 km/h. Noise emitted by commercial vehicles (whether moving in the traffic or stuck in congestion) can also be important. These different elements will have to be taken into account by the stakeholders of the road sector when they address the stationary noise of motor vehicles.

Tyre-road noise

A tyre alone makes no noise, nor does the road. The noise results from the contact between these two silent elements.

The tyre industry has been successfully working on the reduction of the noise resulting from tyres rolling on the road. Progress made in this field give rise, in turn, to regulatory constraints which are strengthened regularly.

Road surfacing is also the subject of significant research; new materials are now used which allow noise emissions to be drastically reduced (8 dbA less than conventional pavements).

Goods transport and delivery

Whilst the truck manufacturers and the tyre industry are constantly improving technologies to reduce noise emitted by light commercial vehicles and heavy trucks in the traffic, it is nonetheless true that the noise resulting from logistics (deliveries in urban areas, in particular) is a nuisance to the local residents. Technical and technological development must therefore be part of a global approach to a new organization of delivery and logistics in urban areas (pooling goods delivery services, reassessing the urgent nature of certain deliveries, testing different time slots, etc.).

More silent road infrastructures

Noise levels that people living close to highways must bear is considered as a major concern by the companies operating the highways. When they build new highway structures these companies take account of acoustic parameters from the very design stage. Whenever necessary, noise screens or specific landscaping enable the level of noise exposure to be reduced in order to meet the authorized index.

***Ir.* Jean-Pierre Clairbois**
President and Managing Director
Acoustic Technologies SA, Brussels

Jean-Pierre Clairbois is a Civil Electrical Engineer, specialised in electronics, acoustics, and computer science; He made his studies at the University of Liège in Belgium.
He is President and Managing Director of Acoustic Technologies S.A./N.V. Brussels.

Experience:
- Convenor of the working group WG6 "noise reducing devices" of the CEN TC 226 (European Community) (since 1990),
- Certified expert for the European Commission,
- Expert in acoustics specialised in studies, design of noise protections and control of their efficiencies.
- Treasurer and executive officer of the board of the I-INCE (International Institute of Noise Control Engineering),
- Belgian representative at I-INCE General Assembly
- Belgian representative in the working group on noise walls of the I-INCE
- Has designed several new models and P.C. noise propagation software since '82, especially the MAP3D, MAP4D and MAP4D-Design, software that simulates the noise propagation of the vehicles in movement in a complete 3 D + time space,
- More than 100 different scientific plenary lectures, invited papers, contributions, and scientific seminars on noise reducing devices, noise propagation and noise mapping,
- Chairman and organiser of special sessions at different world-wide scientific events,
- Scientific and administrative co-ordinator of the EC funded research on new measurement techniques for noise reducing devices, establishing the new method “ADRIENNE”, using MLS signals and subtraction techniques, and the new research “QUIESST” Quietening the Environment for a Sustainable Surface Transport (2009 – 2012, www.quiesst.eu)
- Acoustician for numerous prestigious buildings, such as EC Berlaymont, Charlemagne, Jacques Delors, EP D1 D2 D3 D4 D5, European Court of Justice, etc.
- More than 800 studies and 3000 km of noise protections for highways, interchanges, trains and tunnels around Europe, and Asia,…

Membership:
CEN European Committee of Standardisation, Convenor of WG6/TC 226 on NRD's.
I-INCE International Institute of Noise Control Engineering
ABAV Belgian Acoustical society
SFA French Acoustical society
GIAC Groupement de l'Ingénérie ACoustique (French society of consulting engineers)

Mitigating road noise impacts: a key factor toward a sustainable mobility

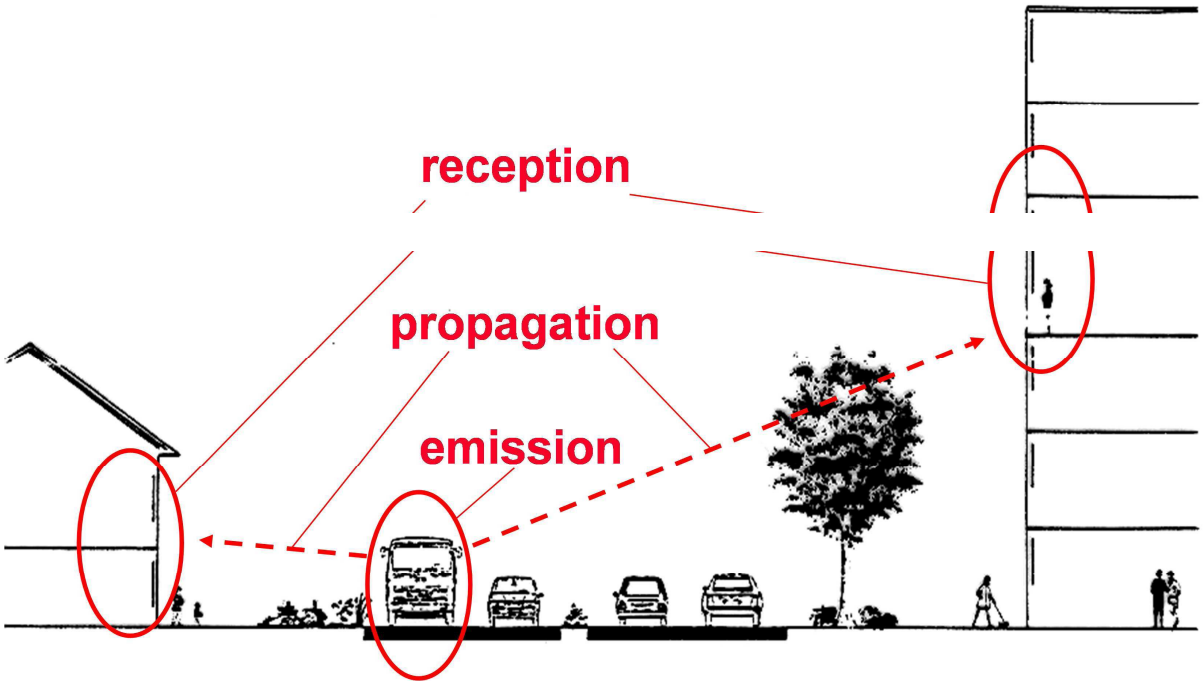
Road noise comes from two major origins: mechanical noise (engine, gear box, transmission,…) related to engine speed and vehicle speed) and rolling noise (only related to vehicle speed). For light weight four wheels vehicles, rolling noise becomes quickly the most important at speeds over 50km/h, while mechanical noise remains important for heavy vehicles (trucks, buses).

Road noise corresponds to a quasi-continuous flow of passing vehicles, each ones impacting the environment with its own pass by noise (gradually increasing when the vehicle approaches, reaching a maximum when close to the receiver, and then gradually decreasing when the vehicle disappears). With such a quasi-continuous characteristic, road noise is better characterized by its equivalent "L_{eq}" level that corresponds to a continuous noise during the same period of analysis [e.g.: $L_{eq,\ 1h}$ = 60 dB(A) of road noise due to, a *succession of pass-by noises* is equivalent to a *continuous* noise of 60 dB(A)].

However, people's perception of road noise drastically differs with the period of the day (day/ evening/ night): the European Noise Directive (END 2002/49CE) defines a global 24H indicator L_{den} that takes those differences into account by applying a weighting factor of +5 and +10 dB(A) in order to take into account that the evening and the night (respectively) are much more sensitive for the human activity. L_{den} is now the right global indicator to use for characterizing road noise, but some other indicators are also relevant, as L_{night}, and statistical indicators as L_{max}, L_{10}, L_{90}, …).

The END defines not only the indicators (L_{den}, L_{day}, $L_{evening}$, L_{night}) but also a whole strategy in order to oblige countries to mitigate road noise in a common fixed way for all the member states.
This strategy starts by the drawing of road noise maps and the counting the number of people exposed to different 5 dB(A) L_{den} and L_{night} level ranges, from 55-60 dB(A) up to L_{den} exceeding 85 dB(A).
Then, the noise maps are used for establishing the strategy and action plans that every member states establish in order to mitigate road noise for the next 5 years.

Road noise mitigations could be done at 3 different stages: sound emission, sound propagation, and sound reception) following the following simple scheme:

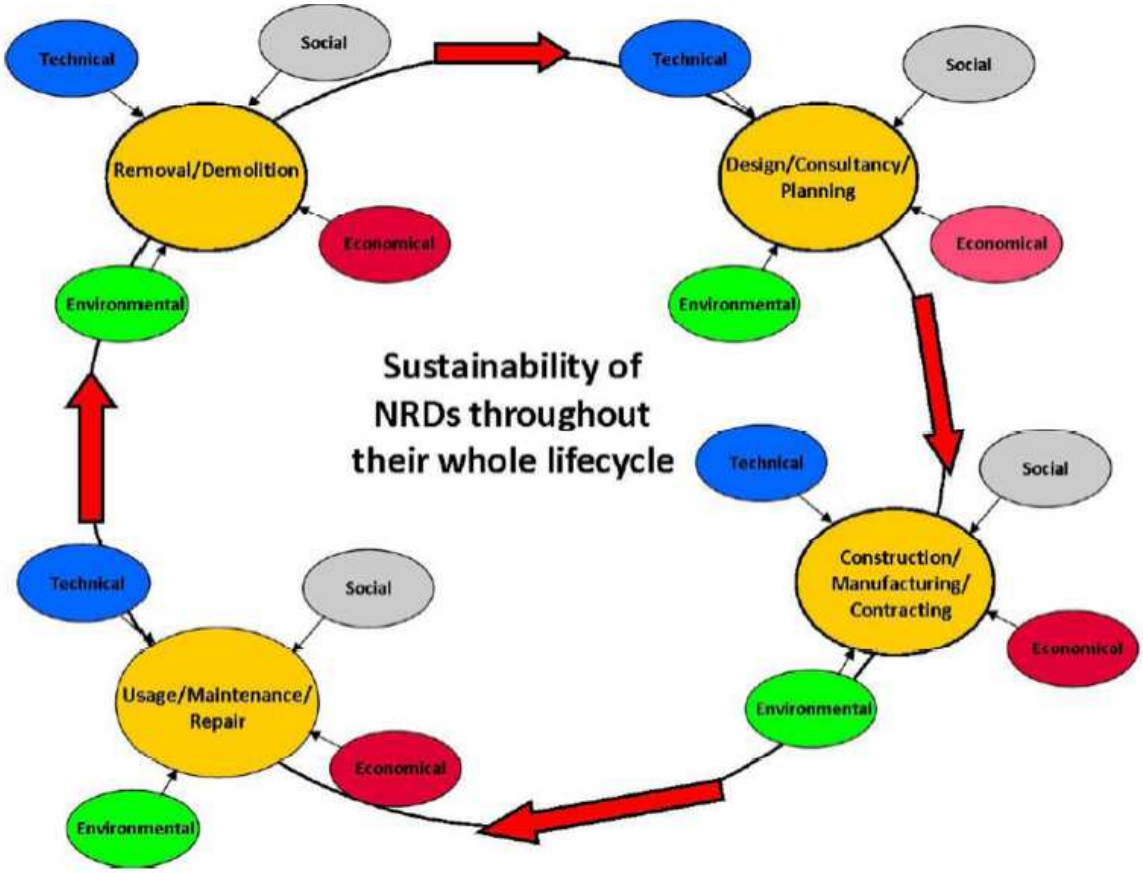


The possibilities of mitigating noise are really different for each of those 3 stages, and combination of actions should be used when targeting very high performances:

Noise Reducing Devices

	Sound emission	Sound propagation	Sound reception
Acting on	- every single vehicle - wheel/road, or wheel/rail interface - traffic management	- sound diffraction - sound reflection - sound transmission	airborne sound insulation (sound transmission)
Efficient where?	everywhere around	Restricted to specific protected areas	restricted to specific protected rooms
Benefits	a few dB → 6 to 8 dB (more for multiple actions)	Strongly depends on geometry : a few dB → over 20 dB (tunnels)	8 to 15 dB improvement (global airborne sound insulation up to 35 / 42 dB)
Effective for	the only concerned noise sources (air, road, train)	Reducing noise from rail and/or road traffic	Reducing all the outside noise (air, roads, trains, other sources)

When deciding the most appropriate action(s) to mitigate the road noise in urban environments, one has to remember that <u>every kind of action has its own acoustic performance but also has non acoustic impacts:</u> one has to consider all the characteristics and impacts of an action at the global scale of sustainability before being able to claim that the road noise mitigation could correspond to a true sustainable development of mobility. For example, the following diagram shows the sustainability considerations of road reducing devices as noise barriers.



Mitigating road noise in a sustainable way has thus to be done at the global scale and is one of the major challenge in the mobility of the future.

Christophe Collette
Program Manager Rhône Alpes Automotive Cluster
Lyon Urban Truck&Bus 2015
Chamber of Commerce and Industry (Lyon, France)

Aged 36, Christophe Collette graduated from the Grenoble Business School (GEM) and did a Master at HEC. Since 2007, he is the General Manager of the Rhône-Alpes Automotive Cluster.

He has a 10 year experience in economic development and automotive industry.

Contribution to the workshop "How to reconcile road noise exposure, urban life and sustainable mobility?"

Lyon Urban Truck&Bus is a non-profit association gathering two different entities:
➲ a R&D cluster aimed at developing innovative mass transit systems for passengers and goods in Europe (Lyon Urban Trucks & Bus),
➲ an automotive business cluster federating the main players of the Rhône-Alpes Region in France (Rhône-Alpes Automotive Cluster)

Our Objectives are:

- **Create future urban transport systems**
- Mobilize skills and regional historical know-how
- Connect Industry, research, education and final users community
- Certify innovative R&D projects for national and European funding

We develop 5 collaborative R&D programs:

- Engine & driveline
- Integrated safety & security
- Architecture & comfort
- Transport system
- Modelling & management of urban mobility

Since 2006: 105 certified R&D projects
Total R&D budget: 196 M€

Rhône Alpes, 1st in Europe for acoustics and vibration in automotive

- Research in transportUniversity of Lyon & Engineering Schools
  - PST (Road & Transport Administration Technical Institutes)
  - Carnot Institutes: IFSTTAR (INRETS), IFPEN, CEA, Ingénierie@Lyon
  - Laboratoire d'Excellence en acoustique

- • Competitiveness ClustersTruck & Bus & Automotive: LUTB
  - « Technology enablers » AXELERA, Plastipolis, Viameca, TENERDIS…
- 1st region in France for suppliers in automotive industry
  - 900 companies, 80 000 employees, 80 laboratories
  - Abundance of subcontractors in all the automotive fields: mechanics, electronics, plastics, technical textiles, ...

Specific R&D topics about acoustics and vibration

- Motorization
  - Reduce Powertrain noise emission by using optimized designed tools and by setting up active systems
  - Improve characterization of the perceived noise levels to reduce impact by optimizing vehicle technology and usage
- Vehicle Architecture and confort
  - Improve the overall sensory comfort for passengers and goods (noise and vibrations)
  - Enhance the ergonomics of the driver's immediate environment, improve the visual and olfactory sensory comfort, as well as the overall general comfort
- Vehicle & Transport System
  - Reduce the overall noise emission of vehicles under operational conditions (cruising, accelerating, braking, and stationary (during deliveries and boarding)),
  - Improve their perceptive acoustic impact,
  - Assess and reduce near-by residents annoyance.

LUTB R&D Projects in acoustics and vibration

- LUT (Low noise Urban Truck)
- PRE-CONNAISSANCE (Pre-connaissances Imagerie acoustique moteur poids lourd)
- MACOVAM (Maîtrise du COmportement Vibratoire d'Auxiliaires Moteurs)
- MABCA (Maîtrise du Bruit de Chaine Cinématique)
- ACCOR (ACoustique de la COmbustion : estimation et Réduction du bruit des moteurs thermiques)
- AVELEC (Acoustique des Véhicules ELECtriques) : projet co-labellisé par Moveo et LUTB
- ACOUBUS (Moyen d'imagerie pour la mise au point acoustique des bus hybrides)
- IMPACT (Interfaces Mécaniques Passives et Actives, analyse et ConcepTion vibro-acoustique)
- GESTIP (Gestion de l'empreinte sonore des transports publics et industriels urbains)
- CityCalm (Solutions acoustiques pour camions urbains respectueux de l'environnement sonore)

Roberto CORDERO
Research and Development on Transport and Energy
CIDAUT Foundation

Roberto Cordero, graduated in mechanical engineering at the University of Valladolid (Spain). He has experience in loudspeakers numerical modelling including retrofitting effects with own codes. As a technician in acoustics simulation he has performed several finite elements models especially in the automotive field to evaluate sound power radiation, insulation and diffraction effects. He has been involved in FP7 proposals as coordinator and also work package leader. He is currently project manager in Acoustics and Vibrations department of Cidaut Foundation, and takes part in the Spanish National Association of Industry of Noise Reducing Devices and also attends as a member of the CEN/TC 226 WG6 TG1 (Noise Protection Barriers). He has published papers in the 12th International Congress on Sound and Vibrations and in the 19th International Congress on Acoustics.

Proposal of topics to be discussed at the workshop:

1. **As part of the already identified by the organisation:**

   a. ***What are the major sources of road noise?***

The main factors responsible for the biggest contributions to road noise are vehicles, tyre/road interaction, drivers behaviour and traffic management, and in a secondary level roads construction and maintenance works. Development of tyres with lower noise emission properties is continuously being done, however according to the current tyres construction technology the main noise generation mechanism remain being pumping noise, horn effect, stick-slip, and Helmholtz resonances. On the opposite side, the construction parameters which mostly influence roads acoustic behaviour are road surface quality, mechanical impedance and acoustic absorption.
Apart from this basic classification of tyre and road noise sources, attention has to be paid to additional parameters such as tyre stiffness and inflation pressure, road surface maintenance and environment conditions. The degree of influence of these factors are so close, that a small change in one of them might lead to a sensible modification in the rank of noise sources and its contribution to the total level. Thus a universal noise sources ranking can't be done, moreover it will depend on the several possible combinations of tyre and surface types. Generally speaking we can say that:

- For rigid pavements, tyre radiated noise is predominant more than it is in more flexible ones
- For dense pavements, pumping noise is predominant more than it is in porous ones
- For pavements with poor noise absorptive properties, the horn effect is predominant more than it is in porous ones.
- For pavements characterised by its megastructure, radiated noise from tyres is predominant
- And speaking about tyres, radiated noise is more predominant than pumping noise for winter tyres

   b. ***How to determine the nature and scale of road noise impacts?***

Road noise contribution is predominant in the range between 800-1600 Hz. That range coincides with speech frequencies, that's one of the reasons why road noise is so annoying. Besides road noise is wide band frequency type, being particularly difficult to design monotone solutions to effectively reduce it. On the other hand we should note the high variability of the previous commented factors influencing it; namely tyre conditions, vehicle weight, road surface quality, pavement type, environmental conditions, which causes its amplitude to strongly vary in a hardly controllable way.

c. How to measure them?

A possible measuring methods classification would be:

- Noise direct measurement:
  - Proximity method, currently the measurement standard is its approval phase. This method is much less sensible to propagation effect, since it measures the noise close to where it is generated. It can be used for the assessment of quality in pavement production as part of a quality control procedure
  - Statistical method, as described in ISO 11819-1, measures the noise generated by a certain traffic flow in a certain point, can be used for pavements characteristics assessment
- Complementary parameters measurement, which don't measure noise, but can serve as an estimation of road acoustic performance measuring it indirectly, through other road parameters such as:
  - Acoustic absorption
  - Texture
  - Mechanical impedance

d. What has been done to mitigate those impacts?

Starting from the legal noise emission limits imposed by the European Noise Directive, the industry is continuously investing in research to find solutions to the noise issue. In particular in the field of road surfaces, new pavements are under development to produce lower noise levels, such as porous, poroelastic, controlled texture…

e. What remains to be done to reconcile road noise exposure with urban life and sustainable mobility?

We shall keep in mind that roads main function is to guarantee vehicles displacement in a safe and efficient way, then any proposal attempting to reduce road noise must take into account those three aspects; safety, efficiency and sustainability (including being environmentally friendly with regards also to low noise emission). In that sense, scientific community is addressing the issue of road noise from a global perspective, considering those three relevant factors. Any solution must be optimized according to the boundary conditions imposed by safety, efficiency and sustainability.

2. Additionally some other topics that might be interesting:

Technological lacks and challenges in each specific field:

- How to realistically reflect road noise annoyance in noise maps, noise level is not the only relevant parameter for hot-spots detection (social and economic aspects…)

- How to deal with high seasonal road noise variability in noise mapping, that can be found in touristic or residential areas
- Roads noise monitoring and control, is it feasible in a urban scale?
- Road surface noise characterisation and CE labelling, how much scatter would be acceptable?
- How much real noise reduction potential can be expected from road surfaces?
- Are noise barriers being correctly installed? Is there a way to accurately measure and check that noise reducing devices are providing the expected noise reduction?
- Which are the current research initiatives under the European 7th Framework Programme?

Dipl. Ing. Peter Ehinger
Manager vehicle NVH chassis
Dr. Ing. h.c. F. Porsche AG Vibration & Acoustics

Graduated from the University of Applied Sciences Esslingen, Peter Ehinger entered Porsche AG Vibration & Acoustics in 1981. He then became supervisor for gas exchange systems, manager exterior noise, and manager vehicle NVH in 1997. Since then, he kept developing his experience as manager vehicle NVH, working on simulation and chassis.

He has chaired the VDA working group on vehicle noise from 1995 to 2005, and has had different functions in national and international working parties on vehicle noise.

Traffic Noise - Strategies for Reduced Environmental Noise

The reduction of traffic noise is one of the big environmental challenges. In difference to other disciplines as exhaust emissions, CO2 or fine particles noise exposed people can assess their personal situation quite good and mostly have a clear idea how to improve the situation they are faced with. There are many situations and reasons where people can feel annoyed and the span can range from high noise levels due to heavy crowed streets up to individual spontaneous situation as an idling bus waiting at a bus stop for people. The situation gets further complicated as a discrete traffic situation is rated by multiple observers very different. What seems to be no problem at all for one person might be already intolerable for another. The impression of noise annoyance is strongly related to the personal position of an observer relative to a sound event. It is further dependent from the mood of the observer. The decision that a sound event is noisy is made in the mind of an individual.

Multiple factors work together to create a potential noise annoying situation. The composition of traffic, the traffic density and flow, the road management, the involved vehicle types, the technical condition of vehicles and very important the individual driving behaviour of drivers result in a discrete sound emission. Even the weather has its shares. On a rainy day the sound levels are higher because of the bigger splash noise from the roads, with snow or fog levels are lower because of better absorption.

Thus it is very difficult to make an overall assessment of the noise situation. In a first step the European Union has focus with the European Noise Directive (END) on the registration and mapping of the noise situation of big traffic streams and in big agglomerations. The collected are average sound levels representative for day, evening and night and number of noise exposed people in certain sound level classes. These maps are publicly available since 2009 but only limited conclusions can be drawn from these data as the method of data acquisition and analysis is not harmonized among the European Member States. Consequently the variation from country to country if very high although the vehicle populations are not so different due to a harmonized market. Some data are obviously wrong as some cities report more noise exposed people as inhabitants at all. Despite the noise mapping the estimation of the European Environment Agency (EEA) from 2001 seems to be credible that about a third of the EU population is exposed to noise levels which exceed the WHO recommended maximum sound exposure of 55 dB(A) Lden. But, as said already before, the number of exposed people does not automatically mean that all these people feel annoyed.

According to the noise maps the local sound levels differ very much. In residential areas with few traffic levels of 45 dB(A) Lden are quite common, while close to big city arterials with daily traffic volumes of more than 100.000 vehicles per day levels can exceed 75 dB(A) Lden. An efficient improvement of the noise situation requires the synchronization of a bundle of measures well adjusted in an integrated approach. The automotive industry has it

shares by providing continuously more quiet vehicles and this support was always confirmed by industry if the technical improvements of their products result in a remarkable effect in real traffic.

To enable this progress the test method for exterior noise type approval was completely revised in the last years to make this test more representative of the behaviour of vehicles in real traffic. After a three years “monitoring phase” in the EU/ECE enough type approval data are available now to implement the new test procedure into the regulation. As a consequence of a change in the test method the maximum allowable sound values need to be revised because in a trend most light vehicles are assessed at somewhat lower sound values, but the trend has a high scatter so that some vehicles deliver even higher test results. For commercial vehicles the trend is much more unclear and the dynamic is even higher.

Overall, the correlation between the new test method and the old is rather poor, which makes it difficult for the European Commission to create a start-off scenario for the first application. Focusing too much on an average trend will require in singular cases extreme sound reduction measures, which will hardly be possible in a realistic time frame. Sound improvements of a product in a way that it results in measurable reduction in traffic need a consequent improvement of the whole acoustical treatments of a vehicle. Regardless of the question of available technologies such a step need development work and development time, to guarantee proper function, durability and safety. The necessary time frame must be granted when considering the phase-in time.

Other regulatory fields cannot be neglected because the acoustic treatment is not limited to some obvious components as a silencer. The continuous development of other regulatory requirements, especially in the area of exhaust emissions and fuel consumption, change important parameters like propulsion concepts and combustion technologies which have a direct impact on the acoustical behaviour. Even the request for further improvements in safety standards can create technical difficulties in the sound development.

A sustainable improvement of the environmental noise situation is only possible when all primary and secondary noise measures are considered together. Most important is the quality of our road network. Modern road surfaces support already a low rolling sound for the tyres and with special technologies local hot spots can be further optimized in a way as it is not possible with improvements at the source. Often neglected is the circumstance that old and worn road surfaces show a tremendous decrease of acoustic performance and a simple replacement of the top layer with the original or slightly improved material can solve many complains. The selection of a road surface is still today often focused on non-acoustic criteria as durability, costs or even optic, like cobble stone in inner city areas. This enables local sound improvements in a range which will not be possible with measures at the source within the next 10 years.

One big problem of noise abatement measures are the primary invest costs. The infrastructure and the traffic management have a very positive effect for the local situation,

but require substantial changes of the network. A road tunnel can isolate big traffic streams for whole city quarters but the enormous costs give the impression that such measures will never provide a return of investment and are therefore typically refused instantaneously. Taking such a measure as a long term project over many years and the extreme high possible noise reduction and the positive side effects can justify high costs. Costs and benefits need to be balanced with a fair view on what is really the scope, the reduced environmental burden. Beside high invest costs there a many smaller actions that can make a remarkable benefit. Flowing traffic is much more preferable compared to interrupted traffic. So roundabouts instead of crossings with traffic lights or the shutdown of traffic lights in times of low traffic volume ease the traffic flow, reduce stress for the drivers and reduce noise.

Back to the source there are many influence factors on the in-use sound emission of a vehicle. Worn tyres, rusty silencer components or destroyed absorption material need technical maintenance to avoid a degradation of the sound performance. And last but not least the driver determines by its driving style to a very large extent the real sound output. Early gear shifting and a farsighted driving style does not only save fuel, it reduces the noise for the community at crossing and area for low speed movement.

Different from the other environmental disciplines in the acoustical area is sound not only a burden. Via sound information is carried and delivers an important benefit for pedestrians and other road users. The introduction of new engine technologies, like electrical and hybrid electrical vehicles, come along with a new unusual sound performance. Often these technologies are praised to be noiseless, but these vehicles run on the same tyres and roads as all other vehicles. So at higher speeds above already 30 km/h there is no remarkable difference in the acoustical behaviour. However in the low speed area there are many traffic situation where vehicles meet pedestrians, like during back-up, pull-away or parking situations. Associations of visually impaired people have raised complains that vehicles could become too quiet. Their complain starts from the new electrical vehicles, but their criticism is not limited to those. They need sound information from vehicles for safe travelling and orientation in traffic. But not only these people need an acoustical feedback, nearly all pedestrians, cyclists rely in many situation to a large extend on their ears. This will be another challenge in the acoustical field to balance the need for reduced traffic noise mainly caused by big traffic streams with minimum sound output as an individual car to be recognizable.

So far the acoustical performance of a vehicle is in a sandwich situation which implicates that the single vehicle is limited with respect to noise reduction.

The consequence has to be a bundle of technical solutions focused on the selected noise situation.

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Employed since 1980 at the **Bundesanstalt für Straßenwesen** [BASt] (Federal Highway Research Institute) in the Department "Automotive Engineering" in the Section "Passive Safety and Crash Testing".

Since 1993 **Head of Section "Vehicle Pavement Interaction"** at BASt. Several national and international research projects and publications related to tyre/road noise and vehicle noise.

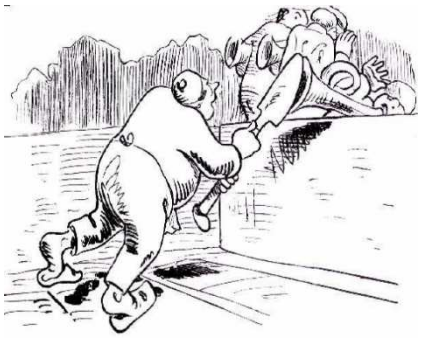
Statements for the workshop

"How to reconcile road noise exposure, urban life and sustainable mobility?"

Basics:

- Noise is an annoying sound.
- Sound is a hearable pressure pulsation in the air, measured in the logarithmic dB(A) - scale.
- A sound pressure above 80 dB(A) may damage the audibility.
- The probability of damage is dependant of the exposure time.
- A sound pressure of below 70 dB(A) is "only" annoying.
- The decision of 'what is annoying' is dependent of the personnel emotion (music, engine noise) and probably age.
- Permanent noise above 55 dB(A) may lead to sicknesses: from sleep disturbance up to heart diseases.

- Cost of health-impairment related to traffic noise in Germany is estimated to 6,8 Billion €/a.
- Noise depreciates the value of real estates by 1,4% per dB(A) above 55 dB(A).
- There is a (strong) correlation between noise nuisance and economic wealth.
- Humans need every time background sound.



Musik wird oft nicht schön gefunden,
Weil sie stets mit Geräusch verbunden.

Music is sometimes not a treasure, its noise diminishes the pleasure. [Wilhelm Busch]

Traffic noise:

- Traffic noise can be distinguished in road traffic noise, railway traffic noise and air traffic noise. (Noise from traffic on inland water ways seems to be less annoying).
- One of three people in Europe experiences annoyance during the daytime and one of five have disturbed sleep at night because of noise from roads, railways and airports [WHO 2011].
- In the following only ***road traffic noise*** will be discussed.

- In cities 20% of the residential areas have a noise exposure above 55 dB(A) daytime and 45 dB(A) nighttime, in villages 30% in average.
- The annoyance of road traffic noise has to be distinguished in time of occurrence, location and noise source.
- Time of occurrence: daytime or nighttime, week or weekend.
- Location: urban areas or rural areas.
- Noise source: vehicle type, road type, constant background noise or sudden sound impact.
- Examples: Motorcycle noise is a weekend problem in rural, mountainous areas; cobblestone pavements and no speed limit in residential areas; truck traffic is dominant on weekdays at night time on highways……..
- Disturbance by road traffic noise is (mainly) an urban problem, because most people live in dense populated urban areas. But on the other hand: noise is affiliated with city live: “Beautiful Noise” [Neil Diamond].
- Traffic noise is dependent of traveling speed.
- Tyre/road noise of passenger cars is dominant between 40 and 130 km/h.

Noise mitigation is a technical challenge

- The principles of silencers for combustion engines are known since decades. Increased muffler volume can reduce combustion noise.
- Much research has been carried out to reduce the tyre/road noise, but improvements of both, tyres and road surfaces, are still possible.
- High sound absorbing materials of house facades are needed for urban canyons.
- Is “noise on demand” a technical progress in vehicle technology?
- Electric vehicles will open a new more silent age in cities. (But utterly quiet vehicles may be unsafe for blind pedestrians?)

Noise prevention is a demand for political action

- Legislation to mitigate road traffic noise has a long history: E.g. ban of coach driving at night time in Rome.
- Legislation and limits for noise emissions of vehicles (motorcycles, passenger cars and trucks) exists.
- Legislation and limits for tyre/road noise emissions are on the way incl. consumers’ information (tyre labeling).
- In the German Road Traffic Regulation it is laid down that unnecessary driving is forbidden, to pollute unnecessary noise is forbidden, noise emissions of cars may technically be oriented at the state of the art.
- Legislation on noise emissions and limit values for day and nighttime exist. (noise mapping and action plans)

- There is no (direct) legislation concerning road surfaces (and e.g. bridge expansion joints).
- Silent road surfaces exist and they are classified.
- Noise barriers besides roads and highways have become popular (about 3200 km in Germany).
- The governments have spent a lot of money into passive noise prevention (e.g. program of investments into double glass windows).
- Traffic calming and traffic light coupling leads to a more constant and silent traffic flow.
- Fines for driving a too loud vehicle (e.g. with illegal replacement silencer) are too low.
- Investment in silent public transport (minimization of noise per person-km).
- Promotion of bicycle riding.

Noise Mitigation is a social challenge

- Driving a motorcycle with a manipulated exhaust system is anti-social!
- The motor biker's slogan: "Loud Pipes Save Lives" is absolutely stupid !
- Omit unnecessary trips. Leisure trips of motorcyclists are unnecessary!
- A racing start from traffic light in the night is anti-social……..
- There is a need for an education to a "relaxed" driving style.
- If you have the choice, buy silent machinery (cars) and equipment (tyres)!
- Rednecks are loud, distinguished people are silent!
- Education goal: "***Loud is out!"***

What to do:

- Improvement of legislation, enforcement and education.
- Further search for technical solutions.

The Federal Highway Research Institute (BASt) is a technical scientific research institute responsible to the Ministry of Transport, Building and Urban Development. The main objective is to improve the safety, economic and operational efficiency of roads and make them more environmental friendly. BASt has about 400 employees and a budget of 30 million Euros annually.

Jacques Marmy
Head, Technical Affairs
International Road Transport Union (IRU)

Of Swiss nationality, born in 1967 in the canton of Fribourg, **Jacques Marmy** graduated in Automotive Engineering in 1995 from Bienne Engineering College, Switzerland.

From 1990 up to 2005, he was respectively Automotive Technician for BMW in Switzerland, Cab Designer for Freightliner in Oregon, US, Accident Reconstruction Expert for DEKRA in Germany and Manager of Vehicle Homologation at DaimlerChrysler Corp. in Switzerland.

Board Member of the **International Forum for Road Transport Technology** (IFRTT) and Dangerous Goods Safety Adviser, Jacques Marmy entered the **International Road Transport Union** (IRU) in 2005 as engineer in charge of technical affairs.

He has experience in several areas of expertise, notably the organisation, direction and coordination of the work of the IRU International Commission on Technical Affairs and the coordination of the work of the IRU Group of Experts on the Transport of Dangerous Goods; he represents the IRU in particular at the UN Committee of Experts, in the Working Parties on the Transport of Dangerous Goods at the ECE in Geneva and the European Union in Brussels.

Vehicles' noise
Analysis and recommendations for abatement

I - Analysis

The Directive 92/97/EEC, which fixed noise limits at 74 dB (A) for cars and 80 dB (A) for commercial vehicles, entered into force on 1 October 1996 for all vehicles. It was expected that traffic noise in general would be reduced in the same way as exhaust emissions, but no substantial efforts were made in comparison to the inner noise of all vehicles, which increases tare weight of all vehicles.

Road noise is expected to be a large contributor to environmental pollution in the years to come and governments are starting to look into policy measures to be taken, especially concerning growing traffic volumes and the proximity between transport infrastructures and living areas.

Furthermore, road traffic is the major contributor of society noise based on several European studies. The noise from road vehicles can be classified as:

- noise due to tyre-road contact (rolling noise);
- noise from engine exhaust (motor noise),
- noise due to interaction of air with the vehicle body (aerodynamic noise) and braking elements,
- noise due to maintenance of infrastructure and road surface, potholes, rail track crossings and pavement structure.

Traffic noise is affected mainly by the speed of vehicles, but exception is made at very low speeds where braking and acceleration noise (engine noise) dominate over the aerodynamic noise.

Under steady operating conditions of a vehicle, the rolling noise dominates, whereas under passing running conditions motor noise dominates. However, the noise from the motor of a vehicle depends on the operating conditions of the vehicle (transitional or cruise).

Member States of the European Union consider that development of new vehicles is the task of the UNECE based in Geneva. The EU is focusing on noise policy measures for all sources. Directive 2002/49/EC of 25 June 2002 indicates that Member States should develop noise maps and action plans in order to reduce noise annoyance.

During the 45th session of the Working Party on Noise (GRB) at the UNECE in 2007, several experts drew attention to the importance of noise abatement with its costs and benefits. It has been mentioned that most inhabitants are exposed to high road traffic noise, between 70 to 75 dB, and it would be necessary to reduce this by 15 to 20 dB in order to avoid any negative impact on the health of the population.

For the experts of the GRB, it became clear that tyre noise levels depend significantly on the status of the road. Low noise road surfaces, such as porous asphalt, might reduce vehicle noise by up to 9 dB at constant vehicle speed and by 3 to 4 dB at vehicle start/acceleration in comparison with dense asphalt pavements. However the performance decreases by 1 dB per year during the lifetime of porous surfaces, which is twice as short as that of dense surfaces (12 to 15 years).

Recent European studies demonstrate that 20% of the population is exposed to road traffic noise, with levels exceeding 65 dB (A) during the daytime. The World Health Organisation (WHO) pointed out that long-term exposure to road traffic noise has some effects on health and well-being, such as annoyance, sleep quality, sleep disturbance, insomnia etc.

In 2007, a report on traffic noise reduction in Europe was published by the European Federation for Transport and Environment (CE Delft), where recommendations were drawn, especially on the need for road vehicle improvement, as this seems to be the main contributor to noise exposure.

It was noted in the report that:

(a) The most cost-effective measures are those at the level of vehicles and these measures should be afforded priority at the EU level;

(b) There is already scope for tightening the noise limits for vehicle drivelines, by at least 3-4 dB(A) as an initial step, and after 2012 year-on-year improvement targets (x dB(A) every year) should be introduced, outlined well in advance to give the industry sufficient time to adapt;

(c) All tyres should be labelled with their noise approval rating and rolling resistance. Retreaded tyres should be included in the directive, at least for heavy vehicles, since these account for a surprisingly high share of about 50% of the market.

The European Commission has recently adopted the Regulation 1222/2009 on energy labelling tyres, which aims at promoting market transformation towards low rolling resistance tyres (LRRT), where attention will be drawn to the noise aspect emitted by tyres.
Today, the pass-by-noise measurement (in compliance with the ISO 362 standard) currently calculates the noise emissions of vehicles through full load acceleration from 50 km/h in second or third gear. This measurement is not representative of the noise emissions in real traffic conditions. A new method closer to the real noise behaviour of vehicles is under discussion and would enable further technical developments on vehicles to meet future limit values.

II – IRU Observations and Recommendations

It is true that road transport, like most human activity, has a negative effect (externality) on the environment such as emissions and noise. However, the main task of governments should not be limited to the protection of the environment by suppressing any human activity or by suppressing transport, upon which modern life and society depends. All the more so as noise emissions are much higher in the developing countries than in our developed countries and, contrary to what the specialised agencies (WHO) may claim, the population does not seem to suffer much from this. As it is not the case in developed countries, people living in Brazil or in most of the African countries consider noise as a source of life and this does not cause any stress to the human being.

Therefore, the task of the governments should rather be to optimise any lawful economic and human activity by promoting efficiency, especially in such an essential area as road transport. It must be understood that any penalty on road transport is an even greater penalty on the economy.

To date, the road transport industry is the only transport mode which has made the promotion of sustainable development a constitutional obligation. To strive for sustainable development and to fulfill the EU Lisbon agenda, the IRU's 3 "i" strategy for achieving sustainable development based on innovation, incentives and infrastructure is the most robust and cost-effective approach. Following this approach the road transport industry has been able over the last few decades to considerably increase its energy efficiency and considerably reduce negative effects; for example today, based on the European Commission communication, 25 modern trucks make no more noise than one built before 1980.
Any new policy measure aimed at improving the environment should be based on the results of joint efforts of Authorities / Industries with at-source measures to reduce overall emissions. This would improve the public image of the road transport industry and professional drivers as a whole.

All measures should be carefully analysed, because currently development is centralised on vehicles, without analysing the cost benefits of improving infrastructures. The cost effectiveness of quieter vehicles on inefficient road surfaces is jeopardised.

III – Possible solutions and actions

Vehicle noise emissions can be reduced through measures **focusing on different part noise sources**, major sources of vehicle noise are: exhaust noise, engine noise, fan noise, air intake noise, tyre-road noise, drag air noise and noise from miscellaneous equipment.

Today, to increase economy without affecting performance, the **turbocharger** significantly reduces engine exhaust noise levels. The increased air/fuel ratio produced by this device also produces a more complete combustion, achieving greater horsepower and less smoke.
Tyre and pavement noise reduction potentials have certain threshold limits which are up to 5 dB for tyres and up to 9 dB for pavements.

Air forces pushing on vehicles in motion create an aerodynamic noise source due to aerodynamic drag forces. Drag forces have a considerable effect on the fuel consumption of vehicles as well as on aerodynamic noise source. The flow of air creates resonances occurring all around the body of the transport unit in motion. The greater the frontal area of a vehicle and the higher the vehicle speed, the greater the aerodynamic drag and noise source will be.

Cost effectiveness measures for the **entire infrastructure** (noise barriers, isolation of surrounding buildings, pavement maintenance etc.) should be considered. Noise barriers are not always required at locations where an absolute threshold is met. There is no "standard number" which requires the construction of a noise barrier. Noise barriers are solid obstructions built between roads and homes along motorways. They do not completely block all noise; they only reduce overall noise levels. Effective noise barriers typically reduce noise levels by 5 to 10 decibels, cutting the loudness of traffic noise by as much as one half.

Free-flowing traffic is an important traffic reduction contributor in urban areas. It is known that traffic which is constantly slowing down and accelerating causes higher noise levels than free-flowing traffic because of more engine noise. This is especially the case near crossings that are controlled by traffic lights. In order to minimise the number of vehicles that accelerate, traffic lights should be in phase. With such a procedure, traffic will flow more freely causing significantly less noise. Additionally, other environmental emissions will drop and fuel savings can also be achieved.

Silent pavements should be used in certain highly populated areas, identified by noise maps, and not as an ultimate replacement for all conventional road pavements. The noise reduction of porous asphalt is based on acoustical absorption. Rolling noise as well as engine noise is absorbed. At high speeds the noise reduction is about 5 dB, however, at low speeds there is no significant noise reduction. In general, silent roads are more expensive than standard road surfaces like dense asphalt. Costs are determined by construction costs,

maintenance and durability. It is also a fact that the higher the noise reduction of a road surface the higher the costs. However, a silent road surface not only carries traffic, it is also a noise reduction measure like noise barriers. Application of silent roads will lead to lower noise barriers or no barriers at all. This would lead to a significant cut in overall expenses. In many cases silent roads are the most cost efficient solutions. The costs are less than half compared to the classic solution of high barriers.

The use of **hybrid vehicles** in urban sectors would contribute to a substantial reduction of all emissions. The electric motor offers smooth performance at low speeds, supplemented by the diesel engine's performance as speed rises. All this together allows a truck, bus or coach to accelerate under electric power alone, generating lower fuel consumption, lower emissions and lower noise levels. But in order for this to happen, governments should work on harmonising adequate real incentives, which must outweigh the extra cost and be implemented during a vehicle's entire life. Diesel hybrid systems are more difficult to break in terms of business than gasoline hybrids. The diesel engine is costly, on top of which there is the hybrid system, adding an extra layer of very high cost.

As part of the driver training, the **behaviour of drivers** needs to be taken into consideration, such as diminishing idling times at traffic lights or during deliveries of goods, using main corridors in order to avoid sensitive urban zones, etc. Authorities might establish financial aid to pay for drivers' initial training and to establish proper infrastructures based on the cheapest cost avoider principle.

Industry resources are limited at the moment to known technologies to reduce vehicle noise emissions. This is why further improvements should be focused on targeted measures based on reliable causal statistics and where the main sources are mapped (city centres, main junctions etc.). Retrofitting of vehicles to reduce noise emissions should be avoided as vehicle design may cause fitting problems and safety issues. Other existing systems to reduce noise have to be investigated as they may be more cost-effective than retrofitting vehicles.

Dr Phil Morgan
Senior Consultant
Transport Research Laboratory (TRL)

Dr Phil Morgan is a Senior Consultant within the Noise and Vibration Group at TRL and has over 14 years experience in the study and assessment of road and rail transport noise mitigation measures, with an emphasis on noise barriers and low-noise road surfaces.

He has worked on a wide range of environmental noise projects, was editor of the EU SILVIA project *'Guidance manual on the implementation of low-noise road surfaces'*, Secretary to the Scientific Board on the Dutch national IPG (Innovatieprogramma Geluid) programme for reducing road traffic noise and is a member of several national and international standards committees.

Contribution to the workshop:
How to reconcile noise exposure, urban life and sustainable mobility

Sources of road traffic noise:

Tyre/road interaction noise is the dominant source at vehicle speeds above 20 km/h whereas propulsion noise is the dominant source at speeds below 20 km/h. Traffic composition and volume are also important factors.

On medium-high speed roads, where traffic volumes are high, the overall traffic stream is the source of disturbance. However on lower speed roads, noise disturbance from individual vehicles becomes an increasing problem, e.g. vehicles with noisy exhausts, idling vehicles (particularly HGVs and buses) in congested traffic, airbrake noise from heavy vehicles, and noise resulting from body rattle/unsecured loads when driving over uneven surfaces.

Assessing the scale of traffic noise impacts:

Over large areas, this is most readily achieved using noise modelling or noise mapping, since large scale measurements of traffic noise are generally impractical. However, accurate assessments of the noise impacts (as well as the effects of mitigation) will be dependent upon the capabilities of the noise models (their accuracy, scope and complexity) and associated traffic models. Where models cannot be used, small-scale noise measurements at a local level can be used to assess the impacts.

Work is ongoing at European level to develop harmonised road traffic noise prediction models for use across Europe. These will allow the impacts of road traffic to be uniformly assessed and also allow approaches to traffic noise mitigation in different countries to be robustly compared. The need for up-to-date models is necessary to take account of the changes in noise emissions of the vehicle fleet, changes in road surface characteristics, etc.

Measuring/monitoring noise levels:

It is expected that many national noise prediction methods will include practical methods to allow measurements for when traffic conditions are either difficult to model, fall outside the range of validity of the prediction method, or are too complex to allow the use of standard traffic data. National legislation will also often provide measurement methods as part of planning or noise insulation assessments.

International standard measurement methods are available for assessing the impact of roads surfaces on traffic noise or for characterising the performance of mitigation methods. For road surfaces, the method is set out in ISO 11819-1 (the Statistical Pass-By method); more recently, the development of the CPX (close-proximity) tyre/road noise assessment method in ISO/CD 11819-2 has removed some of the practical limitations of the SPB method. For noise barriers, EN 1793 comprises a suite of standards for assessing sound reflection/airborne sound insulation performance, although these focus on the performance of the barrier materials and do not take account of the physical dimensions of a barrier.

Mitigation of the impacts:

In terms of noise mitigation through *legislation*, whilst the noise levels from individual vehicles are controlled by type approval noise limits (for both vehicles and tyres), the most significant attempt to control road traffic noise impacts in recent years has been the introduction of the European Directive on the assessment and management of environmental noise (2002/49/EC) and its transposition into national legislation. Individual countries may also have their own national noise policies and transport strategies.

In terms of physical mitigation measures, the most common are the use of low-noise road surfaces and noise barriers. However, use of the latter requires space and has a more restricted (localised) impact than the former. Reduction of vehicle noise and tyre noise type approval noise limits has, to an extent, been cancelled out by increasing volumes of traffic.

In areas where conventional noise mitigation measures are less easily introduced, options such as traffic calming and reduced speed limits can help to reduce noise, however the effects on factors such as vehicle emissions must also taken into account.

Increasingly, the use of quieter (electric) vehicles is being promoted, albeit primarily for the benefits in terms of vehicle emissions and greener transport, particularly in cities where vehicles speeds are low. Development of larger electric/hybrid goods vehicles (and the introduction of low-noise ancillary technologies) offers the scope for allowing increased night-time freight movement and night-time deliveries without disturbing residents. Such an approach offers wider benefits in terms of reduced daytime congestion, fuel savings, reduced journey times, etc. Test methods have been developed for in-service assessments of vehicle noise, particularly in relation to noisy exhausts; variants of these test methods are already used by police forces in some EU member states as a mechanism either for directly tackling noise nuisance or for prosecution based on the use of modified exhaust systems.

Measures to control vehicle movement provide further options. Many of these are introduced with the aim of reducing vehicle emissions and improving air quality, i.e. reduced noise levels are therefore a secondary benefit. These measures include the use of congestion charges, lorry control schemes and low-emission zones.

Reconciliation of road noise exposure with urban life and sustainable mobility:

Despite these measures, work still remains to be done to reconcile road noise exposure with urban life and sustainable mobility. Research into the effects of traffic noise on health may be a key driver in encouraging this.

In urban environments, there is a greater need to promote and encourage the use of public transport and to make this mode more sustainable, e.g. through the use of low-carbon vehicles. This offers benefits to the wider community beyond simply a reduction in traffic noise, e.g. reduced congestion and improved air quality.

Whilst mitigation products such as surfaces and barriers continue to be developed, the scope for increased noise reduction is limited unless the problem is tackled at source. There needs to be increased collaboration between vehicle and tyre manufacturers in developing future vehicles. Vehicle type approval procedures and test surfaces need to be more representative of real-life conditions (new methods for the former are already in development). Introduction of in-service vehicle noise tests into routine MOT tests would help to keep noisier vehicles off the public highway.

Vehicle type approval noise limits need to be further revised. Together with consumer demand, this will encourage further development of quieter HGVs (including electric and hybrid vehicles) to generate a shift in the types of vehicles used for deliveries, e.g. one large HGV can replace multiple 3.5t vans and offering overall reduced noise impact and emissions.

Careful planning of road improvement schemes is required. For example, on motorways on the outer boundaries of urban areas, the use of Active Traffic Management (variable speed limits and hard-shoulder running) offers an alternative to simply widening motorways.

Not all of the changes necessarily need to be technology driven. Changes in public attitude and driver behaviour can play an important part.

Dr. Jacqueline Soule de Bas
Performance Analysis Engineer (NVH)
Research and Development for truck tyres
Michelin

After a Bachelor in Mechanical Engineering obtained at the University of Adelaide, Australia, Jacqueline Soule de Bas completed a Doctorate in Mechanical Engineering in the Active Noise and Vibration Control (ANVC) group at the same University. She wrote a thesis on "Virtual Sensors for Active Noise Control".

She then joined Marshall Day Acoustics Pty. Ltd in Melbourne and Sydney as a Senior Acoustic Consultant, in charge of noise assessment and noise reduction recommendations for new and existing major roads, noise assessments of large wind farms, noise modelling of large industial installations, and as a responsible for distribution of SoundPLAN noise prediction software.

Since 2009, she works as a Performance Analysis Engineer at the Manufacture Française des Pneumatiques Michelin, in charge of research and Development for truck tyres, and noise technical expert for Standards and Regulations.

Noise Exposure, Urban Life and Sustainable Mobility

Living in an urbanised environment means exposure to environmental noise as a result of activities including the transportation of people and of goods by road, rail, air or waterway.

Our modern lifestyle is characterised by an ease and availability of personal transportation and of goods which inevitably produces environmental noise. This mobility is an important part of our modern lifestyle however; the resulting ever increasing noise exposure has been shown to be detrimental to health and given the large population living in an urbanised environment, this is a very important public health issue.

The recently published World Health Organization report "Burden of disease from environmental health effects" links the exposure to high levels of environmental noise to adverse health effects and as a consequence WHO considers environmental noise not just as a nuisance but also as a concern for public health.

Therefore, the control of environmental noise is a very important issue in today's society that needs to be addressed from all aspects through appropriate changes in regulations and efficient implementation of new technology. The European Union Directive 2002/49/EC relating to the assessment and management of environmental noise requires the creation of noise maps with the aim of monitoring environmental noise and curing noise black spots. In addition, the noise limits for tyre noise emissions are being progressively reduced and the measurement method and the noise limits for vehicle noise emissions are currently being modified.

However, to reduce the urban noise problem a holistic approach is required.

Through the reduction in noise limits, the tyre industry is making significant progress in the reduction of tyre noise emissions. However, the beneficial effects of this reduction will not be immediate given the diffusion time of the new technologies to all circulating vehicles.

A tyre has many performance requirements including wear, rolling resistance, grip and noise and all these parameters are equilibrium so improving one nearly always leads to a reduction in at least one of the other performance parameters. While it is important to reduce the tyre road noise emissions, this can not be at the expense of the other important safety and environmental functions of the tyre. Therefore, Michelin is committed to improve the overall balance of performances of the tyre, including environment, safety and durability.

There are other ways to reduce road traffic noise including quiet road technology which already exists and where the effect on the noise exposure of the surrounding population is immediate. Traffic management is another possible noise reduction mechanism through the circulation control including speed reduction or incentives to reduce the number of vehicles. The prohibition of trucks in built-up areas especially during night time will reduce the noise level as well as sleep disturbance for the surrounding population.

It is Michelin's opinion that overall traffic noise reductions can only be achieved when all of the stakeholders are solicited and work together in an equilibrated fashion.

Mr. Seiji TAKAI
Environnent Management Bureau
Environnemental Control Technology Office
Ministry of the Environment

Measures against Road Noise from Vehicles in Japan

In Japan, the environmental quality standard of noise is designated, and based on the situation of the environmental noise standard achievement, the regulation for noise, especially from vehicles, was developed. Currently, the consideration of further reinforcement has been conducted.

○ **Environmental Quality Standard of Noise**

Environmental Quality Standard of Noise, shown in Table 1, is designated as the standard to be kept for the purpose of the protection from damage to health by Basic Environmental Law, Article 16.

Table 1 Environmental Quality Standard of Noise

Types of area		Standard (dB(A))	
		Daytime(6:00~22:00)	Nighttime(22:00~6:00)
In general	AA area(where silence is especially required. Ex. hospital)	50 or below	40 or below
	A or B area(for residence exclusively or mainly)	55 or below	45 or below
	C area(for commerce)	60 or below	50 or below
Areas close to roads	A area facing road with two or more lanes	60 or below	55 or below
	B area facing road with two or more lanes or C area facing road	65 or below	60 or below
Areas facing trunk roads		70 or below	65 or below

○ **Achievement of the environmental quality standard of noise**

The achievement of the environmental quality standard of noise (Areas close to road) has been improved slightly for several years, shown in Fig.1, while No. of residences

exceeding the standard has been kept. Fig.2 shows the number of complaints to the local government, which are usually caused by the temporary but extra high level of noise, that is Lmax. The numbers are decreasing slightly in several years.

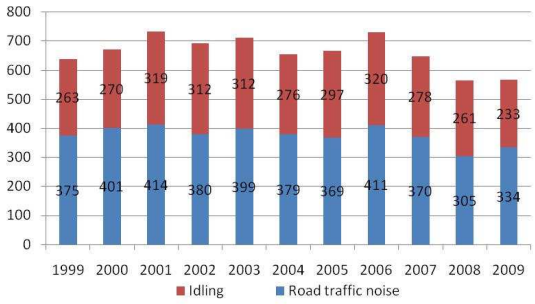


Fig.2 No. of complaints from people (to Local governments)

○ **Current noise regulations for vehicles**
There are three test method of vehicle noise as follows. And the limit values are shown in Table 2.

- ✓ Full Throttle Acceleration : Measure the sound level when approaching at constant speed (ex. 50km/h or 0.75S for vehicle having at least four wheels) and accelerator fully depressed (throttle control fully opened) between the test tracks
- ✓ Constant Speed : Measure the sound level when approaching at constant speed (ex. 50km/h for vehicle having at least four wheels) and keeping the constant speed between the test tracks
- ✓ Stationary : Measure the sound level in the immediate vicinity of the exhaust-system outlet during a period consisting of the target engine speed and the deceleration by the release of accelerator/throttle.

Full Throttle Acceleration test and Constant Speed test require a wide area and test devices, while Stationary test does not require a wide area and is practical for in-use vehicles.

Table 2 Limit Value for vehicle noise (Since 2000)

Vehicle types		Full Throttle Acceleration	Constant Speed	Stationary
Passenger vehicle (11 passengers or more) and commercial vehicle	GVW > 3.5t and P >150 kW	81 (82*1)	82 (83*1)	99
	GVW > 3.5t and P ≤150 kW	80 (81*2)	79 (80*2)	98
	GVW ≤ 3.5t	76	74	97
Passenger vehicle (10 passenger or less)		76	72	96 (100*3)
Motorcycle	cc ≤ 50	71	65	84
	50 < cc ≤ 125		68	90
	125 < cc ≤ 250	73	71	94
	250 < cc		72	

*1 For an all-wheel-powered vehicle, tractor or vehicle with a crane
*2 For an all-wheel-powered vehicle
*3 For a rear engine vehicle

○ **Consideration of the reinforcement of vehicle noise regulations**

1. Silencing System Certification Scheme

In-use vehicle (passenger vehicles (10 passengers or less) and motorcycles) shall be equipped with the original silencing system or replacement silencing system which is certified by the recognized organizations since April 1, 2010. The limit values for the replacement silencing system are 79 dB for motorcycles with 125cc or less engine and 82 dB for the others by the full throttle test method.

2. Tire Noise Regulation

Introduction of Tire Noise Regulation (ECE R117) and abolition of constant speed test have been considered since 2009. As the portions of tire noise during in case of cruising are over 80% for passenger vehicles, shown in Fig.3, tire noise regulation seems to be effective especially for the noise reduction in areas close to trunk roads. Furthermore, noise regulation for replacement tires is effective for in-use vehicles. Evaluation of the environmental effectiveness with simulation will be conducted, then the conclusion will be reached by the end of 2011.

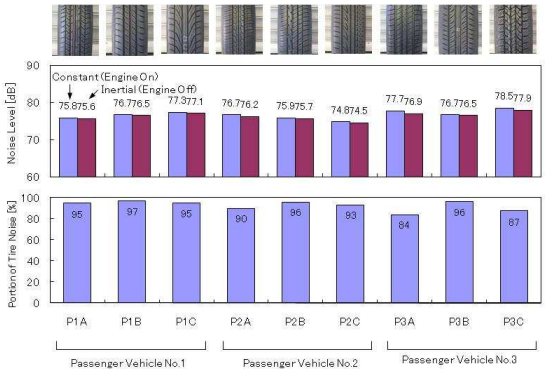


Fig.3 Portion of Tire Noise (100km/h, Passenger Vehicle)

3. Review of Acceleration Test (Introduction of revised ECE R41-04 and R51-03)

Review of Acceleration Test (introduction of ISO 362-1 and -2) has been considered since 2009. As for vehicles with four or more wheels, a_{urban} formulated in ISO362-1 tends to be slightly higher than a_{95} measured in metropolitan area (around Tokyo). After limit values (ECE R51-03) is proposed at GRB, consideration will be resumed. And as for motorcycles, consideration of the introduction of ISO362-2 and ECE R41-04, especially limit values, will start this year. The conclusion will be reached by 2012.

4. Harmonization to international standards

As environmental measures are an issue of international importance, it is desirable for Japan to promote the international harmonization of standards, as long as the Japanese environment would not be harmed. It is expected that ECE regulations should be applicable not only in the restricted countries but also all over the world. For example, in the discussion of revision of R51-03, the subcategory division can be used in Japan (ex. Typical line-up of trucks is shown in Fig.4) as well as in other countries.

Vehicle Type	Light-duty 3.5≦GVW≦7.5ton	Medium-duty 7.5<GVW≦12ton	Heavy-duty 12ton≦GVW
			
Power Range	75-132kW (Main range : 75-125kw)	110-199kW (Main range : 150-180kw)	165-382kW (Main range : 250-300kw)

Fig.4 Typical Line-up of trucks in Japan

Pascal Valentin
Head of Noise and Physical Agents unit
Ministry of Ecology

Following a master's degree in private law and a diploma from the Superior School of Transportation (ENOES group), Pascal Valentin completed his training by graduating in Transports, communication, logistics and international exchanges (master thesis).

He then worked for ten years in the river transportation field (*Voies navigables de France*), before joining the French Ministry of Equipment where he spent three years involved with land planning litigation, followed by five years as chief officer of the Prevention and Studies department of the Road safety directorate. More particularly, he was by then in charge with partnership policies with organizations and businesses.

In the year 2002, he joined the Ministry of Ecology and sustainable development where, two years later, he was appointed Chief officer of the Noise mitigation bureau. In 2008, his registry of activities was recently widened to physical agent's issues, dealing with electromagnetic exposure and light pollution.

Contribution to the Workshop: How to reconcile noise exposure, urban life and sustainable mobility?

I Public opinion polls

Survey CREDOC 1989: 43% of the population (58% of Parisian) are annoyed by the noise in their residence.

Survey IFEN 2000: 56% of French think that noise abatement is priority.

Inquire INSEE 2002: (living conditions of the households) 54% of the households are declared annoyed by the noise in their residence. Transport is the first quoted source.

Inquire TNS SOFRES 2010: Two thirds of the French are said personally constrained by the noise to their residence (difficulties of drowsiness, of concentration, tires…) and close to a French on six was already constrained at the point to think of moving.

The most constrained French live in agglomerations of more than 30.000 inhabitants (28% are declared often or permanently constrained there, 38% for Paris, Lyon and Marseilles) and live in apartment. Transport is regarded as the first source of noise pollutions (54%). Among various transports, the first source of embarrassment is the road traffic (59%), air transport (14%) and the rail-bound transport (7%).

The most underprivileged populations naturally are exposed to the noise (proximity of infrastructures and residences badly sound-proof).

II Actions: The law noise of 1992 and its applications

a) The "sound classification" of the roads. The government classifies the transport infrastructures according to their characteristics (more than 5000 vehicles per day) He determines the sectors affected by the noise (band from 10 to 300 meters) inside whose constructions must respect insulations norms (objective: 35 dB inside sleeping rooms). Are concerned: residences, hotels, educational establishment, care and health constructions. The certificate of land planning indicates the situation in sector exposed to the noise.

Classification is based on calculation. Evaluated traffic knows 2 periods (day and night). Takes into account the share of the heavy lorries, the profile and the slope of the way, the carriageway surfacing and speed.

The European directive 2002/49/CE: noise maps concerning the principal infrastructures and the greatest agglomerations. Action plans

b) Regulation applicable to the new or modified infrastructures

c) Identification of the black spots of the noise and their treatment.

National road network not conceded. The plan contracts State-Territorial collectivities 2000-2006 programmed more than 1.23 billion euros for acoustic work of protections in the vicinity of the national road network not conceded.

Their realization being prolonged until 2008, it was thus invested approximately 137 M€ per year, including 41 M€ by the State and 96 M€ by the Territorial collectivities.

Conceded national Highway network during the same period, the companies of motorways invested more than 140 M€, that is to say approximately 16 M€ per annum on acoustic work of protections.

These actions were supplemented by operations consisting exclusively of reinforcements of frontage (walls and windows) of residences of the private park located near the national roads network.

550 M€ devoted to the national highway network not conceded from 2010 to 2014.
110 M€ devoted to the national highway network conceded over 3 years. 5 companies of motorways engaged in “green endorsements”, in which are identified important investments to be carried for sustainable development.

As regards noise abatement, it is envisaged to carry out approximately 100 M€ of work for acoustic protections over these three years.

100 M€ devoted to the actions of abatement of the noise black spots of Railway network.

As regards road transport (as plane transport) technological and technical progress (vehicles, coatings, tires…) are “canceled” by the increase in traffic.

III Necessary political choices

Grenelle of the environment (modal transfer to the train and inland waterways navigation). Action plans of the European directive (contained left with the appreciation of the competent authority), research.

Which financial sources? (cf pollutant payer Principle). A “tax” sat on the fuel, atmospheric pollution?