Several European Technology Platforms (ETPs) have been established to define research and development priorities, time frames and action plans on a number of strategically important issues where achieving Europe's future growth, competitiveness and sustainability objectives is depending on major research and technological progress in a mid- to long-term[41]. The ETPs providing a wide framework for stakeholders are led by industry so that a high industrial relevance of the strategic research agendas developed by the ETPs is ensured. Amongst others, technology platforms which include aspects of transport noise exist for road traffic (ETP "ERTRAC"[42]), rail traffic ("ERRAC"[43]) and air traffic ("ACARE"[44]). Consequently, the noise research road maps for these transport modes have been developed by CALM in close cooperation with the related ETPs.

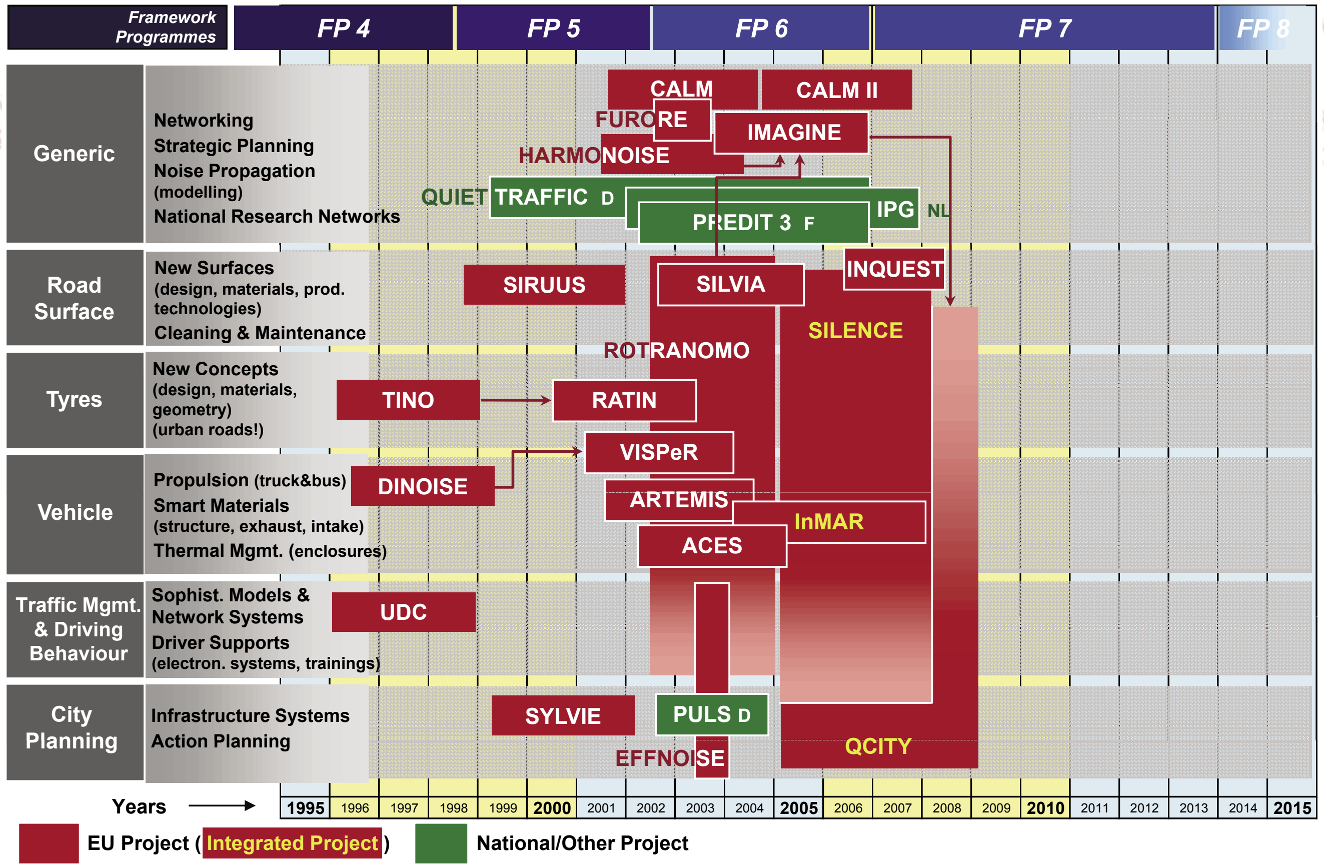
5.3.1. Research Targets

Independent of the noise category considered, planning of research and technological development in the field of noise control at source shall be combined with research targets which identify necessary reductions of noise emission and achievable or expected reduction potentials. Currently, such research targets are defined for each noise category, but usually in different ways. It would be desirable to harmonise research targets between the noise categories in terms of noise descriptors, test methods and reference basis including a broad acceptance by the related stakeholders and taking into account the different annoyance from the various noise sources. Attempts towards harmonising targets have been made in the past[45,46], but agreement could not be achieved so far. The research targets are defined individually for each noise category also in this Strategy Paper, but they should be related to the common minimum, medium and optimum targets for noise reception (immission) as stated in Chapter 4.

"The research targets of the different noise categories shall be harmonised on the basis of a broad acceptance by the related stakeholders."

5.3.2. Road Traffic Noise

The noise reduction targets for the noise emission from road traffic extend up to 10 dBA[47]. This kind of target typically in terms of L_{den}, refers to the average real traffic situation so that the whole variety of noise control measures for real traffic (e.g. low noise road surface, low noise tyres, vehicle-related measures, traffic management, driving behaviour etc.) is to be considered. These examples of control measures form the main fields of research as illustrated in the graph below. The research activities of the last years, in particular those initiated by the 5th and 6th Framework Programme, cover most of the main fields. However, technology gaps and needs for further deeper research still exist and are summarised in the related noise technology road map.



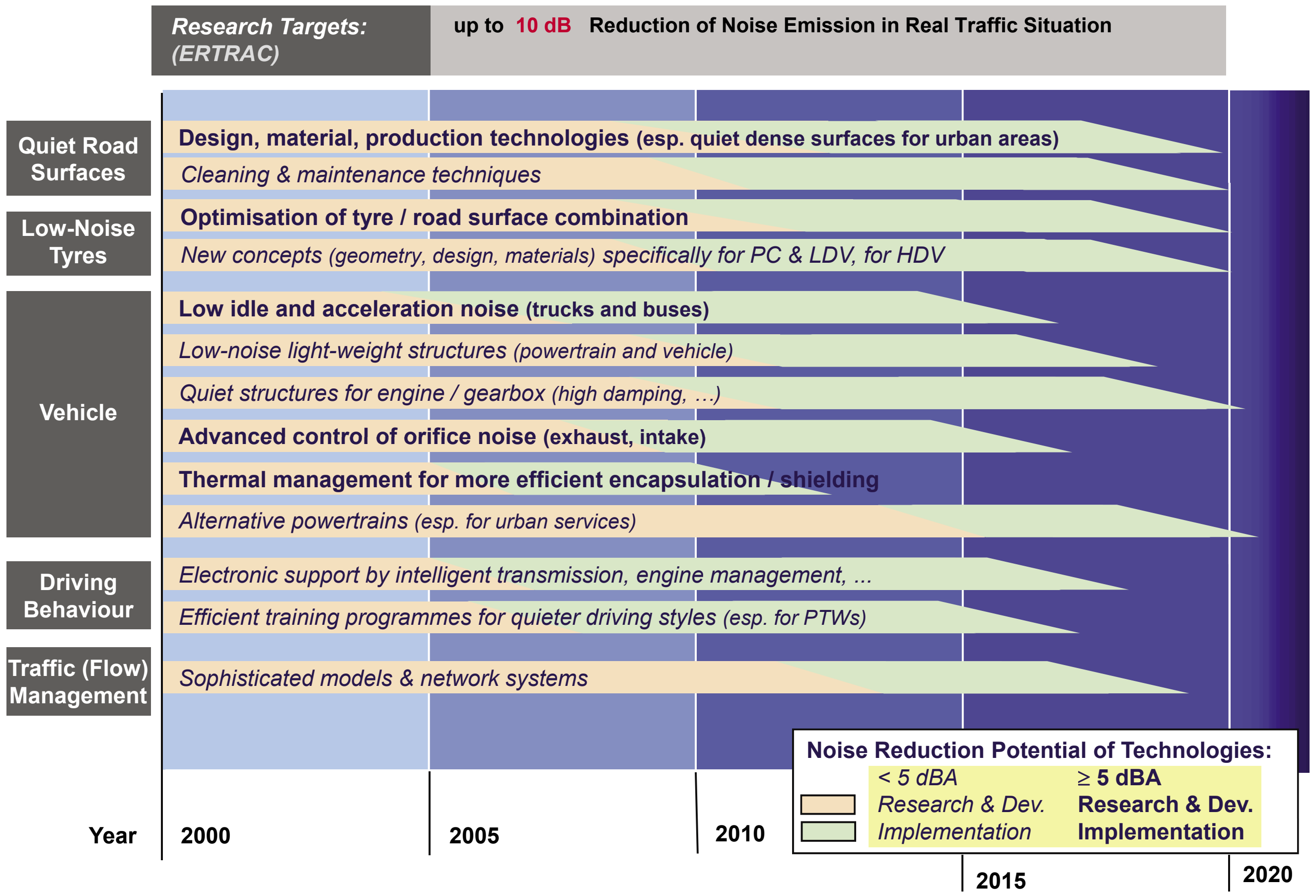
Overview of Key Research in Road Traffic Noise

[41] See: http://cordis.europa.eu/technology-platforms/home_en.html
[42] ERTRAC – European Road Transport Research Advisory Council, see also: http://www.ertrac.org/
[43] ERRAC – European Rail Research Advisory Council, see also: http://www.errac.org/
[44] ACARE – Advisory Council for Aeronautics Research in Europe, see also: http://www.acare4europe.com/
[45] Michael Jaecker-Cueppers: Quieter Roads and Rails in Europe: a Vision for 2030. CALM Workshop with Stakeholders, Brussels, 18 - 19 March 2002.
[46] Martin van den Berg: Targets for Noise Immission. CALM Workshop "Road Maps for Future Research in Environmental Noise", Brussels, 16 March 2006. http://www.calm-network.com

[47] Derived from UBA Workshop "Further noise reduction for motorised road vehicles", Berlin, 17 - 18 Sep. 2001, and CALM Workshop with Stakeholders, Brussels, 18 - 19 March 2002.
The same target is formulated in the Strategic Research Agenda of ERTRAC (Dec. 2004): "Transport noise will be reduced by up to 10 dBA through a system approach including better indicators and improvements to vehicles, tyres and infrastructure."
Applying this target to the situations of highest noise exposure ("hot spots of road traffic noise") would result in reaching the minimum level of the reception-related reference targets stated in Sect. 4.2 (see H. Steven: From Hot Spots to Research Needs in Road Transport Noise. CALM-Workshop "Road Maps for Future Research in Environmental Noise", Brussels, 16 March 2006).

The road map presents the major research topics with optional splits into sub-topics (noise reduction technologies) and estimated reduction potential per sub-topic at two levels (< 5 dBA or ≥ 5 dBA indicated by italic and bold characters respectively). These noise reduction potentials refer to noise reduction at the source and do not reflect the sub-topic's contribution to environmental noise. The road map also includes estimated time scales for the research and implementation phase of each sub-topic. The inclined transitions of the time bars are to give some indication of uncertainties of the time scale estimates. The road map for road transport is based on several CALM workshops and a dedicated study[48]. The update of the road map is based on CALM workshops held in 2005 and 2006[49] and has a stronger focus on the needs for noise mitigation in urban areas.

"Rolling noise is predominant in many road traffic situations and currently limiting further significant progress in noise reduction."



Noise Technology Road Map for Road Transport

[48] Study on the Time Scales for Availability and Implementation of New Future Key Technologies for the Reduction of Road Traffic Noise in the EU. IKA-Report 33290, Sep. 2003. (www.calm-network.com).

[49] CALM Workshop "Research Priorities for Noise Mitigation in Urban Areas", Brussels, 18 Oct. 2005
CALM Workshop "Road Maps for Future Research in Environmental Noise", Brussels, 16 March 2006.

For the achievement of the above targets, research leading to a more thorough knowledge and new technologies (including also new system approaches) is required for the following primary issues relating to road transport noise:

- **Rolling noise** *(consisting of the two elements 'tyres' and 'road surface'):*
  - *Better understanding of road-tyre interaction for improved simulation tools with increased accuracy*
  - *New concepts for low-noise tyres (geometry, design, material, matching to road surfaces for optimised tyre-surface combinations)*
  - *New concepts for low-noise road surfaces (design, material, production technologies), in particular quiet dense surfaces for urban areas*
  - *Cleaning and maintenance techniques for low-noise road surfaces (cleaning techniques, winter maintenance, renewal techniques)*

Rolling noise is the predominant noise contributor in many traffic situations and this limits further significant progress in noise reduction. A deeper understanding of the interaction between the tyre and road surface is necessary to progress, especially in rolling noise modelling. New concepts for low-noise tyres and road surfaces have to be established based on models with increased accuracy (without jeopardising safety relevant features). For road surfaces, solutions are required for new production technologies as well as cleaning and maintenance techniques for open porous surfaces to achieve sustainable noise reduction. For urban areas, quiet dense surfaces are needed.

"Emission-related legislation must be well adapted to the real world for efficient noise reduction."

- **Vehicle noise** *(also called propulsion noise consisting of engine, transmission and exhaust noise)*
- *Acceleration noise (particularly for trucks and buses)*
- *Cold start low idle noise of diesel powered vehicles*
- *Quiet structures of powertrain and vehicle (low-noise design of light-weight structures, high damping in engine and gearbox structures)*
- *Advanced control of orifice noise (intake, exhaust; active systems)*
- *Thermal management concepts for improved encapsulation of powertrain*
- *Alternative powertrains (especially for urban services)*

Particularly in urban traffic, diesel powered vehicles are noisy and annoying at (cold) low idle and under acceleration (starts at traffic lights, especially of trucks and buses) requiring innovative solutions for quiet, clean and fuel-saving combustion systems. Light-weight vehicle structures are increasingly used for reasons of fuel-saving and lower exhaust emission, but they may sometimes be disadvantageous for the vehicle acoustics and require dedicated solutions. Further promising aspects for the future are new materials with enhanced damping properties, advanced thermal management for more efficient encapsulation, production of efficient systems for active noise control of intake and exhaust noise, and alternative propulsion systems preferably used for low or zero exhaust emission operation in urban areas. A further topic of importance is the efficient control of low frequency vibration from commercial vehicles which can cause considerable disturbance in urban environments.

- **Driving behaviour** *(driver assistance systems, training programmes)*

Systems are needed which support and promote low-noise driving styles e.g. by engine management, intelligent transmissions and electronic driver assistance systems. In the specific field of powered two-wheelers (PTWs), the driving style and the manipulation of the engine and exhaust system have a big impact on the noise emission[50] so that investigations towards efficient training and control programmes for quieter driving of PTWs are needed.

- **Traffic management**

More sophisticated systems for traffic management are required to reduce noise emission, particularly with regard to preventing congestion and improving safety.

- **Improved regulations related to noise emission** *(including test methods)*

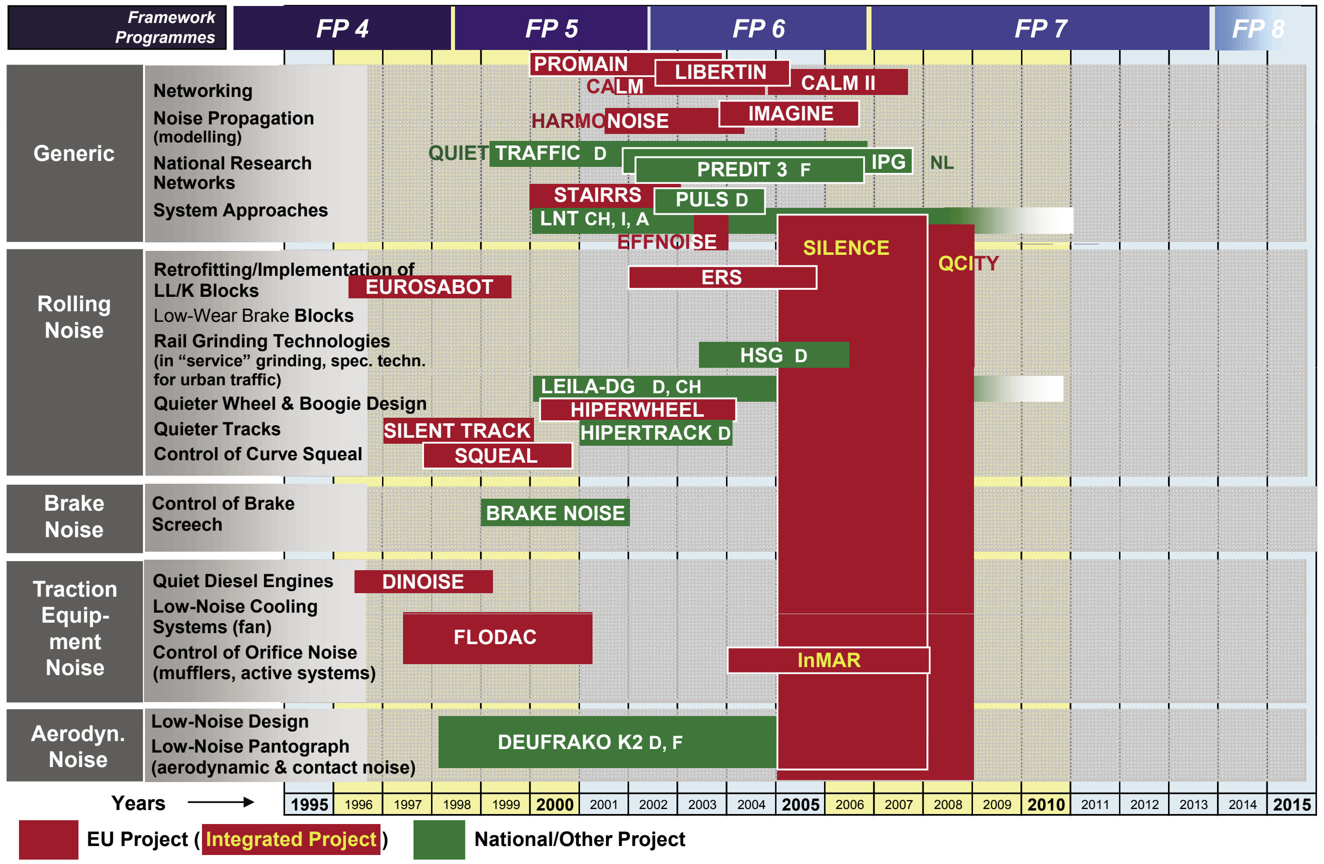
The methods for legislative noise emission testing of road vehicles are based on operating conditions which are not sufficiently representative for the typical conditions in real situations.
Better adaptation to the real situations is required and has already started to make the noise emission limitation a more effective and efficient tool for contributing to environmental noise reduction through noise control at the source. For the development of new regulations (e.g. for road surfaces), a comprehensive and reliable data base is required which must be derived from adequately resourced research.

[50] ACEM Report: Striving against Traffic Noise - How Powered Two-Wheelers can contribute. 2004.

5.3.3. Railway Noise

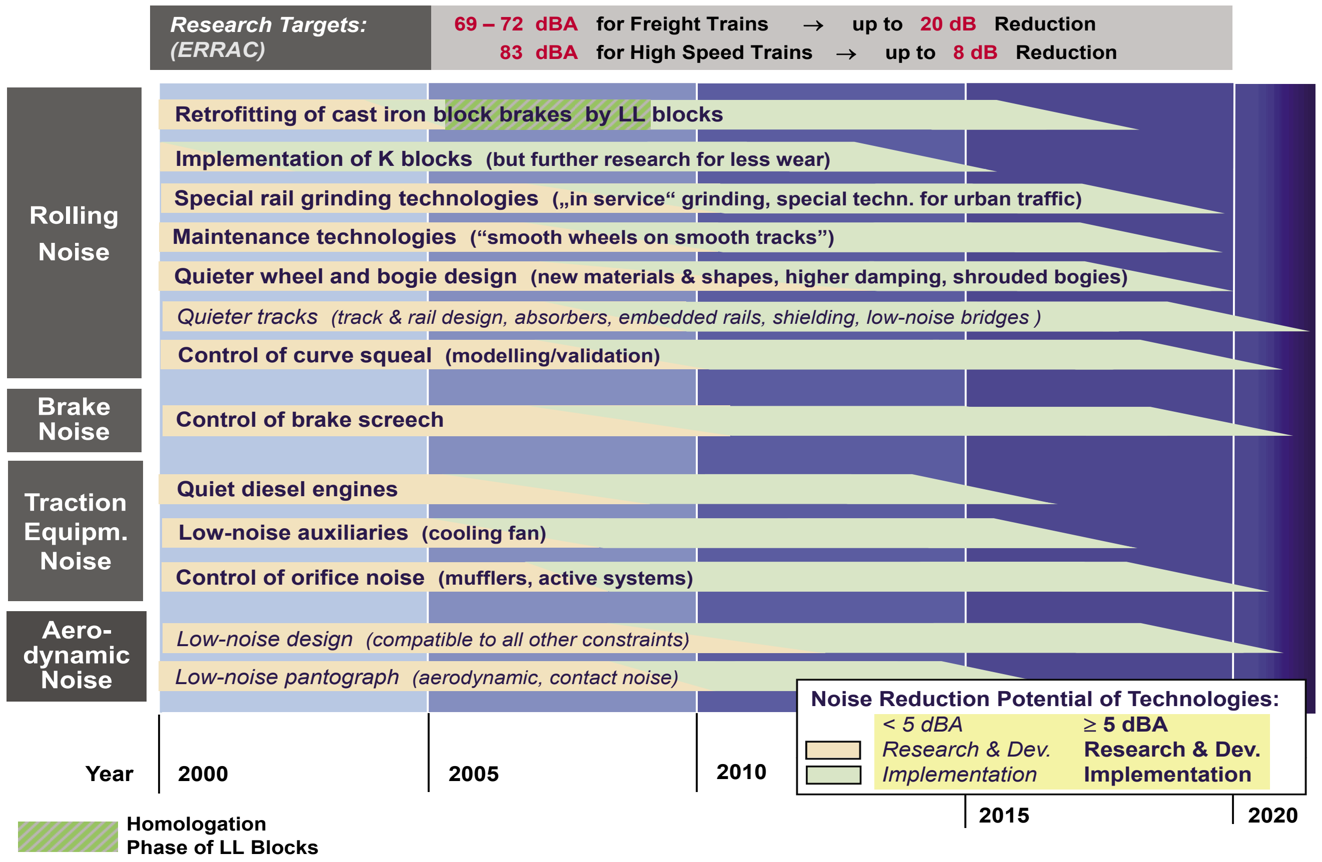
The ERRAC target for noise emission by 2020 is 69–72 dBA for freight trains and to 83 dBA for high speed trains (at 300 km/h)[51]. This means noise emission reductions up to 20 dBA for freight trains and up to 8 dBA for high speed trains. These are challenging targets for railway noise research.
An overview of major research activities in the recent past and present is given below. The main research fields concerning railway noise are rolling noise, brake noise, noise from the traction equipment and aerodynamic noise. In addition to detail research in specific topics, the challenging targets demand for a more holistic and systematic approach. This trend is evident in the research project overview, in particular with the EU Integrated Projects SILENCE and QCITY, the national research programmes and networks like Quiet Traffic, PREDIT and IPG and multi-national projects like Low Noise Train (LNT).

Based on former research and the direction of current research, the future demands are directed towards more thorough knowledge of existing systems and new technologies (including also new system approaches) leading to the following primary requirements of future railway noise research[52].



Overview of Key Research in Railway Noise

[51] P.-E. Gautier, C. Cheron: Updating the Strategic Rail Research Agenda: Railway Noise Issues. Euronoise2006 Conference, Tampere, 30 May – 1 June 2006.
[52] See also: Position Paper of WG 6 (Railway Noise) on the "European Strategies and Priorities for Railway Noise Abatement", 2003, and Technical Annex of the Strategic Rail Research Agenda 2020 of ERRAC (European Rail Research Advisory Council), Sep. 2002.

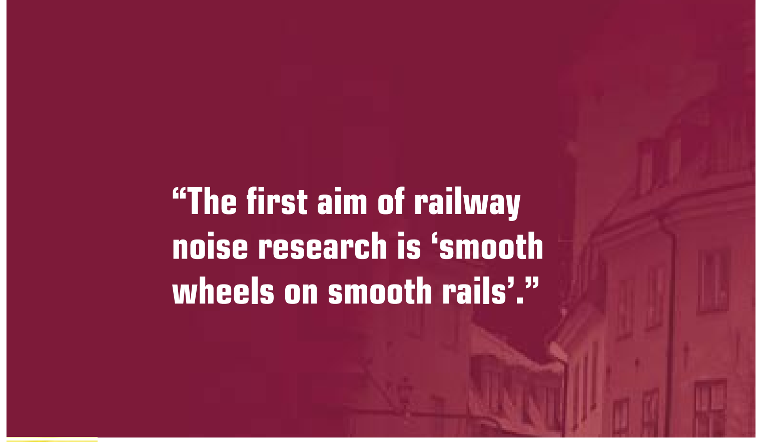


Noise Technology Road Map for Railway Transport[53]

- **Rolling noise** *(mainly for freight trains, arising from wheel and rail roughness caused by cast iron block brakes)*
- *Retrofitting technologies for cast iron block brakes (composite braking shoes for cost-neutral retrofitting)*
- *Rail grinding technologies (especially “in service” grinding)*
- *Quieter wheel and bogie design (new materials and shapes, higher damping, shrouded bogies)*
- *Control of curve squeal and brake screech*
- *Quieter tracks (track and rail design, embedded rails, shielding, low-noise bridges)*

Increased roughness of wheels and rails caused by cast iron block brakes resulting in increased rolling noise especially from freight trains is currently the predominant contribution to railway noise. Therefore, because of the high reduction target of up to 20 dBA for freight wagons, research and noise reduction technologies, first of all technologies for cost-neutral retrofitting of cast iron braking shoes, must have top priority. So-called “K-block” composite braking shoes are already homologated, but require costly adaptations when retrofitted. Current research on the less expensive composite “LL-block” solutions is yet to be completed and evaluated. In parallel with retrofitting, rail grinding is as important (“smooth wheels on smooth rails”). New rail grinding technologies and procedures shall consider higher grinding quality, optimisation of grinding intervals, roughness monitoring and in-service grinding. In addition, basic research is required for a better understanding of the generation, growth and control of rail roughness.
Although curve squeal and brake screech are rather local noise issues, they can also lead to high (local) annoyance for short durations of time.

53 The road map presents the major research topics with optional splits into sub-topics (noise reduction technologies) and estimated reduction potential per sub-topic at two levels (< 5 dBA or ≥ 5 dBA indicated by italic and bold characters respectively). These noise reduction potentials refer to noise reduction at the source and do not reflect the sub-topic’s contribution to environmental noise. The road map includes also estimated time scales for the research and implementation phase for each sub-topic. The inclined transitions of the time bars are to give some indication of uncertainties of the time scale estimates.



For efficient solutions a better understanding of the wheel-rail contact including the interaction of different parameters is required. There is also a need for more accurate modelling.
Further advances in control of railway rolling noise at the source aims at innovative low-noise, low-cost and low-wear solutions (design, materials, damping) considering all components of the rail-wheel interaction (wheels and bogies, rails and rail support structures). Due to the deterioration of the rail and wheel running surfaces with service time, technologies and procedures to maintain low roughness levels are of high importance.

- **Traction noise** *(including auxiliary systems)*
- *Quiet diesel engines*
- *Low-noise cooling systems (especially fan noise)*
- *Control of orifice noise (mufflers, active control systems)*

Engines of diesel locomotives can be a significant source of pass-by noise. Transfer of automotive diesel engine technologies is needed including the adaptation to the specific railway requirements. The control of cooling system noise, in particular fan noise, requires advanced solutions which may be also based on technologies in the fields of automotive and construction equipment. Further reduction of orifice noise arising from diesel engines and cooling systems requires the increased acoustic performance of mufflers (considering the spatial and other boundary conditions) and advances in active control systems, in particular for covering broader frequency ranges.

- **Aerodynamic noise** *(from high speed trains)*
- *Low-noise design*
- *Low-noise pantographs (airflow noise, contact noise)*

In future, high speed trains need to be more streamlined and optimised in aeroacoustics. This requires improved and powerful simulation models for the airflow and the associated noise generating mechanisms. New solutions must be, of course, compatible with all other constraints, first of all with safety constraints. Pantograph noise is a special challenge at high speeds requiring sophisticated approaches for controlling both aerodynamic noise and contact noise.

- **Monitoring and type testing techniques** *for noise emission*

Railway noise can be additionally controlled by traffic management. Monitoring of noise emission levels on a real-time basis is needed to include noise into traffic management systems.
In future, more sophisticated type testing methods (including more rigid specifications of track conditions) are required for low-noise vehicle identification (e.g. incentives) and for better separation of the noise emission contributions from vehicles and tracks. Better identification of individual noise sources is also important as input for calculation schemes of reception levels.

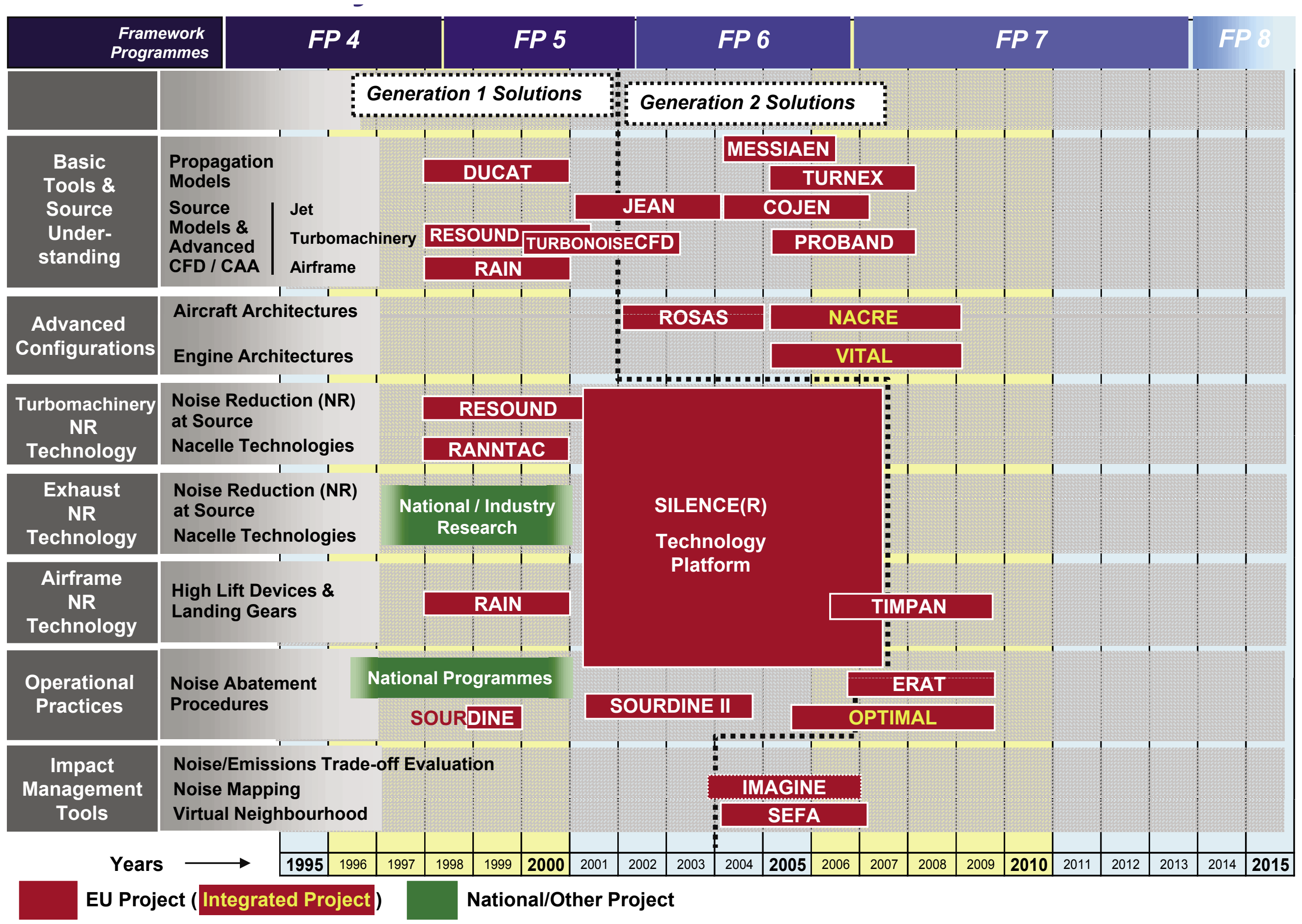
5.3.4. Air Traffic Noise

Since 1991 a major review has been undertaken within the ICAO Committee for Aviation Environmental Protection (CAEP) which has now led to the implementation of the more stringent Chapter 4 noise limits[54]. As another major outcome of the process, recommendations were made in favour of a "Balanced Approach" encompassing four elements: reduction of noise at the source, land-use planning, noise abatement procedures and aircraft operating restrictions. This concept implies the elaboration and implementation of a process meant to help the assessment and resolution of noise problems at airports in the most cost-effective manner. The Balanced Approach challenges the ICAO member states to „study and prioritise research and development of economically justifiable technology", to foster the development of noise abatement procedures, while addressing airport land-use planning and management aspects.
Within Europe, through the early activity of the "Aeronautics Task Force" on "The Environmentally Friendly Aircraft" and the subsequent work carried out

in ACARE for the SRA-1 and now SRA-2[55], there has been a definite will to develop a consistent research strategy aimed at addressing aviation environmental issues on a problem-solving basis. Under the hat of the X-Noise network, major industrial partners have been involved with leading research establishments in supporting the development of strategic research agendas in the noise area. This has led to the effective implementation of a number of complementary projects in the frame of a well coordinated technical strategy. Through FP4 and FP5 projects, the effort aiming at the EC short/mid term improvement of 5 dB, also called "Generation 1 Solutions", is now well under way culminating with the achievements to be reached by the large SILENCE(R) Technology Platform.
Taking up on the elements provided by the ACARE SRA-1, X-NOISE has in particular identified gaps and priorities, considering through a common methodology the research to be carried out on each engine / nacelle / aircraft component of interest as well as on generic enabling factors such as Computational Aero-Acoustics (CAA) techniques. As a result, a series of new projects aiming at Generation 2 solutions have been initiated. The figure below represents the projects involved in achieving the Generation 1 step as well as the early stages of the effort aiming at the 2020 goals.

"Noise is an important topic in the strategic research agenda of ACARE."

[54] Convention on International Civil Aviation, Annex 16 „Environmental Protection", Volume I, Chapter 4. 2001.
[55] Strategic Research Agenda (SRA-1) of ACARE, Oct. 2002; this SRA has been updated end of 2004 as SRA-2. ACARE is the "Advisory Council for Aeronautics Research in Europe", supported by the X-Noise network regarding noise topics. See also: http://www.acare4europe.com/ and: http://www.x-noise.net/

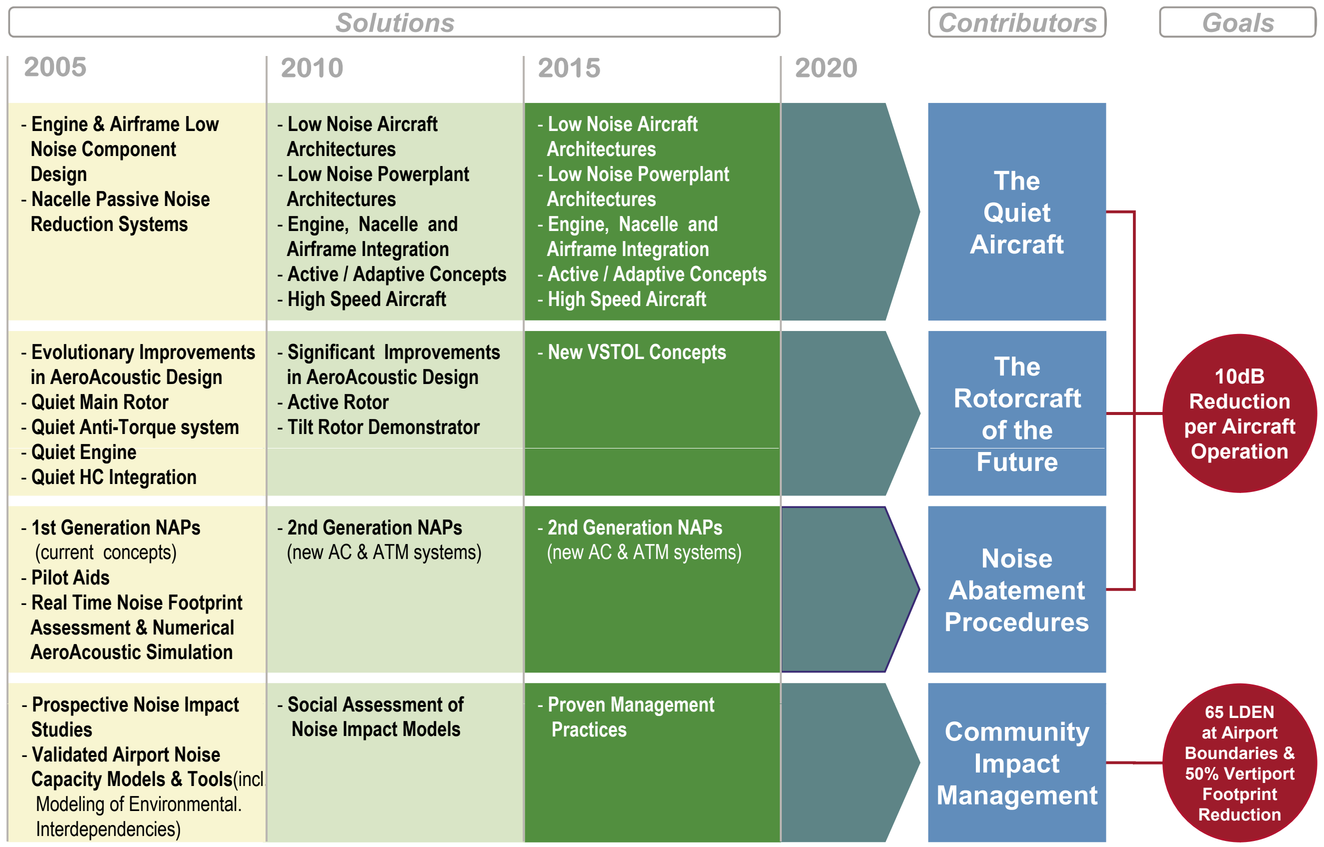


Overview of Key Research in Air Traffic Noise

As indicated above, the on-going effort is fully consistent with the Strategic Research Agenda SRA-1 first published in October 2002 under the direction of ACARE. Its contents covered five key challenges to address for 2020, namely Quality and Affordability, Environment, Safety, Air Transport System Efficiency and Security. The SRA-1 challenge **Environment** was more specifically described as meeting a continually rising societal demand by reducing the environmental impact of operating, maintaining, manufacturing and disposing of aircraft and related systems.

To meet such challenges, quantified 2020 goals were set and specific "Contributors" were identified, representing the constituent elements contributing to the achievements of the goals. Each contributor has associated with it a set of technical and operational solutions which are not mutually exclusive, and which, if appropriately funded, researched and applied would be capable of meeting the 2020 goals. The goals, contributors and solutions involved in the noise reduction aspects of the SRA-1 are represented below.

While the most significant element remains here technology development, other elements of the Balanced Approach are being considered as well, aiming at a combined noise reduction of 10 dB per aircraft operation as the first 2020 goal. The agenda is also stating the importance of research aiming at improving tools and practices involved in the management of noise impact to take full advantage of novel technology and successfully manage situations emerging in the transition period. Meeting the second 2020 goal would then translate into ensuring that such a global approach will limit noise nuisance to 65 dBA L_{den} at airport boundaries and lead, for rotorcraft, to a noise footprint area reduced by 50 percent around heliports or vertiports.



Noise Technology Road Map for Air Traffic (ACARE)

A second edition of the Agenda was released by the end of 2004. One of the key development areas of SRA-2 has been then to examine the sensitivity of the Agenda to alternative views of the future. These future views are determined by the sets of unique characteristics that describe different drivers of the air transport system and the challenges to it (environment, security etc.). By exploring the technology implications of each of these unique characteristics along a particular research axis, it was then possible to see how they would be used within a system operational context.

This led to elaborate High Level Target Concepts (HLTCs) which extend thinking to a moderately extreme view in five different directions: protecting the environment, saving time, improving security, increasing choice and reducing cost. The component "Environment" of the SRA-2 is concentrated under the SRA-2 HLTC **Ultra Green Air Transport System.** As such, the concept stretches the world's sensitivity to environmental damage and examines possible technological responses to it, the most relevant scenario being "Constrained Air Traffic Growth" under which there will be an increased public awareness in industrialised as well as in emerging countries of the need to protect the environment. In full consistency with the quantified SRA-1 goals detailed above, the HLTC "Ultra Green Air Transport System" addresses the whole range of vehicles for a future air transport system within the added dimension of an operational context described earlier.

Within the context of both SRAs, a number of conditions, prerequisites and enabling factors have been emphasized. They state in particular that the objectives are not achievable without important breakthroughs, both in technology and in concepts of operation, and that evolutions of current concepts will not be sufficient. In sum, the technological and operational future needs are as follows:

Aircraft

- *Low-noise architecture of powerplant and aircraft*
- *Individual component aero-acoustic design associated with low-weight technologies*
- *Optimised integration of engine, nacelle and airframe*
- *Innovative noise reduction techniques such as active / adaptive systems*
- *Low-noise concepts for high speed aircraft*

A significant and sustained effort is in fact needed to achieve the necessary technology breakthroughs, if the ACARE goals of environmental performance are to be met. Such breakthroughs aiming at "Generation 2 Solutions" will, in practice, encompass a wider range of areas as outlined above each providing technology building blocks along the multidisciplinary path leading to an environmentally optimised aircraft.

Rotorcraft

- *Evolutionary improvements in aero-acoustic design*
- *Quiet concepts of main rotor (incl. active rotor), anti-torque system and engine*
- *Optimised helicopter integration of components*
- *New concepts for very short take-off and landing (VSTOL)*

Noise abatement procedures (NAP)

- *Novel concepts of noise abatement procedures (2nd generation NAPs, new aircraft and air traffic management systems)*
- *Pilot aids*
- *Real-time noise footprint assessment and numerical aero-acoustic simulation*

As can be seen above, the European research effort is also increasingly tending to consider more global solutions addressing aviation environmental issues through a system approach as recommended in the ACARE SRA-2 (the Ultra Green Air Transport System concept). In the wake of current efforts such as SOURDINE II, effective implementation of novel Noise Abatement Procedures (NAPs) will substantiate the need for a sustained research activity.

Community impact management

- *Prospective noise impact studies and social assessment of noise impact models*
- *Validated airport noise capacity models and tools (incl. modelling of environmental interdependencies)*

Relatively little has been done so far in Europe in the area of understanding and modeling noise and emissions interdependencies, as well as defining their role in shaping future product design and possible future regulations. A serious effort needs to be initiated in this area starting with an analysis of the stakes and strengths and gaps of European assets, whilst at the same time formulating an active dialogue with US counterparts on the non-competitive aspects of this international issue.

5.3.5. Outdoor Equipment Noise

The target for the vision of 2020 is to halve the noise annoyance caused by outdoor equipment[56]. A strong basis for the reduction of noise from outdoor equipment (OE) is given by the Directive 2000/14/EC relating to the noise emission in the environment by outdoor equipment which needs, however, further development towards higher efficiency in real world noise reduction. For the achievement of the above target, research leading to a more thorough knowledge and new technologies is required for the following prime topics of OE noise[57].

- **Identification of the most suitable noise-relevant parameters** *per OE class or type*
  Due to the many different kinds and sizes of outdoor machinery, it is necessary to group them in classes and types as done in 2000/14/EC. Noise emission may depend on type and size via different parameters. It is essential for a good efficiency of the noise regulation that the most suitable noise-relevant parameters are known and considered in setting emission limits.

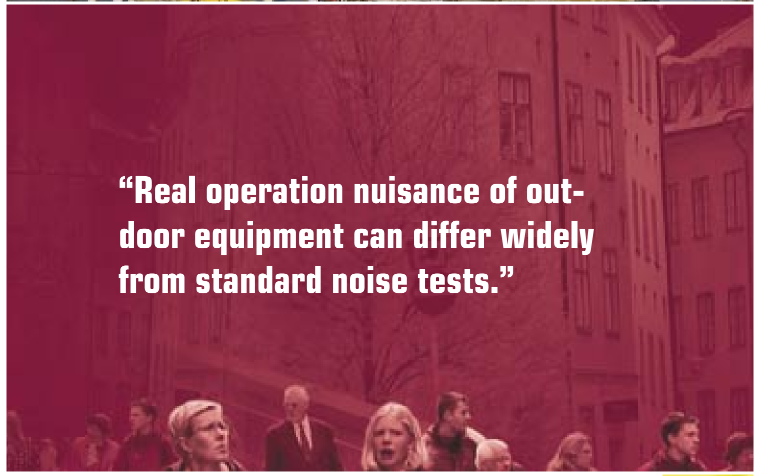
- **Correlation between noise emission, performance parameters and real operation nuisance**
  - *Correlation / divergence between test cycle noise and real operation noise*
  - *Trade-offs between noise emission and performance parameters*
  - *Interaction with the ground or material to be handled*

  All research items related to the correlation (or divergence) of OE noise emission between test cycle operation and real use operation are important for a further development of the OE noise legislation towards an increased efficiency and a better knowledge about the lowest possible limit threshold.

- **Improved regulation related to noise emission** *(including test methods)*
  The methods for legislative noise emission testing of OE are based on operating conditions which are not sufficiently representative for the typical conditions in real situations. Based on the outcomes of research as described in the two items above, a better adaptation to the real situations is required to make the noise emission limitation a more effective and efficient tool for contributing to environmental noise reduction by noise control at the source.

- **Effect of single and combined noise sources on noise perception**
  Very often, several types of OE are in use on one site at the same time (e.g. on construction sites) so that the overall noise emission is a combination of several sources. For better protection against such combined noise patterns, deeper knowledge in the combined effects on the noise perception is required in comparison with the effect of single sources.

- **In-use compliance**
  Practicable test and maintenance methods are needed to avoid a noise increase during the life cycle of OE.



5.4. Implementation of Research Results

Basically, research shall serve society. To make research results useable for the society, these results have to be implemented appropriately. Very often, however, the results of research are not implemented (or are delayed) for several reasons. Such reasons (or potential barriers of implementation) include:

- higher cost of the product
- conflict with other targets
- life cycle of the product

Such barriers have to be considered in implementation plans, and adequate actions to overcome such barriers have to be included. As implementation is more a political issue than a technical one, it is not the task of the CALM network to prepare and provide implementation plans. However, the topic is mentioned in this paper to draw attention to this task and to emphasise the importance of implementation as the logical next step after successful completion of research.

[56] Derived from CALM Workshop with Stakeholders, Brussels, 18 - 19 March 2002.
[57] See also: Study on the Status of Research Related to the Noise of Outdoor Equipment in Operation. CRF-Report, Sep. 2003. (www.calm-network.com).

6. Conclusions

- The cornerstones of current and future noise policy in Europe are, without doubt, the Environmental Noise Directive and the set of source-specific emission-related directives.

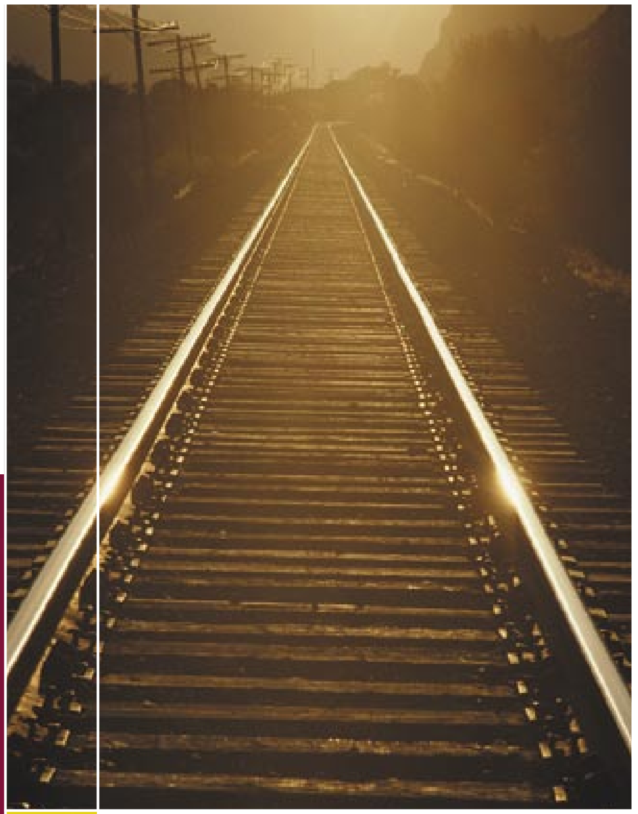
For the effectiveness of research, the coordination of European and national activities including the research advisory councils of the different sectors is also of vital importance.

- Experience to date has shown, however, that for the future development of effective emission-related directives, there must be a research-based focus on real-world situations, including environmental health[58]. Otherwise, stricter theoretical noise emission limits will not result in reduction of environmental noise in practice.

- Stakeholders supporting this research will develop improved products leading to a strengthening of their competitiveness in the international market.

- The outcome of future research applied to all thematic areas of environmental noise will substantially support a sustainable development towards a quieter Europe.

- Europe continues to need major efforts in research, if its citizens are to be freed from burden of unacceptably high levels of noise pollution. Future environmental noise reduction will depend, for its effectiveness and efficiency, on a well-balanced portfolio of research into noise emission, noise propagation, noise immission and human perception of noise. A co-ordinated programme of research in all these fields is of vital importance to the development of improved noise control strategies and improved regulatory legislation.



"A good balance of research in noise emission, propagation and perception will be essential for a sustainable development towards a quieter Europe."

[58] "Environmental Health" comprises those aspects of human health and disease that are determined by factors in the environment. It also refers to the theory and practice of assessing and controlling factors in the environment that can potentially affect health. (http://www.euro.who.int/eprise/main/WHO/Progs/HEP/Home)

7. Abbreviations

AC	Aircraft
ACARE	Advisory Council for Aeronautics Research in Europe
ACEM	Association of Motorcycle Industry in Europe (Association des Constructeurs Europeens de Motorcycles)
ACMARE	Advisory Council for Maritime Research (meanwhile substituted by the Technology Platform WATERBORNE TP)
AEN	Assessment of Exposure to Noise
ATC	Air Traffic Control
ATM	Air Traffic Management
ATS	Air Transport System
CAA	Computational Aero-Acoustics
CAEP	ICAO Committee for Aviation Environmental Protection
CBA	Cost-Benefit Analysis
CFD	Computational Fluid Dynamics
COM	Official Commission Document
CRF	Centro Ricerche Fiat, Italy
dBA	decibel, A-weighted
DG	Directorate General (of the European Commission)
EC	European Commission, European Community
EEA	European Environmental Agency
EEC	European Economic Community
END	Environmental Noise Directive
ENTR	Enterprise, Directorate General of EC
ENV	Environment, Directorate General of EC
ERRAC	European Rail Research Advisory Council
ERS	Euro Rolling Silently (EU Research Project)
ERTRAC	European Road Transport Research Advisory Council
ETP	European Technology Platform
EU	European Union
FP	Framework Programme
GDP	Gross Domestic Product
GIS	Geographical Information System
HC	Helicopter
HLTC	High Level Target Concept
HP	Hedonic Price (Method for CBA)
HSEA	Health and Socio-Economic Aspects
ICAO	International Civil Aviation Organization
I-INCE	International Institute of Noise Control Engineering
IKA	Institut fuer Kraftfahrwesen Aachen, Germany
IP	Integrated Project
L_{den}	Equivalent Sound Level over Day, Evening and Night Period
L_{eq}	Equivalent Sound Level (over a certain period)
L_{night}	Equivalent Sound Level over Night Period
NAP	Noise Abatement Procedure
OE	Outdoor Equipment
OJ	Official Journal (of the European Communities)
PTW	Powered Two-Wheeler
RTD	Research, Technological Development and Demonstration
SP	Stated Preference (Method for CBA)
SRA	Strategic Research Agenda
TREN	Transport and Energy, Directorate General of EC
TSI	Technical Specification for Interoperability
UBA	Umweltbundesamt, Germany
UIC	International Union of Railways
UNECE	United Nations Economic Commission for Europe
US	United States (of America)
VROM	Ministry of Housing, Spatial Planning and Environment, Netherlands
VSTOL	Very Short Take-Off and Landing
VTOL	Vertical Take-Off and Landing
WG	Working Group
WHO	World Health Organization
X-Noise	Aircraft External Noise Network

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