

Sustainable roads and optimal mobility



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Key definitions

SUSTAINABLE DEVELOPMENT OR SUSTAINABILITY: According to the **World Commission on Environment and Development**, sustainable development or sustainability is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs"¹. It refers to economic and social growth coupled with environmental protection, with one reinforcing the other.

The essence of this form of development is a stable relationship between human activities and the natural world such that future generations are able to enjoy a quality of life that is at least as good as the present one.

SUSTAINABLE TRANSPORT: In 1994, the Organisation for Economic Cooperation and Development (OECD) defined sustainable transport as "transportation that does not endanger public health or ecosystems and meets mobility needs consistent with (a) use of renewable resources at below their rates of regeneration and (b) use of non-renewable resources at below the rates of development of renewable substitutes".

SUSTAINABLE ROADS: the ERF IRF BPC has defined the concept of sustainable roads as:

Effectively and efficiently planned, designed, built, operated, upgraded and preserved roads by means of integrated policies respecting the environment and still providing the expected socio-economic services in terms of mobility and safety.

By **social**, we mean that roads should meet users' needs in terms of mobility (improvement in the quality of passenger journeys), safety (reduction in the numbers of deaths of and injuries to users) and physical accessibility of key services such as jobs, education and healthcare, thus ensuring social cohesion at local and European level.

By **economic**, we mean that roads actively contribute to maximising the overall competitiveness and productivity of national economies, contributing to a sustained high level of GDP growth. As a consequence, roads must be cost-effective and continuously responsive to changing demands through the creation of a more competitive road transport sector. This implies that roads should keep on generating employment opportunities within the transport sector and beyond.

INTEGRATED APPROACH: This concept has been mainly used within the road safety field.

The integrated approach is also required to fully address the issue of sustainable mobility. The main aim is to prevent accidents by improving the interaction between drivers, vehicles and road infrastructure. It also aims to ensure that existing legislation is enforced more effectively and that there is interaction between all these elements.

LIFE CYCLE: According to the European Commission, the life cycle of a product "covers all the areas from the extraction of natural resources, through their design, manufacture, assembly, marketing, distribution, sale and use to their eventual disposal as waste"², including all the intervening transportation required due to the existence of the product. The sum of all these steps is the life cycle of the product.

Including the life cycle in the analysis of a project's impact, as in road construction for instance, requires a careful evaluation of all the economic, social and environmental aspects connected to the project throughout its expected lifetime.

¹World Commission on Environment and Development of the United Nations, *Our common future*, 1987

²European Commission, DG Environment website, <http://ec.europa.eu/environment/ipp/integratedpp.htm>

I) Introduction

The French philosopher Montaigne claimed that “our life is only movement”³... In the natural world, both complex and elementary entities benefit from the possibility of moving in space as a way to improve their condition. From electrons shifting their orbit or being exchanged by atoms, to birds flocking together to migrate, our natural environment is full of movement, which is carefully balanced so as to guarantee a benefit for all the entities involved, irrespective of their size.

By contrast, human movements around the world are motivated by social and economic considerations, sometimes with negative and long-lasting consequences on the natural order. Montaigne could not predict that climate change and resource scarcity would require people, goods, services and capital mobility to become **sustainable** in order to preserve our planet's natural equilibrium.

In recent times, society has understood the importance of making its actions **sustainable** so that, in the long-run, we can benefit ourselves. In this context, **we are now calling for mobility to be re-invented in the context of the 21st century**. There is a growing need for people and goods to be mobile. People are calling for more efficient and more high-quality mobility, which will benefit the economy and their quality of life. Particular attention is now being paid to anticipating the impact of increasing traffic volumes when comprehensive urban/suburban/rural master plans are being developed.

As a consequence, **means of transport and transport infrastructure are also being reconsidered** in order to address the issue of land use and to take people's requirements into account. Today, it is widely recognised that cost-effective, reliable and affordable transport is a key component of sustainable mobility. Similarly, new and existing infrastructure must comply with high-quality technical standards, meet strict environmental and health standards and anticipate future demographic developments.

In recent years, the road transport sector has proactively worked to prepare itself for and adapt efficiently to these changes. It is proposing more **sustainable roads**. Sustainable roads together with more sustainable transport can help Europe and its Member States face the critical challenge of sustainable mobility without jeopardising national economies and people's well-being.

The ERF IRF BPC discussion paper will demonstrate all these facts step by step. It will argue that sustainable roads are a crucial component of a safe and efficient mobility in the future. The paper will then argue that it is time to recognise the ongoing efforts made by the road sector to reduce its environmental footprint at all stages (from planning and design to preservation). Finally, the paper will invite policy-makers to consider appropriate solutions that incorporate sustainable transport and infrastructure.



II) Evaluating the impact of having sustainable roads

At a time of widespread concern about the global economic downturn and about the environment, it is tempting to come to the extreme conclusion that the drastic reduction or elimination of road transport would be a viable solution towards a more sustainable future. It is always an easy solution to blame road transport for lacking a vision of sustainability. However, no measure could have more dramatic consequences than artificially curbing the mobility of goods and citizens.

It is of course wise to reduce the impact of transport on the environment, but not at the expense of mobility. It is always of paramount importance to consider the considerable socio-economic impact of making a change to a particular transport sector before deciding to implement such drastic measures, thus **adopting an optimal mobility approach**. This consists of maximising the economic and social benefits of the many and diverse variables which make up the complex mechanism of mobility and minimising the associated environmental, social and economic costs.

A subtle combination of measures, whose impact could be assessed, should be put in place to capitalise on the existing means of transport, infrastructure and citizens' behaviour. Hence, infrastructure has a crucial role to play in steering the transport sector towards a balance between socio-economic development and care and respect for our planet. In other words, **preserving individual mobility, making our roads safer, protecting global and individual economies and reducing the environmental impact of traffic are all linked to the condition of our road infrastructure**.

The following summary of the positive impacts of road transport on the three pillars of sustainable development demonstrates this.

Economic indicators

GDP:

- ▶ It is obvious today that economic development and transport are inextricably linked. The World Bank study *"Road infrastructure and economic development: some diagnostic indicators"*⁴ investigated the link between per capita income and the scale and quality of road infrastructure. It showed that the average density of paved roads in high-income economies is 59 times higher than in low-income economies. The density of paved roads in good condition varies from 40 km per million inhabitants in low-income economies to 470 km per million inhabitants in middle-income ones and 8,550 km per million inhabitants in high-income economies. More recent studies carried out in the developing world have shown that an increase in infrastructure investment by 3-4% of GDP would lead to a reduction in poverty by 0.61% annually⁵.
- ▶ The total turnover of the road sector in the European Union is estimated to amount to 2,445 billion euro per year (data from 2006)⁶. This amount is six times higher than the total amount invested by the European Union in the Trans-European Transport Network between 1996 and today (400 billion euro⁷).
- ▶ Road transport generated more than 360 billion euro in the EU of 15 Member States (2005) in the form of taxes going into Member States' coffers⁸. This money is then used by different government departments to pay for hospitals, schools, communications, environmental improvement and so on.

"Mobility has become an essential factor for competitiveness; one should not restrain it when our growth levels are low."

Excerpt from a speech by Commission Vice-President and EU Transport Commissioner Jacques Barrot

⁴Road infrastructure and economic development : some diagnostic indicators, Queiroz, Cesar Gautam, Surhid, The World Bank Policy Research Working Paper Series, 1992

⁵Asian Development Bank, 2007

⁶European Road Statistics 2008 (European Union Road Federation)

⁷Green paper "TEN-T: A policy review. Towards a better integrated Trans-european transport network at the service of the common transport policy". 2009.

⁸"The socio-economic benefits of roads in Europe" (European Union Road Federation)

Employment:

- According to the European Road Transport Research Advisory Council, the road sector overall (i.e. from automotive manufacturers and suppliers to infrastructure providers, communication organisations and rental companies) provides employment for more than 14 million people in Europe, generating turnover amounting to 11% of the EU's GDP⁹. Apart from being an important generator of employment, the road sector also provides people with highly-skilled manufacturing, engineering and research jobs.

Social and community indicators

Mobility:

- 73% of freight transport and 91% of passenger transport by land is by road¹⁰. It is not a simple task to change these percentages, not only because it would mean having to make considerable and very expensive improvements to infrastructure for other means of transport but also because it would mean acting against the notion of freedom of choice for citizens.
- Roads are shared by different users: private vehicles, public transport, motorbikes, cyclists and pedestrians. For example, 5% of all journeys are made by bicycle in the EU. In quite a few Member States this percentage is even considerably higher: the Netherlands 28%, Denmark 18%, Sweden 12% and Germany 10%¹¹. All these means of transport use road infrastructure together in a relatively smooth way. Road space in urban areas in particular is currently being reallocated to promote walking, cycling and public transport.

Safety:

- Riding on poorly maintained road networks may expose users to unacceptable health and safety risks, says the European Commission-co-funded ROADEX III project final report¹². Touring Belgium, referring to a EuroRap (European Road Assessment Programme) study, confirms this information. In Belgium, 50% of the total reduction in fatal accidents is due to better road infrastructure, 24% due to safer cars and 24% due to driver behaviour. In Sweden, these percentages are, respectively, 59%, 15% and 20%.

Measures to address "transport exclusion"

In the UK Department for Transport's March 2006 report on social exclusion and the provision of public transport, 52% of job-seekers said that lack of private transport was an obstacle to their getting a job and 23% said that they had been prevented from getting a job due to poor public transport.

- Current road accident death and injury rates are generally regarded as being far from acceptable, putting Europe on course to fail its 2010 objective of halving the number of road-related deaths by comparison with 2000. The ERFIRF BPC is calling for new solutions to be adopted to reduce the number of fatalities on European roads¹³.

- As already proven in recent years, the road infrastructure sector is ready to play its part in saving lives on European roads. Existing road infrastructure solutions can be immediately implemented and have a direct impact on road safety.

- Prevention strategies are also clearly efficient. In the UK, Surrey County Council measured the accident history of audited vs. non-audited schemes and concluded that the audit had saved one casualty a year per scheme. The cost of an audit is generally less than 1% of the cost of the scheme. The

recently approved Directive on Road Infrastructure Safety Management will make this auditing tool, and others, compulsory for the Trans-European Road Network in Member States.

Accessibility:

- Development increases transport demand whilst the availability of transport stimulates even more development by allowing trade and economic specialisation. There cannot be growth and poverty reduction without physical access to resources and markets or quality of life without physical access to jobs, health, education and other amenities.

⁹http://ec.europa.eu/research/transport/transport_modes/road_en.cfm

¹⁰Energy and transport in figures 2007 (European Commission)

¹¹Association of the European Two-Wheelers Parts' and Accessories' Industry (COLIPED)

¹²ROADEX III project, final report, March 2008

¹³Infrastructure Safety Forum 2008 (European Union Road Federation)

Roads are a fundamental element in improving access to these services and in facilitating the free movement of people in Europe.

- Roads provide a structure for mobility to pedestrians, cyclists, taxis, public transport such as buses, etc. Accessibility but also affordability, availability and acceptability are thus key features which make road infrastructure a mobility tool to be shared by these different users, and not just by private cars and freight vehicles.

Environmental indicators

- Do roads really pollute more than other means of transport? If global emissions were to be more carefully analysed, the conclusion 'roads do pollute more...' would emerge due to the high percentage of passengers and freight using road transport. But, if the analysis is carried out on the basis of equal conditions (emissions calculated per passenger-kilometre), the story would be different. The European Environment Agency¹⁴ established that buses with high occupation rates (45-80 CO₂ grams per kilometre) and environmentally-respectful vehicles (100-150 CO₂ grams/km) do not pollute more by kilometre than high speed trains (80-165 CO₂ g/km) or short-haul flights (77-240 CO₂ g/km) when data is assessed per passenger-kilometre.
- A life cycle approach and the corresponding practices are being increasingly adopted in the construction of roads. Putting environmental requirements into tendering competitions for road construction allows 'eco-efficient' procurements to be set up. These are procurements that aim to provide cost savings and a competitive advantage whilst also reducing the total amount of environmental damage caused during construction work.

Let's now imagine a world without roads or, rather, a world in which infrastructure investment goes on falling to dangerously low levels while ageing road infrastructure requires increasing amounts of maintenance. In their daily consideration of how to develop transport policies that comply with sustainable development objectives, the 27 Member States should rethink their approach towards road infrastructure.

In this context, the use of sensible and realistic measures pursuing an ideal of optimal mobility is the *sine qua non* for achieving sustainable transportation. In the specific case of road transport, the strategy would consist of separating the urban, interurban and rural segments and looking for appropriate solutions for each segment. The forthcoming European Commission Urban Mobility Action Plan, following the European Green Paper "Towards a new culture for urban mobility" adopted on September 2007, is a first relevant step towards a targeted approach.

The non-exhaustive list of initiatives, best practices and products referred to in Chapter 3 of this document provides clear evidence of the road sector's commitment to reduce its environmental footprint at each stage of the road life cycle and to help road users (especially motorised vehicles) to do likewise.

"Safe Road Design
Can Save Europe
50bn euro Every
Year"

The annual cost of handling road crashes is 160bn euro 2% of Europe's GDP. The EuroRap "European campaign for safe road design" states that "a modest investment in simple safety engineering" could cut deaths and serious injuries by up to one third in less than ten years (150 per day), thus saving the European economy 50bn euro per year.

¹⁴Climate for a transport change Report. EEA 2008

III) Some best practices

When looking at the sustainability of roads, a lot of systematic research and attention is devoted to the environmental aspects of sustainability. This chapter will therefore focus on the initiatives, methodologies and products which the road sector has implemented to meet society's environmental needs and hedge against tomorrow's risks. Some best practices are included here.

But before we do that, it is well worth remembering that, as already stated, sustainability also covers a comprehensive set of economic and social issues. It means that a **comprehensive sustainability framework that goes beyond existing environmental considerations must always guide social and economic activities, programmes and specific projects towards decisions and sustainable actions**. As an example, issues such as how the road scheme will affect health, social capital, and many other factors important to communities should always be considered, even though they are particularly difficult to quantify¹⁵.

In addition, it is important to note that, many years ago, the road infrastructure sector decided to adopt a pro-active attitude taking into account both socio-economic and environmental parameters. Indeed, the road sector may well have an economic interest in anticipating future policies and adapting to legitimate social concerns. Today, it operates within a broad, community objectives-led process based on the principle that the sustainable infrastructure that it develops should be able to face the changes that will have an impact on the infrastructure itself (deterioration over the years) and its use (demographic changes for instance).

A - ROAD PLANNING AND DESIGN

■ Optimising route planning via environmental impact analyses

In recent years, the Strategic Environmental Assessment (SEA) has performed its role as an essential instrument through which specific environmental criteria are built into the design of policies, plans and programmes. The SEA seeks to overcome shortcomings detected in Environmental Impact Assessments (EIA), allowing the decision-making process to address environmental issues in a timely and cost-effective fashion and providing a framework for dialogue and cooperation with civil society.

The application of the SEA to road projects makes it possible to assess alternatives in project design and to consider synergies with other plans or programmes. In particular, it leads to the selection of the most appropriate routes whereby negative environmental impacts on particularly valuable areas are avoided.

■ Mitigating habitat fragmentation

Transport infrastructure can act as a barrier between areas of land and constitute a threat to biodiversity when the infrastructure is not carefully designed and run. **Nevertheless, this fragmentation effect can be minimised in different ways.**

For **new transport infrastructure** developments, **finding the optimal alignment of roads** in the landscape can minimise conflicts and the need for mitigation measures. For existing transport infrastructure, the environmental impact can be mitigated through **changes in the design and operation** such as avoiding stationary traffic, the planting of shrubs along roads and animal over/underpasses. When fragmentation is unavoidable and mitigation measures are ineffective, then compensation in the form of habitat creation may be the appropriate response to achieve 'no net loss' because of infrastructure development plans.

On the other hand, some roadsides, e.g. hedges protecting a road infrastructure, can spontaneously form **"ecological corridors"** which link protected zones and allow flora and fauna migrations. As hunters and hikers do not venture into roadside areas, some fauna which may have escaped because of road constructions can come back and develop quickly. Besides, roads often act as an accidental means of transportation for plant seeds, which, once converted into stable plant communities, increase animal biodiversity.

¹⁵In fact, much of the criteria presented to assess the social effects of road infrastructure appear to be based upon subjective and speculative elements.

■ Special consideration for areas with high environmental value

The **Spanish A-381 highway** was given an International Road Federation award in 2003 for its preventive, corrective and compensatory measures (40% of the total construction budget was invested in this area). The road links Jerez and Los Barrios, two municipalities in Spain, and is an excellent example of a sustainable road. It runs through a natural park. In order to mitigate any environmental impacts, the project team worked with different public institutions and gathered the opinions of various stakeholders. Specific paths (underpass) for fauna, noise barriers specifically designed for their optimal integration in the environment, false tunnels, structures that are kept to a size that will have a minimum impact on a particular species of vegetation and a wide range of compensatory measures, including the protection of the imperial eagle and otters, are keys to the A-381's success.

■ Soft alignment leads to lower emissions and energy consumption

The SINTEF study released in 2007¹⁶ has found conclusive evidence that road realignments and upgrades reduce car emissions. Taking three baseline scenarios, the emissions of CO₂ were found to have fallen by up to 38% while local pollutants dropped by a staggering 75%. The same study indicated that, in a majority of cases, the changes did not generate new car trips, putting an end to one of the most enduring myths about transport.

B-ROAD CONSTRUCTION, OPERATION AND PRESERVATION

■ Avoiding water pollution

The construction and upgrading of a road should be an opportunity to check and redesign water management in order to protect underground water reserves, wetlands and rivers and to reduce the risk of flooding. On roads open for traffic to use, there are many potential sources of interference with surrounding water (metal, chlorides, pesticides, hydrocarbon and accidental spillages). Road authorities and private operators have a range of mitigating measures at their disposal, such as well-designed surfaces, the adoption of intelligent spraying of de-icing solutions or the provision of adequate drainage to ensure contaminated water is contained and treated to avoid the release of residual pollutants into the environment.

With regard to drainage techniques, the previous engineering paradigm is now evolving. As having water on the road is dangerous, there was no choice but to collect it and get rid of it as quickly as possible. Today, it is not only a matter of safety, but also a matter of protection of the environment. Water caught by the road drainage system is collected in specific settling basins, ensuring that it does not seep directly into the ground.

■ Use of recycled and environmentally-friendly construction material

As they work in a material-intensive industry, **road contractors have a long history of recycling**. There is an economic logic to this, particularly when the recycled material adds value to the road asset, saves money and provides an outlet for waste generation. Today, any road construction project has to include a specific study about the use of waste materials as part of a series of environmental tests. Many techniques are currently available.

Some solutions make it possible to reuse damaged pavement layers, demolition and construction waste, waste materials and sub-products from other industrial activities (which otherwise would have been thrown away), thus reducing the need to remove so much earth. The use of tyre crumble in bituminous mixtures for road construction is also a key method. Noise reduction, improved vehicle traction, an increase in fissure resistance, longer periods of good use and minimum maintenance are some of the recycled tyres' advantages, not to mention their important contribution towards the preservation of the environment. According to the European Commission, nearly 3.5 million tonnes of old tyres are added to the already substantial European stockpile every year. A third of these tyres were recycled in 2007, largely to make aggregate for use in road construction, quarry rehabilitation and other projects.

Better road surfaces reduce truck fuel consumption

- In the case of a truck driving at 85 km/h, 40% of its rolling losses come from the tyre/road interface. Rough road surfaces can increase fuel consumption by 11%.
- An uneven* road can increase fuel consumption by 7%.
- With rain or snow on the road surface, rolling resistance increases and fuel consumption may increase by 10-20%.

*The unevenness might arise from the construction of the road, settlement after construction or from pot-holes, trenches, joints and patched repairs

Source: Volvo, BAST, TRL, VTI, COST 334

¹⁶Environmental consequences of better roads, SINTEF Technology and Society, Norway - February 2007

For the bottom layer of a double-layered concrete pavement, 60% and even more of the coarse aggregates can be replaced with recycled crushed concrete. For road materials and fixtures, clean alternatives (such as water-based markings) exist.

Recycled and environment-friendly material has a major impact on vehicle fuel consumption. Bearing in mind the integrated approach for sustainable roads and considering that operation is the longest stage of a road life, many studies analyse vehicle fuel consumption from the infrastructure point of view. Some studies state that a significant reduction in energy consumption is feasible through proper maintenance of a pavement and reducing its roughness.

A study from the Swedish National Road and Transport Research Institute VTI showed that fuel consumption for a passenger car varies over a range of approximately 11% from the smoothest to the roughest pavement tested¹⁷.

Optimal solutions could reduce this fuel consumption by up to 10%.

■ Best practices for road equipment

Road markings are today less contaminating. Road barrier manufacturers and traffic sign producers have developed best practices to reduce the energy consumption of their production stage and transport patterns. The latest generation of retro-reflective materials for traffic signs not only consumes less energy, generates less waste and VOC (volatile organic compounds) during manufacturing, but also offers more visible and brighter signs, addressing the needs of a more complex traffic situation and demographic changes (an ageing but mobile population). Greener infrastructure is possible with the use of the proper materials and the correct maintenance.

■ Better use of existing infrastructure

Roads are synonymous with flexibility in terms of mobility but also in terms of management. Engineering, industrial and regulatory solutions provide a broad range of options for the better use of existing infrastructure, thereby increasing capacity (for example by providing lanes according to traffic demands), traffic fluidity, safety, etc.

In this context, the growing deployment of **intelligent transport systems (ITS)** across Europe provides decision-makers and infrastructure operators with an extraordinary tool with which to improve road management so that the environmental, mobility and safety performance of the network is enhanced. Indeed, ITS optimise the use of existing infrastructure with relatively low levels of investment and a lower environmental impact than the construction of new infrastructure or the expansion of existing infrastructure. The European Commission's ITS Action Plan, released in December 2008, and the much-anticipated ITS Directive will make a considerable contribution towards fostering their development for all European citizens.

In the urban and sub-urban context, the provision of real time traffic information, which allows motorists to make informed route choices and book car parking ahead of their trip, is one of the most cost-effective value-added ITS-based services. For example, reducing traffic generated by drivers looking for a place to park their cars (this is estimated to account for 30% of urban traffic at peak hours) can help reduce congestion as well as make a significant contribution to energy savings and environmental protection. In the United States for example, Intelligent Transport Systems (ITS) have been installed in 75 of the largest urban areas, an investment which has helped reduce journey times by 15%. All of these systems (traffic information, e-Call, collision warning, avoidance system, etc.) are already available or soon will be.

■ Best practices for sustainable road maintenance and preservation

The conventional approach to road maintenance incurs a huge environmental burden: the disposal of excavation spoil to landfill, the use of primary aggregates and the fuel consumption, emission and road safety impacts of using heavy vehicles to transport materials. As a result, the road sector quickly understood that it had to consider a different approach to road maintenance. It started by adopting a “**preservation culture**” which

consists of immediately protecting structures once they have been constructed or renewed, finding potential defects before they become a real problem, proactively fixing the defects before they grow and using the most convenient and cost/environment-effective method to find and fix defects.

These best practices have been developed in several countries and compiled in the IRF publication “**Innovative Practices for Greener Roads**”¹⁸. The aim is to showcase the road sector's green products, research and applications, and show evidence of the environmental commitment of IRF members.

■ Promotion of carbon and NOx sinks close to roads

There have been some initial experiences in carbon sinks linked to highways such that part of the emissions produced by traffic on the road could be compensated by new green areas. This approach has also been followed by vehicle manufacturers, as shown in the attached case study. However, it is not always necessary to plant trees as CO₂ sinks. If our roads were made with carbon capture in mind, then they could become giant carbon sinks.

Different private studies have proved that concrete used in road pavement and structures absorbs a high amount of CO₂ and that this amount is proportional to the surface area concerned, which is very considerable in the case of road pavements or bridges. In this way, a significant percentage of the total CO₂ generated during production can be rescued from the atmosphere during the lifetime of the road without any external measures.

Moreover, innovative types of paving structure can also act on other pollutants such as nitrogen oxides (NOx). Such paving contains a chemical product, titanium dioxide, which transforms NOx on the paving surface into nitrates during daylight hours. The nitrates are washed off the paving during rainfall. This chemical reaction should reduce NOx concentrations in the atmosphere. Trials of titanium dioxide-based materials carried out in Italy and Japan report a marked improvement in ambient NOx concentrations - some manufacturers report a 50% reduction¹⁹.

■ Quieter roads

Traffic noise is another area of conflict between the individual's need for mobility and legitimate social aspirations for quieter lifestyles. The World Health Organisation (WHO) estimates that around 40% of the European population is exposed to noise from road traffic exceeding 55 decibels during the day. There are numerous cost-effective and relatively easy ways that combine traffic management strategies with road infrastructure improvements to reduce transport noise significantly.

First of all, environmental impact studies for new roads now take into account environmental noise impact in their design criteria, which is a major step towards the recognition of noise as a major nuisance. The entry into force of the **European Directive on Environmental Noise 2002/49/EC** known as the Environmental Noise Directive which requires Member States to produce strategic noise maps followed by action plans, is a successful measure which may, however, suffer from the implementation of ineffective solutions. No method whatsoever is envisaged to assess the real effect of the recommended solutions on noise reduction.

At national level, approaches differ slightly from country to country. General practices include using both quieter pavements and noise barriers as well as implementing policies that set noise level thresholds and seek noise reductions from both vehicles and tyres. As an example, in the United Kingdom in 2000, a 10-year plan for transport was adopted that set a target for advancing noise reduction policies on major roads. The overall goal is to resurface 60% of major roads with quieter materials over the 10-year period.

Carbon dioxide compensation

Developed by Volkswagen in 2007, it considers the carbon dioxide compensation based on carbon sinks. The new and recently launched Polo is one of the least polluting cars to date. Furthermore, for each Polo sold, 17 trees are planted in a forest in Spain, a measure which is estimated to compensate for the CO₂ emissions of the vehicle during its first 50,000 kilometres.

The financial impact of noise reduction

The Dutch government's Noise Innovation Programme has calculated that, for every decibel of noise reduction at-source, 100 million euro in expenditure on 'end-of pipe' measures such as noise barriers and insulation will be saved. This calculation only takes major interurban roads and railways into account. Actual savings will probably be even greater, because other regions and urban areas will also benefit from such noise reduction via at-source measures.

¹⁸Innovative Practices for Greener Roads, IRF, August 2009

¹⁹London Borough of Camden, Photocatalytic Paving Trial, 2006

At industry level, several road companies have been taking part in research activities on noise in recent years. New solutions to tackle noise from the source are now being implemented. It is estimated that **pavement properties** on a well-maintained road network can reduce noise emission levels. As an example, some European motorways are built with fine grained exposed aggregate concrete surfaces, providing substantial noise reductions and adequate friction characteristics, which are both maintained over the pavement lifetime, thus reducing the costs of maintenance. **Acoustic barriers** offer another on-site noise solution. An additional effect for acoustic barriers may be achieved by varying the shape or installing top devices able to reduce the diffracted noise.

■ Protect animals from being run over

Every year, thousands of animals are killed on roads. It is one of the most major causes of death for traffic-sensitive species. At the same time, stray animals making their way onto our roads cause driver injuries and material damage.

There are many factors that determine the risks of accidents involving animals, including road density, road width, location, traffic density and speed, road surroundings, state of the road, driver and animal behaviour, etc. There are therefore numerous measures to be carried out and they are specific to each situation. For instance, fence installation, reflectors, sound barriers and odour signs, habitat alteration, animal escape devices, animal presence detectors and signals, prevention campaigns, etc., are some of the existing solutions to ensure that fewer animals are run over.

■ Development of specific guidelines to protect special value areas

Protected areas with very unique environmental value must be given special consideration and measures. An adequate SEA will contribute to avoiding, from the very beginning (planning stage), any possible negative environmental footprint. However, specific actions must also be developed to mitigate those negative environmental impacts that are intrinsic to road construction, operation and maintenance. Some countries have therefore put together specific manuals for these unique areas, for example the Spanish “White Paper of roads and protected natural areas of Andalusia”.

■ Roads and landscape

The new **European Landscape Convention** (2008), also known as the Florence Convention, boosts landscape considerations in the construction and maintenance of roads. Landscape-friendly roads have three main responsibilities: firstly, they must comply with society's demands to be able to enjoy and observe the landscape; they must also be carefully integrated into the landscape, respecting environmental values; and finally, the service and safety levels they provide must be as high as possible. In this context, general public awareness and participation is crucial as the public is the main actor in landscape perception.

The functionality of different landscapes will demand specific practices and resources for each road project. Maintenance and preservation operations can be seen as a good opportunity to introduce landscape issues without incurring significant additional costs.



M) Financing sustainable roads: Is it a luxury?

In recent years, the road infrastructure sector has significantly increased the safety of its products while reducing their environmental impact but also their financial cost. When customers are considering how to have the best roads, the road infrastructure sector is now able to provide them with adequate solutions supporting individual requirements (technical, financial, etc). However, **quality has a direct cost which is generally seen as a major barrier in the infrastructure investment decision, whether it is to build new infrastructure or simply upgrade the existing ones. Should we then consider good roads as a luxurious product?**

The answer is clearly no. The road sector owes society high quality infrastructure. It does its utmost to address the mobility, environmental and safety challenges throughout the road's life cycle. Similarly, public authorities owe efficient and environmentally-friendly roads to society.

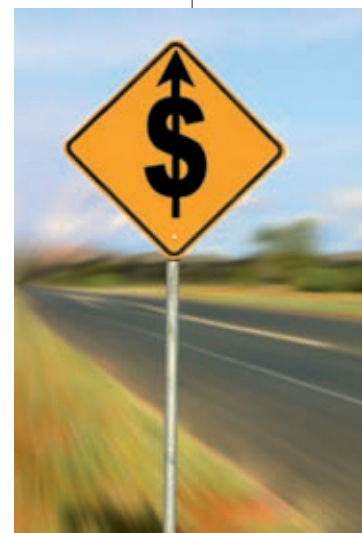
Europe still has no specific study examining the quality of its infrastructure network. But a US report produced by the American Association of State Highway and Transportation Officials (AASHTO) in conjunction with the research group TRIP, provides relevant information which can be extrapolated to Europe.

According to the "Rough Roads Ahead: Fix Them Now or Pay For It Later" report²⁰, only half of the major US roads are in good condition. As a result, the US public pays for roads that have deteriorated twice: first through additional vehicle operating costs (approximately 280 euro per year extra in costs for the average driver and up to 525 euro per year in urban areas with high concentrations of rough roads) and then in higher repair and reconstruction costs. Indeed, when society spends one euro to keep a road in good shape, it saves seven euro that it would have spent on reconstruction.

Clearly, proper infrastructure investment to make roads fit to carry a given volume of traffic, to reduce bottlenecks and create smooth and efficient traffic flow are needed to increase safety and boost economic recovery while reducing automobile fuel use and emissions. Unfortunately, budget allocation procedures usually push transport into competition with other fundamental public services like health, education, administration and defence. In some European countries, the current fear of global economic recession does not tip the scales in favour of road investment, although this would give a much-needed boost to economic re-development.

Additionally, innovative road design, an increased number of high occupancy vehicle lanes in high-traffic areas and new transportation technologies such as advanced traffic management systems contribute to optimising the use of roads, to encouraging eco-driving and to making roads safer, i.e. making them more sustainable. In urban areas, it is also important to incorporate investment in alternative means of road travel, which include walking, cycling, public transit and car-pooling, in order to offer a range of practical and effective mobility options to citizens. Roads are a space for sharing and a key element in the challenges that are part and parcel of all the different means of transport on offer.

Therefore, innovative ways of financing upgraded roads must be envisaged so as to reach the objective of sustainable development while contributing to the economic recovery. As an example, the European Commission's proposal for a Directive amending Directive 1999/62/EC, the "Eurovignette directive", relaunched the debate on the internalisation of external costs to reflect the real cost of infrastructure investment. Yet this economic incentive must guarantee **revenue recycled to road infrastructures themselves** and not to unrelated financing purposes. Taxes would benefit the entire transport system only if the tax revenues are directed towards improving the road network and setting up intelligent transport systems.



²⁰Rough Roads Ahead: Fix Them Now or Pay For It Later, American Association of State Highway and Transportation Officials, May 2009

V) ERF - IRF BPC recommendations...

The road transport sector is changing to tackle the many challenges facing society but the unpredictable parameter of transport demand may drastically influence the solutions to be adopted. Despite pessimistic forecasts because of the current economic situation, no huge increase or decrease in passenger and freight transport is expected.

However, whatever the scenario, deliberately restricting the availability of finance for transport infrastructure investment will be counterproductive for sustainability. Proper road infrastructure networks need to be maintained in any circumstances: efficient safety barriers must be built, high quality markings must be installed and environmentally-friendly material must be used.

In this context, there is a moral obligation to generalise methods and techniques that can contribute to more sustainable forms of road transport to achieve more sustainable mobility, whether transport demand decreases or not. However, this debate cannot be based on biased arguments. No one is seriously suggesting today that lives can be saved by obliging citizens to use public transport. Nor should this be a pre-condition for optimal mobility.

Given that road infrastructure is the backbone of the European transport system, **the European Union Road Federation (ERF), the Brussels Programme Centre of the International Road Federation (IRF)**, therefore proposes:

- developing a common approach for sustainable roads between European institutions and road stakeholders while taking account of the different scenarios required for urban areas and rural areas;
- communicating a new approach based on the criteria of performance - roads should be understood from an overall perspective, not only as creators of negative environmental externalities, but also as promoters of wealth, support for the economy, generators of employment, etc;
- promoting and expanding the EU's research activity aimed at reducing the environmental impact of roads at all stages and stimulating their socio-economic benefits;
- Informing European citizens about the sustainable road infrastructure improvements achieved so far and raising awareness about the greener solutions available.



VI) About the authors

The European Union Road Federation (ERF) is a non-profit association that coordinates the views of Europe's road sector and acts as a platform for dialogue, information and research on mobility issues.

The ERF is the Brussels Programme Centre of the International Road Federation (IRF), was established in 1948 and has over 500 members in six continents. The IRF seeks to promote the benefits of a valid road transport infrastructure at all levels of society.

The ERF - IRF BPC Sustainability Programme members, who are actively contributing to promoting more sustainable roads, provided invaluable input for this publication.

Further information available from: <http://www.irfnet.eu>

Source documents

Front page cover picture: A-381 Jerez - Los Barrios. The Sustainable Motorway.
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Page 5: Excerpt from a speech by Commission Vice-President and EU Transport Commissioner Jacques Barrot on 5 June 2005

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