

**A substainable future** for transport

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**A sustainable   
future**  
for transport

* Towards an integrated, technology-led and user-friendly system

# Introduction

In 2001, the Commission issued a White Paper setting an agenda for the European transport policy throughout 2010. This programme was updated in the mid-term review of 2006. Approaching the end of the 10-year period, it is time to look further ahead and prepare the ground for later policy developments.

Transport is a complex system that depends on multiple factors, including the pattern of human settlements and consumption, the organisation of production and the availability of infrastructure. Owing to this complexity, any intervention in the transport sector must be based on a long-term vision for the sustainable mobility of people and goods, not least because policies of a structural character take a long time to implement and must be planned well in advance.

That is why transport policies for the next 10 years must be based on a reflection on the future of the transport system that embraces also the following decades. The Commission has launched such a reflection, comprising: an evaluation study on the European transport policy (ETP); a debate within three 'focus groups'; a study identifying possible low-carbon scenarios for transport; and a consultation of stakeholders, notably through a high level stakeholders' conference.

The present communication summarises the results of this wide reflection. In Section 2, it refers to recent developments of the ETP and outstanding issues. In Section 3, it looks at the future, identifying trends in transport drivers and the likely challenges they could pose to society. In Section 4, it proposes some intermediate policy objectives, which could be pursued to address the emerging challenges in the transport sector. In Section 5, it describes some available instruments and possible lines of intervention for achieving the stated objectives.

The ideas put forward in this communication are meant to stimulate further debate aimed at identifying policy options, without prejudging the formulation of concrete proposals in the next White Paper of 2010.

# European transport policy in the first decade of the 21st century

Before looking at the future, it is useful to take stock of developments in the recent past. While it is too early to fully assess the impact of a number of policy measures taken since 2000, a few indications can nevertheless be distilled from market trends and data. These can be assessed against the policy objectives set in the mid-term review of the White Paper and those set for transport by the sustainable development strategy (SDS) of 2006. The following section shows that the ETP has largely achieved the objectives set out in the abovementioned strategic documents, by substantially contributing to the development of the European economy and its competitiveness, by facilitating market opening and integration, by establishing high quality standards for safety, security and passenger rights and by improving working conditions.

Transport is an essential component of the European economy. The transport industry at large accounts for about 7 % of GDP and for over 5 % of total employment in the EU. The ETP has contributed to a mobility system that compares well in terms of efficiency and effectiveness with that of the economically most advanced regions of the world. The ETP has assisted social and economic cohesion and promoted the competitiveness of the European industry thereby contributing significantly to the Lisbon agenda for growth and jobs. More limited, however, have been the results with respect to the goals of the EU SDS: as indicated in the progress report of 2007, the European transport system is still not on a sustainable path in several aspects.

Market opening has generally led to more efficiency and lower costs. This can be seen in air transport, where the process is more advanced. The EU is on its way to create a level playing field in the increasingly integrated transport market, but issues such as differences in taxation and subsidies still need to be addressed. It is worth noting that not only large companies but also small and medium-sized enterprises (SMEs) have benefited from market opening and integration in the different modes of transport.

Trans-European transport networks (TEN-T) policy has much increased the coordination in the planning of infrastructure projects by the Member States. Progress in implementation has been substantial and about one third of the necessary investments (EUR 400 billion) in the TEN-T have been made. The extension of the TENs to cover the new Member States, building on the investment already made prior to enlargement, has provided the blueprint for Structural and Cohesion Funds to gradually fill their infrastructure deficits. Much remains to be done, but the TENs have already gone a long way in linking EU markets and peoples.

Progress has been achieved in reducing air pollution and road accidents. Air quality in European cities has significantly improved through the application of ever-stricter Euro emission standards, but more needs to be done, above all to reduce emissions in urban areas of NOx and fine particles (PM10) - the latter being particularly damaging for human health - as well as ensuring that real world emissions are adequately controlled. The expansion of transport infrastructure has also resulted in habitat loss and landscape fragmentation. The objective to halve casualties in road transport by 2010, included in the 2001 White Paper, will probably not be achieved although action has been triggered in many Member States, leading to significant progress. With still over 39 000 deaths in the EU in 2008, transport by road remains far too costly in terms of human lives.

In the maritime sector, marine pollution and maritime accidents were considerably reduced and the EU has established one of the most advanced regulatory frameworks for safety and for pollution prevention (most recently with the third maritime safety package). In aviation, it has adopted a comprehensive set of common, uniform and mandatory legislation covering all the key elements affecting safety (aircraft, maintenance, airports, air traffic management systems, etc.). Safety agencies have been set up for aviation (EASA), maritime affairs (EMSA) and rail transport (ERA).

The 2001 White Paper did not refer to security. After the attacks of 11 September 2001, however, a security policy was developed. Nowadays there are EU legislative measures on transport security for most transport modes and for critical infrastructures. The EU also cooperates with the international community to improve security: recently, EU naval operations have been launched to fight piracy.

Quality services for transport users have been promoted by strengthening passenger rights. Legislation on aviation passengers' rights has been adopted and is now in force. In the field of rail, a regulation was adopted in December 2007 which provides for extensive passenger rights. In December 2008 two proposals were adopted on passenger rights in the field of buses and coaches and in the maritime sector. On the other hand, public transport (bus and rail) has been identified as one of the sectors where consumer satisfaction is the lowest.

The social dimension of transport policy was strengthened also with respect to transport workers. Legislation on working time, the minimum level of training and mutual recognition of diplomas and qualifications was introduced - in collaboration with the social partners - to improve working conditions in road, rail and maritime transport.

The environment remains the main policy area where further improvements are necessary. In the EU, compared with 1990 levels, in no other sector has the growth rate of greenhouse gas (GHG) emissions been as high as in transport. GHG emissions can be seen as the product of three components: the amount of the activity that generates the emissions; the energy intensity of that activity; and the GHG intensity of the energy that is being used. Applying this analysis to past developments in transport, it can be seen that the sector has greatly increased its activity while making insufficient progress in reducing its energy and GHG intensity.

Decoupling transport growth from GDP growth, which was one of the objectives of the 2001 White Paper and of the SDS, has taken place on the passenger side, where transport demand grew on average by 1.7 % per year between 1995 and 2007, as opposed to an average GDP increase of 2.5 %. The demand for freight transport in the EU, on the other hand, grew on average by 2.7 % per year. The strong increase in global trade and the deepening integration of the enlarged EU prevented the decoupling of freight transport from GDP in the last decade. The growth of freight transport is also linked to economic practices - concentration of production in fewer sites to reap economies of scale, delocalisation, just-in-time deliveries, widespread recycling of glass, paper and metals - that allowed reduction of costs and, possibly, of emissions in other sectors at the expense of higher emissions from transport.

The energy efficiency of transport is increasing, but the gains in efficiency have not been entirely devoted to reducing overall fuel consumption and have not been enough to outweigh the larger transport volumes. Legislation setting emission performance standards for new passenger cars was adopted in April 2009 in response to the insufficient pace of improvement. There has also been limited progress in shifting transport to more efficient modes, including through the development of short sea shipping, although a certain rebalancing has taken place and the relative decline of rail transport appears to have stopped. A number of surveys show that in many cities the modal share of cycling has grown significantly in recent years.

Transport did not reduce significantly its GHG intensity by switching to cleaner energy sources and is still 97 % dependent on fossil fuels, which has negative implications also for the security of energy supply. Measures to improve fuel quality and a binding target of a 10 % share of renewable energy sources in transport by 2020 have been adopted recently as part of the climate and energy package.

# Trends and challenges

This section describes trends in the main transport drivers up to the middle of the century and the related challenges. It is difficult to anticipate which of them will have the greatest influence in shaping the future of transport.

## Ageing

By 2060, the median age of the European population is projected to be more than 7 years higher than today and the number of people aged 65 or more is expected to represent 30 % of the population as opposed to 17 % today.

Although above a certain age people generally travel less than when they were younger, aged people of today tend to travel more than their parents did. This tendency is expected to continue and is reinforced by improved health, more travelling options and better foreign language skills. An ageing society will place more emphasis on the provision of transport services involving a high level of perceived security and reliability, and which feature appropriate solutions for users with reduced mobility.

A society with a higher ratio of older people will need to devote more public resources to pension payments, health care and nursing. Through its effect on public finances, ageing will put a strain on the supply and maintenance of transport infrastructure and set a limit for funding available to public transport. A scarcity of labour and skills may arise, further aggravating the shortage of skilled labour already experienced in some segments of the transport sector. Overall, this may result in higher transport costs for society.

## Migration and internal mobility

Net migration to the EU might add 56 million people to the EU's population in the next five decades. Migration could play an important role in mitigating the effect of ageing on the labour market. Migrants, generally young and mainly living in urban areas, will further intensify Europe's ties with neighbouring regions, by creating cultural and economic links with their country of origin. These links will entail more movement of people and goods.

Mobility of workers within the Union is also expected to increase with the gradual removal of administrative and legal barriers and further deepening of the internal market.

## Environmental challenges

There is growing urgency for the transport sector to mitigate its negative impact on the environment. The EU has recently adopted a climate and energy package that sets a target of reducing GHG emission in the EU by 20 % with respect to 1990. Transport has a key role to play in achieving this goal and an inversion of some of the current trends will be necessary.

The 2008 TERM Report of the European Environment Agency, which provides indicators tracking transport and environment in the EU, shows that many Europeans still remain exposed to dangerously high levels of air and noise pollution. In particular, the concentration of PM10, of which transport is the second most important source, exceeds the 2005 limit value in many air quality zones. Also pollution from shipping emissions of NOx and SOx needs to be addressed.

Transport itself will suffer from the effects of climate change and will necessitate adaptation measures. Global warming resulting in a rising sea level will amplify the vulnerability of coastal infrastructures, including ports. Extreme weather events would affect the safety of all modes. Droughts and floods will pose problems for inland waterways.

## Increasing scarcity of fossil fuels

In the coming decades, oil and other fossil fuels are expected to become more expensive as demand increases and low-cost sources dry up. The negative impact on the environment will be greater, as conventional sources are replaced by more polluting supplies. At the same time, the need to move to a low-carbon economy and the growing concerns about energy security will bring about a greater supply of renewable energy, made much cheaper by technological progress and mass production.

The shift in relative prices will make investments in alternative energy sources more attractive, in spite of the high variability of those prices. The need to establish supporting infrastructures and the long life span of vehicles will delay the transition process.

The immediate consequence of such transformation will be the reduction in the need to transport fossil fuels, which currently represent around half of the volume of international shipping.

## Urbanisation

Urbanisation has been a clear trend in the past decades and is expected to continue, with the proportion of the European population residing in urban areas increasing from 72 % in 2007 to 84 % in 2050.

The proximity of people and activities is a major source of advantages that drive urbanisation. However, in the past 50 years, the growth of urban areas across Europe was even larger than that of the resident population. This urban sprawl is the main challenge for urban transport, as it brings about a greater need for individual transport modes, thereby generating congestion and environmental problems. Urban transport accounts for 40 % of CO2 emissions and 70 % of emissions of other pollutants arising from road transport.

Congestion that is prevalent in agglomerations and in their access routes is the source of large costs in terms of delays and higher fuel consumption. As most freight and passenger transport starts or ends in urban areas, urban congestion also negatively impacts on inter-urban travel. While denser cities are better served by collective modes of transport, the availability of land and public acceptability to construct new infrastructures for public or alternative means of transport will remain a great challenge.

## Global trends affecting European transport policy

Together with further deepening of the single market, integration of the EU with neighbouring regions (eastern Europe, North Africa) and into the world economy is likely to continue. Globalisation has been a powerful trend of the past decades, enabled by trade liberalisation agreements and by revolutionary developments in transport and communication technologies (from containers to satellite radio-navigation) that have reduced distance and time barriers.

Although it may be temporarily halted by economic crises and geopolitical instability, the strong economic growth of many developing countries implies further globalisation. Transport outside Europe will increase much more than inside Europe and EU external trade and transport are likely to keep growing rapidly in the coming years.

The world population is expected to exceed 9 billion by 2050. This increase, by roughly a third from 6.8 billion people in 2009, will have a tremendous impact on global resources, making the goal of setting up a more sustainable transport system - one which uses fewer resources - all the more important.

More people and greater economic affluence mean more mobility and more transport. Some studies suggest that the number of cars in the world will increase from around 700 million today to more than 3 billion in 2050, creating serious sustainability problems unless there is a transition towards lower and zero-emission vehicles and a different concept of mobility is introduced.

# Policy objectives for sustainable transport

The goal of the ETP is to establish a sustainable transport system that meets society's economic, social and environmental needs and is conducive to an inclusive society and a fully integrated and competitive Europe. The ongoing trends and future challenges highlighted in the previous paragraphs point to the need for satisfying a rising demand for 'accessibility' in a context of growing sustainability concerns. The most immediate priorities appear to be the better integration of the different modes of transport as a way to improve the overall efficiency of the system and the acceleration of the development and deployment of innovative technologies - within an approach that always keeps the transport users and workers, with their needs and rights, at the centre of policymaking. The following chapters break the above priorities down into more operational goals, proposing seven broad policy objectives for consideration.

## Quality transport that is safe and secure

Transport provides access to many of our freedoms - the freedom to work and live in different parts of the world, the freedom to enjoy different products and services, and the freedom to trade and to establish personal contacts.

Demand for these freedoms will probably increase in the more multicultural, heterogeneous society of the future, with deeper links to other regions of the world. Access to goods and services will have to be ensured for an ageing society that is likely to demand greater transport safety, security and comfort, at a time in which the growth of traffic and the tensions of the urban environment risk to work in the opposite direction. Therefore an improvement of the overall quality of transport, including personal security, the reduction of accidents and of health hazards, the protection of passengers' rights and the accessibility of remote regions, must remain a high priority of transport policy. Road safety will remain an issue of concern and, following the expiration of the road safety action plan in 2010, appropriate consideration must be given to a follow-up strategy to ensure that the number of deaths on European roads is reduced. Working conditions must also be improved for transport workers, particularly as regards risks to health and safety.

In improving safety and security conditions, attention should be given to the issue of privacy and data protection that can arise in relation to the means employed for surveillance, registration and control purposes.

People with reduced mobility should be supplied with comfortable transport solutions. Infrastructure has to be built, maintained and upgraded on the principle of accessibility to all. A safer and more secure urban environment can be conducive to greater use of public transport, of cycling and of walking, which would not only ease congestion and reduce emissions, but also have positive effects on people's health and well-being.

## A well-maintained and fully integrated network

Transport is a network industry that comprises several elements: infrastructure, nodes, transport vehicles and equipment, ICT applications related to the infrastructure and on-board, network services, and operational and administrative procedures. The ability to move people and goods effectively and efficiently relies primarily on the optimal functioning of all these elements in combination.

A better exploitation of the network's capacity and of the relative strengths of each mode could contribute significantly to reducing congestion, emissions, pollution and accidents. This, however, requires the optimisation and operation of the network as a single entity, whereas currently modal networks are largely separated and even within modes there is a lack of integration between countries.

In particular, with regard to passenger transport, the integration of aviation with high-speed rail will be a crucial development. Concerning freight transport, an intelligent and integrated logistics system must become a reality, where development of ports and intermodal terminals is a key element. Finally, the urbanisation trend described above will make a 'modal shift' towards more environmentfriendly modes particularly important in the context of urban transport.

Infrastructure should be well maintained and improvement works coordinated. This reduces accidents and operating costs as well as congestion, pollution and noise. New infrastructure should be planned and prioritised with a view to maximising socioeconomic benefits, taking into account externalities and effects on the total network.

## More environmentally sustainable transport

To respond to the goals of the EU SDS and reduce transport's environmental impacts involves progress towards a number of environmental policy objectives. Lowering consumption of non-renewable resources is essential for all aspects of transport systems and their use. The undesired environmental consequences of transport activity will require further action in particular on noise, air pollutant emissions and greenhouse gas emissions. EU legislation sets requirements in many of these areas but these will require assessment and updating in the future.

For some aspects, in view of the long time required to effect change, long-term strategies are required to provide assurance for different actors in the market. In devising the future of the transport system, all elements of sustainability should be taken into account. This concerns the operation of transport means (emissions, noise) as well as the provision of infrastructure (land occupancy, biodiversity).

## Keeping the EU at the forefront of transport services and technologies

Technological innovation will be a major contributor to the solution of the transport challenges. New technologies will provide new and more comfortable services to passengers, increase safety and security and reduce the environmental impacts. 'Soft infrastructures' - such as intelligent transport systems for road (ITS) and traffic management systems for rail (ERTMS) and aviation (the single European sky's SESAR), backed by Galileo - can optimise the use of the network and improve safety; innovative vehicle technology can lower emissions, reduce oil dependency and increase comfort.

The development of technological solutions for sustainable transport is also important to promote growth and safeguard jobs. Population ageing might jeopardise Europe's competitive position in the world economy and its ability to maintain high standards of living. To face this challenge, it will be particularly important for the EU economy to enhance its productivity, namely by maintaining an efficient transport system and by investing more in R & D.

Europe is a world leader in many fields of transport including infrastructure, manufacturing of transport equipment, transport services and logistics. In view of the expected increase in global competition, keeping and enhancing this leadership is a key factor in preserving the overall competitiveness of the EU economy, and will also provide an opportunity for our transport industry to serve new and expanding markets.

## Protecting and developing the human capital

The transport system will experience substantial changes due to further market opening and innovation. The competitiveness of the EU economy and the resilience of the transport firms depend on the capacity to adapt to innovation and new market needs. Competition and innovation have positively impacted on the transport labour market. However, transport workers in some sectors may be displaced from their jobs as a result of the adjustment to a radically different economic and energy context. It is important to ensure that such change is well anticipated and managed, so that changing conditions will also be a source of new jobs and that transport workers can participate in, and respond to, the process. This can be done through a range of instruments, including information and consultation of workers, social dialogue, early identification of skills shortages, training and ensuring that any restructuring is carried out in a socially responsible way. Social protection and public services should provide a safety net to facilitate the adjustment. Gender considerations should also be taken into account, to facilitate women's access to transport jobs.

It must also be ensured that working conditions are maintained or improved. Differences in rights and social conditions between Member States should not result in a race to the bottom and become a factor of competitiveness with the increasing cross-border mobility of transport workers.

## Smart prices as traffic signals

In transport, like in any other sector, there cannot be economic efficiency unless the prices reflect all costs - internal and external - actually caused by the users. By providing information on the relative scarcity of goods or services, prices convey essential information to economic actors. The transport system would particularly benefit from better price signals. It is rare to have price differentiation for the use of the road in peak versus off-peak hours. Similarly, there is no economic incentive to use more silent vehicles, safer modes of transport or more environment friendly means.

Transport operators and citizens are not always in a position to identify among several transport alternatives what is best for the economy and the environment, but with correct pricing of externalities for all modes and means of transport they would make the right choice just by opting for the cheaper solution.

The next decade is likely to be one of transition for the transport system. New practices and new technologies will emerge; long-term investments, for example in infrastructure, will be made. Europe will have to live with these choices for a long time: it is therefore essential that they are guided by correct price signals.

## Planning with an eye to transport: improving accessibility

The introduction of a correct pricing system will help in better factoring transport costs into location decisions; even so, however, there is a risk that transport costs are not properly taken into account by planners and that the availability of cheap transport solutions is taken for granted.

Many public services have been progressively centralised with a view to increasing efficiency. The distances between citizens and service providers (schools, hospitals, shopping malls) have been on the increase. Firms have followed the same trend by keeping a smaller number of production, storage and distribution centres. The trend towards the concentration of activities has produced a large amount of 'forced' mobility, owing to a worsening of accessibility conditions.

When taking land-use planning or location decisions, public authorities and companies should take into account the consequences of their choices in terms of travel needs of clients and employees in addition to the transport of goods. Sound planning should also facilitate the seamless integration of the different transport modes.

Transportation needs can also be reduced by increasing 'virtual' accessibility through information technology (teleworking, e-government, e-health, etc.). Evidence on the effect of these practices is still limited, but it seems they have a significant and yet unexploited potential for replacing travel. On the other hand, greater ease of contact might encourage people to live further from their workplace and firms to disperse their activities. The net result could be fewer, but longer, journeys related to work. In any event, teleworking has the great advantage of providing flexibility in the choice of when to travel, therefore significantly reducing congestion.

# Policies for sustainable transport

Whereas the previous section proposes the broad objectives for future transport policy, this section puts forward some suggestions on how the available policy instruments could be activated to reach those goals and respond to the sustainability challenge.

## Infrastructure: maintenance, development and integration of modal networks

The optimal functioning of the transport system requires full integration and interoperability of the individual parts of the network, as well as interconnection between different (modal) networks. Crucial in achieving this result are the nodes, which are the logistics centres of the network and offer connectivity and choice for both freight and passenger transport. Intermodal and transshipment platforms should be promoted and developed where there is a potential for consolidation and optimisation of passenger and freight flows. This will typically be the case in areas with a high activity of passengers and freight transport, i.e. in urban areas, and where high-volume corridors are intersecting.

Well-focused infrastructure expansion will help in avoiding congestion and time losses. In this respect, infrastructure needs to be carefully planned and prioritised with a view to optimising transport chains and the overall transport network. In addition to the removal of bottlenecks, it will be essential to identify green corridors in order to reduce congestion and environmental pollution. Infrastructure projects include the European global navigation satellite systems (Galileo and EGNOS), which will complement the 'traditional' networks and improve their exploitation.

Drawing from the experience provided by the application of the environmental impact assessment (EIA) and strategic environmental assessment (SEA) directives, common methodologies and similar assumptions should be adopted in the appraisals of infrastructure projects across modes and, possibly, countries. Common data and indicators are needed, starting with those on traffic and congestion. This will help in selecting projects on the basis of comparable cost-benefit ratios and taking all relevant elements into account: socioeconomic impacts, contribution to cohesion and effects on the overall transport network.

New infrastructure is costly and making the optimal use of existing facilities can already achieve a lot with more limited resources. This requires proper management, maintenance, upgrading and repair of the large infrastructure network that has so far given Europe a competitive advantage. Upgrading the existing infrastructure - also through intelligent transport systems - is in many cases the cheapest way to enhance the overall performance of the transport system.

Up until now, infrastructure has been mainly designed for joint usage by passenger and freight vehicles, but the growth in traffic and the related congestion, especially in and around cities, has led to frictions between passenger and freight transport. Where justified by traffic volumes, the possibility to provide dedicated infrastructures for passengers and freight should be considered, either in the form of dedicated freight corridors or by setting 'smart' priority rules. In general, a more efficient use of infrastructure can be obtained when users have similar profiles (loads, speeds, etc.).

Thanks to Europe's long coastline and large number of ports, the maritime sector is a valuable alternative to land transport. The full implementation of the European maritime space without barriers and the maritime transport strategy for 2018 can make the 'motorways of the sea' a reality and exploit the potential of intra-European short sea shipping. Logistics operations using synergies between sea and rail and/or river also have great potential for development.

Information systems are essential in overseeing complex transport chains involving several actors, as well as in informing transport users of available and alternative options and of possible disruptions. Transport documents and tickets should be made electronic and multimodal, while preserving privacy of personal data. Questions of liability, dispute settlement and complaints handling across the whole transport chain should be clarified and streamlined. ICT solutions should be developed as a support for better management and integration of transport flows.

## Funding: finding the resources for sustainable transport

The transition towards a low-carbon economy will impose a substantial overhaul of the transport system. This will require considerable and well-coordinated funding, but the necessary resources will be difficult to find: the current economic crisis is putting public finances under pressure and is likely to be followed by a phase of budgetary consolidation. Ageing will increasingly absorb public funds for pensions and health care.

Transport generates a substantial amount of revenues for public budgets. Energy taxes amount to 1.9 % of GDP, most of them coming from fuel taxes on road transport and the private car. A further 0.6 % of GDP is collected in the form of vehicle taxes. In addition to taxes, there are also tolls and charges for infrastructure use. Transport users thus already pay a significant amount, but the price they pay often bears little connection to the real costs on society of their choices.

Investment in transport infrastructure is mainly financed with public funds, which often also cover around 50 % of operating costs of public transport services. The use of public funding in addition to 'user-pays' sources is justified on the basis of wider socioeconomic benefits (e.g. regional development, public goods). These benefits should be assessed through project appraisal methods progressively harmonised at EU level. Total infrastructure costs in road transport - that is fixed cost plus maintenance - are estimated at about 1.5 % of GDP.

According to the available estimates - which refer to road transport - the most common external costs reach 2.6 % of GDP. These costs are generically paid by all citizens, thus not in ways that are related to the externalities: the incentive effect and the benefits of price signals are lost. The Treaty principle that the polluter should pay is not respected in all cases.

The Commission proposed last year a stepwise strategy for the internalisation of external costs in all transport modes, which contemplates, among other measures, the inclusion of aviation in the EU emission trading scheme from 2012 and the introduction of internalisation charges for heavy goods vehicles. Where appropriate, action from Member States and international organisations should complement this strategy and ensure that users' costs include relevant externalities for all modes and vehicles. The development of technology - for example on-board units and global positioning systems for tolling - will facilitate the future implementation of this strategy. Internalisation charges to complement revenues from energy taxation are likely to be necessary in any event, since excise duties on oil derivatives will presumably decline with wider diffusion of vehicles running on alternative sources of energy.

It is also predictable that the transport sector has to become increasingly self-financing in relation to infrastructure. Congestion charges, which represent the cost of infrastructure scarcity, can give a good indication of the needs for additional capacity and can provide funding for expansion of infrastructure or for alternative transport solutions.

## Technology: how to accelerate the transition to a low-carbon society and lead global innovation

Science and industry are already very active in searching out solutions for transport safety, fuel dependency, vehicle emissions and network congestion. In view of the abovementioned trends in world population and global car ownership, there is a compelling need for a technological shift towards lower and zero-emission vehicles and for the development of alternative solutions for sustainable transport. Europe must pave the way to sustainable mobility, where possible providing solutions that are valid on a global scale and that can be exported to other regions of the world.

For promising technologies, the necessary framework conditions to introduce them commercially on the market have to be put in place by policymakers without giving undue advantage to any specific technology. This requires, in particular, setting open standards, ensuring interoperability, increasing R & D expenditure for technologies that are not yet mature for market application, defining a clear legal and regulatory framework - for example, for liability and privacy issues - and promoting best practice examples.

The most important policy instrument will probably be standard setting. The transition to a new and integrated transport system will only be quick and successful if open standards and norms for new infrastructure and vehicles and other necessary devices and equipment are introduced. The standard setting should aim at interoperable, safe and user-friendly equipment. This is not only important for the internal market, but also to foster European standards on an international scale. The development of intelligent transport systems or alternative vehicles propulsion systems could provide a success comparable to that of GSM technology. Policymakers must, however, ensure that the standard setting process avoids the introduction of barriers to market entry and to the development of alternative technologies.

Another policy instrument is to foster R & D expenditures towards sustainable mobility, for example through the European green cars initiative and joint technology initiatives. New transport systems and vehicle technologies will have to be first implemented as demonstration projects, to assess their feasibility and economic viability. Public intervention would also be needed at various stages of the development of the infrastructure that supports new vehicles, for example smart grids for electric transport or hydrogen distribution networks. Much work remains to be done to speed up the integration of already available applications in our transport system. Finally, state aid rules will also be an important policy instrument to favour the development of new technologies and of alternative modes of transport.

## The legislative framework: further promoting market opening and fostering competition

The EU has embarked on a market opening process which has already proved successful where more advanced. As a result, a growing number of firms are active across national markets and different modes, which benefits overall economic performance and employment in the EU. Partially open markets, however, carry the risk that operators acting in protected environments subsidise their operations in liberalised markets.

The completion of the internal market with a strong enforcement of competition rules is essential. It should also include administrative simplification aiming at reducing unnecessary burdens on transport companies. On the basis of the achievements in the fields of air and road transport, new rules for opening up the markets coupled with effective enforcement of existing legislation will be particularly important in the rail sector.

At the same time, the regulatory framework needs to evolve towards harmonised environmental obligations, effective supervision, uniform protection of workers conditions and users' rights. The legislative framework will need to make sure that competition not only takes place on a level playing field, but also does not sacrifice safety and security standards, working conditions and the rights of customers, with particular care of those with limited mobility and special needs. At the same time, environmental standards must converge 'upwards' rather than on the minimum common denominator.

Large logistics multimodal operators have the know-how and the resources to carry out investments involving advanced technologies and to participate in public-private partnership (PPP) projects, but public authorities must ensure that third-party access to infrastructure is not precluded. The possible creation of transnational infrastructure managers would be a welcome development that may reduce frictions which currently still exist.

## Behaviour: educate, inform and involve

Education, information and awareness-raising campaigns will play an important role in influencing future consumer behaviour and facilitating sustainable mobility choices. Transport policies have a very direct impact on people's lives and tend to be highly controversial: citizens should be given better information on the reasoning behind policy decisions and on the available alternatives. A better understanding of the challenges ahead is a precondition for public acceptance of the solutions.

Greater public involvement in transport planning can be ensured by recourse to participatory instruments, namely open consultations, surveys and stakeholders' representation in decision processes.

Transport workers and the sectorial social partners should be informed and consulted on the development, application and monitoring of transport policy and related measures, both at sectorial and at enterprise level.

## Governance: effective and coordinated action

The transport system involves complex interactions among political, economic, social and technical factors. The sector can only thrive if policymakers are capable of providing sound planning, adequate funding and a proper regulatory framework for market operators.

This is a challenging task since it requires policy coordination between different bodies and at different levels. The ETP is a particular case in point, its success depending to a large extent on how it is implemented and complemented by measures decided at other levels of government. There are at least two areas in which the benefits of effective coordinated action, beyond what is currently done at EU level, are worth emphasising.

* Standards and interoperability. Many new technologies and regulatory practices will develop in the next few years to address transport challenges. Coordination will be needed to ensure equipments' interoperability and to avoid the proliferation of different systems at national level, for example rules and standards for tolling, for ITS or for access to congested areas.
* The urban challenge. For subsidiarity reasons, the EU role in regulating urban transport is limited. On the other hand, most transport starts and ends in cities and interconnection and standardisation issues do not stop at city limits. Cooperation at EU level can help urban authorities in making their transport systems more sustain able. There are a range of activities and fields where the EU can set examples and continue to promote and support demonstration projects and the exchange of best practices, notably through the seventh framework programme and cohesion policy programmes. Moreover, the EU can provide a framework in which it will be easier for local authorities to take measures.

## The external dimension: the need for Europe to speak with one voice

The transport sector is increasingly international. The ETP needs therefore to project itself internationally so to ensure further integration with the neighbouring countries and advance Europe's economic and environmental interests in the global context.

Closer economic integration and migration flows from neighbouring countries and the African continent will be one of the key challenges that Europe will have to face in the future. International transport cooperation aiming at establishing the necessary interconnection of the major transport axes of these regions should be further promoted, helping in ensuring sustainable development in the neighbouring countries and in the African continent.

Indeed, the development of the south east Europe core regional network as a precursor of the TEN-T is crucial for the stability and economic prosperity of south east Europe and will strengthen also the links with the candidate and potential candidate countries from the region. Moreover, the European neighbourhood policy (ENP) action plans, as well as bilateral partnership and cooperation agreements, include substantial sections on transport policy cooperation, including to varying degrees the adoption by ENP countries of EU transport legislation. The EU's transport relations with eastern ENP countries, as well as Belarus, also include ambitious plans for the extension of the TEN-T network.

On a global scale, the EU is already now a major standard setter. To name but a few examples, Euro emission standards for road vehicles and the European rail traffic management system (ERTMS) are also increasingly being adopted outside Europe. These developments need to be supported in international forums. The international role of the EU is particularly important for maritime and air transport, which are intrinsically global industries. To maintain a prominent position in these markets in the next 40 years, Europe needs to speak with one voice in those instances that bring together governments, industry representatives and regulators at a global level.

# What comes next?

The Commission encourages all interested party to contribute to the consultation exercise launched by the present communication. Views on the future of transport and on possible policy options should be submitted to the mailbox tren-future-of-transport@ec.europa.eu.

High-speed **Europe**

* A sustainable link between citizens

# Introduction

High-speed lines (HSLs) offer European citizens a safe, fast, comfortable and ecological mode of transport. A high-speed train is a train capable of reaching speeds of over 200 km/h on upgraded conventional lines and of over 250 km/h on new lines designed specifically for high speeds. Today, trains running on the most recently installed lines can reach speeds of 360 km/h, while trains running on upgraded conventional lines can reach speeds of up to 250 km/h.

HSLs have truly revolutionised sustainable mobility, by allowing a significant increase in the speed and frequency of journeys between the major European cities. This cuttingedge infrastructure illustrates the Union's immense capacity for technological innovation and the vitality of European industry, which is constantly developing new systems, especially in terms of rolling stock. The reduced travelling times, higher levels of passenger comfort and low environmental impact enable HSLs to compete with and complement road and air travel, thereby helping to implement viable mobility at European level.

The development of high-speed rail travel took off after the 1974 petrol crisis. Faced with Europe's energy dependency and concomitant threats in terms of mobility, several European countries decided to develop a new, fast mode of transport which would not guzzle fossil fuels. Italy was the first European country to inaugurate an HSL (on the Direttissima line between Florence and Rome) in 1977, but it was France that led the technological boom, introducing the first high-speed train (HST) (nicknamed Rail Concorde) between Paris and Lyon in September 1981. Germany joined the venture at the beginning of the 1990s, with the Intercity Express (ICE), followed shortly by Spain, which introduced the Alta Velocidad Espanola (AVE) in 1992. At the end of 2009, Europe had 6 214 km of high-speed lines on which trains could run at speeds in excess of 250 km/h.

There are currently different technical standards on the HSL European network and this generates significant extra costs. The huge potential of HSLs in terms of mobility throughout the continent has still not been fully exploited. That is why the European Union is promoting a pan-European HSL network. In order to do so, it is issuing common technical and quality standards for all Member States. It is also establishing a framework for the development and implementation of standardised tools, such as the European rail traffic management system (ERTMS). It is being assisted in this by the European Railway Agency (ERA), the body responsible for helping to integrate the European rail networks by improving rail safety and allowing trains to cross borders within the EU without having to stop.

# The high speed network and citizens

## Development of a truly European network

The European HSL network is expanding constantly. The United Kingdom, Sweden and Germany have upgraded large sections of their conventional network so that they can be used by high-speed trains. The opening in November 2007 of the second section of the Channel Tunnel to St Pancras line is just one of many examples. HSL construction projects are proliferating elsewhere in Europe. The Belgian HSL network has plans to expand, with the 'Diabolo' line to improve rail access to Brussels National Airport, and France has plans to double the HS lines between Paris and Lyon. Spain has plans to lay some 10 000 km of HSLs between now and 2020, so as to ensure that 90 % of its inhabitants have an HST station within 50 km of their home. With its network saturated in the south of the country, Sweden plans to construct a completely new HS line between Stockholm and Gothenburg. This line, which will be restricted to passenger trains, will provide better services to numerous towns between the two principal Swedish cities. This project forms part of a global project, which is designed to improve rail capacity in Sweden by constructing new lines and renovating existing lines. This action is being taken in spite of the climate and terrain in Scandinavia, which make it very difficult to set up railway infrastructure.

Europe aims to use the trans-European transport network (TEN-T) to link all HSLs on the continent into a proper integrated European high-speed network. The liberalisation of the mainline international passenger railway market on 1 January 2010 will also allow operators to compete and offer users a wider range of transport options.

The first trans-European HSL, between Paris, Brussels, Cologne, Amsterdam and London, is already close to completion. This network, which is used by several rail operators (Thalys, Eurostar, Deutsche Bahn, NS Highspeed) will significantly cut journey times between major German, Belgian, French, Dutch and British cities. The ERTMS will guarantee that the system is fully interoperable. In January 2008, the International Union of Railways (UIC) had registered 1 050 HS carriages in service in Europe.

### Advantages for passengers

High-speed trains provide unsurpassed passenger comfort. The layout of the compartments, the interior fittings of the carriages and even the lighting have been designed to create a comfortable and pleasant space suitable both for work and relaxation. Passengers have a great deal of personal space, with access to more and more services, such as Internet, power sockets for their electronic equipment, headrests and folding tables. They can also walk around on board and there are restaurant cars serving food and drinks. Unlike on aircraft, the use of mobile telephones is not prohibited; however, it is confined to dedicated spaces between carriages in order to avoid disturbance to other passengers. Particular attention has also been paid to access to compartments, by reducing the gap in height between the train and the platform.

European standards are gradually being established, both to ensure greater compatibility between trains and lines and to ensure that carriages comply with important quality standards, especially in terms of safety and environmental impact.

Multimodal railway stations in city centres provide quick, easy access to the rail network. The development of HSLs has consistently cut journey times between various urban and economic centres in the Union. At present, London is 2 hours 15 minutes from Paris and 1 hour 51 minutes from Brussels and Brussels is 3 hours 15 minutes from Frankfurt. This compares with 5 hours 12 minutes from London to Paris, 4 hours 52 minutes from London to Brussels and 5 hours from Brussels to Frankfurt in 1989.

The advantages of HSLs, in terms of frequent connections (which can easily be modified depending on demand) and flexibility for passengers, have allowed the railways to compete more effectively against other modes of transport. Since 1997, over 6 million passengers a year have been using the Brussels–Paris HSL. As a result, flights have been cut back on this route.

## Link with trans-European transport network (TEN-T) policy

The programme for the trans-European transport network (TEN-T), as introduced under the Treaty of Maastricht and defined in Decision 1692/96/EC in 1996, is designed to guarantee optimum mobility and coherence between the various modes of transport in the Union. The main priorities of this policy, which accounts for a large part of the White Paper on transport policy in the EU, are to establish the key links needed to facilitate transport, optimise the capacity of existing infrastructure, produce specifications for network interoperability and integrate the environmental dimension.

The TEN-T focuses very closely on the development of high-speed transport. Of the 30 priority projects put forward under this programme, no fewer than 14 concern high-speed lines. The new Lyon–Trieste–Divaca/Koper–Ljubljana–Budapest–Ukrainian border railway axis, the new high-speed railway axis in south-west Europe and the integration of the high-speed rail network on the Iberian peninsula into the European network are just a few examples of TEN-T projects supported by the European Union. The development of the European Rail Traffic Management System (ERTMS) is also one of the projects that receives serious funding as part of the implementation of the TEN-T.

**TEN-T axes and priority projects relating wholly or partly to HSLs**

|  |  |
| --- | --- |
| **Axis** | **Title** |
| 1 | Railway axis Berlin–Verona/Milan–Bologna–Naples–Messina–Palermo |
| 2 | High-speed railway axis Paris–Brussels–Cologne–Amsterdam–London |
| 3 | High-speed railway axis of south-west Europe |
| 4 | High-speed railway axis east |
| 6 | Railway axis Lyon–Trieste–Divača/Koper–Divača–Ljubljana–Budapest–Ukrainian border |
| 12 | Nordic Triangle railway/road axis |
| 14 | West coast main line |
| 16 | Freight railway axis Sines/Algeciras–Madrid–Paris |
| 17 | Railway axis Paris–Strasbourg–Stuttgart–Vienna–Bratislava |
| 19 | High-speed rail interoperability in the Iberian peninsula |
| 20 | Railway axis Fehmarn belt |
| 22 | Railway axis Athens–Sofia–Budapest–Vienna–Prague–Nuremberg/Dresden |
| 24 | Railway axis Lyon/Genoa–Basel–Duisburg–Rotterdam/Antwerp |
| 28 | Eurocaprail on the Brussels–Luxembourg–Strasbourg railway axis |

## Growing demand

Since high-speed lines were introduced, the number of passengers opting for this mode of transport has constantly increased. The number of passengers on all German, Belgian, Spanish, French, Italian and British lines increased from 15.2 billion passenger-kilometres in 1990 to 92.33 billion in 2008.

The continuous development of efficient, interoperable control/management tools allows infrastructure capacity to be increased, while guaranteeing high safety standards. It is possible today to route a train on an HSL every four to five minutes.

## Competitiveness with other modes of transport

Expansion of the HSL network has breathed new life into rail transport in terms of competing with other modes of transport. Today, high-speed trains account for approximately 40 % of traffic over medium distances and even more on certain routes, such as London–Paris, Paris–Brussels and Madrid–Seville. It is, in fact, on journeys which take under three hours that HS trains are most competitive: access time is much shorter than by air and journey times are shorter than by car.

In 2007, passengers on all European rail networks travelled an average of 372 km on high-speed lines. HSLs are preferred over air and road travel for journeys of between 400 and 800 km. At below 150 km, they offer a limited bonus compared with road or conventional rail travel. Between 150 and 400 km, travel by rail (on both HS and conventional lines) is quickest. Above 900 km, air travel gains the upper hand, except for journeys on which rail offers specific advantages (HS snow train, overnight services, car trains, etc.). The European Union is using the TEN-T programme to encourage cooperation between rail companies, airlines and road transport operators, in order to foster synergies between these different sectors and optimise the integration of transport at European level. This approach will improve transport energy use, which in turn will generate environmental advantages.

### Paris–Lille: at the heart of the European HSL network

The 333 km North HSL, which opened in 1993, links Paris to the Belgian border and to the Channel Tunnel via Lille. Trains in commercial service are capable of speeds of up to 300 km/h, which has considerably improved rail journey times between Paris and Lille. The extension of this line northwards to Belgium and the United Kingdom and southwards, via the HSL Interconnexion Est, makes it a key link in the European high-speed rail network. Lille is one of the main winners from this project as it now sits at the crossroads of Europe, in the centre of the Brussels–London–Paris triangle. Euralille has become the third biggest business centre in France in just over a decade.

### Frankfurt–Cologne: an HSL restricted to passenger services

As of 2002, the 177 km Cologne–Frankfurt HSL has set the journey time between these two cities at 1 hour 10 minutes. It now takes no more than an hour to reach Frankfurt International Airport from Cologne. This is a unique case in a network basically designed for mixed passenger/freight traffic; it is restricted to passenger traffic, due to its steep gradient (4 %). It links Rhine-Ruhr and Rhine-Main, two of the most urbanised regions of Germany, which are home to some 15 million people. The engineers applied important technical innovations in order to build this line. For example, the tracks were laid on concrete slabs, rather than on ballast, and the trains use magnetic (eddy current) brakes.

### Turin–Milan–Naples: linking north and south

The Italian HSL network, which was inaugurated in 1977 with the Direttissima line between Florence and Rome, was extended in 2005–06 with the Rome–Naples and Turin–Novara lines. The opening of the Milan–Bologna and Naples–Salerno lines in 2008 increased the AV/AC (Alta velocita/Alta capacita) network to over 900 km. With motorway interconnections at numerous points, the Italian HSL is the backbone of the transport network linking the north and south of Italy. It also forms part of the north-south rail corridor linking Berlin and Palermo and is a top priority project under the trans-European transport network programme.

### Madrid–Barcelona: journey time 2 hours 38 minutes

The Madrid–Barcelona HSL was opened in February 2008. This new 621 km line reduced the journey time between the two cities from 7 hours on a Talgo train in 1996 to 2 hours 38 minutes. In time, this line will be extended towards France via the Perpignan–Figueras cross-border tunnel, linking Spain to the trans-European HSL network. The Madrid–Barcelona line will also help to relieve pressure on the saturated air route between the two cities. After a year in service, Renfe (Red Nacional de Ferrocarriles Espanoles) has captured 40 % of the traffic between Madrid and Barcelona.

# A tool at the service of european transport policy

## Trans-European transport network policy and investments

According to recent forecasts by the European Commission, European demand for transport is expected to increase by 25 % for passenger transport and by 29 % for freight transport between now and 2020 (reference year: 2000). This highlights the importance of the Community trans-European transport network (TEN-T) programme. Facilitating passenger and freight mobility by developing and upgrading an integrated transport infrastructure throughout Europe and complying with strict safety and quality standards is a key objective in safeguarding the competitiveness of the Union. That is why the TEN-T programme also plays a key role in the Europe 2020 strategy for smart, sustainable and inclusive growth.

The cost of implementing the entire TEN-T is estimated at around EUR 900 billion between 1996 and 2020. As far as high-speed rail is concerned, 14 priority projects have been launched to develop new lines and/or upgrade existing ones at a cost of some EUR 269 billion between 1996 and 2020. The European Union is giving financial support to these projects via the TEN-T budget, the Structural Fund, the Cohesion Fund and the European Investment Bank (EIB).

In the past, a large number of European HSLs were financed by the public sector. This was true of France (for the South- East, Mediterranean, European East and Rhine–Rhône HSLs), Belgium, Germany, Spain and Italy. These projects were supported at national level, with help from the European Union via the budget allocated to the TEN-T and/or via the Structural Fund and the Cohesion Fund. The EIB also contributed towards the development of the network by granting loans.

## Territorial cohesion and regional planning

HSLs help not only to increase mobility between major urban economic centres in the EU, but also to improve services to the intermediate towns crossed by high-speed trains. The speed of high-speed rail transport therefore helps to increase the mobility of passengers and freight and to create a feeling of proximity within the Union.

The positive impact of the HSL network on certain sectors, such as the high-tech or upscale tertiary service sectors, helps to boost economic specialisation in the regions concerned and to improve complementarity between the various economic centres in Europe. This is without doubt of benefit to Europe's competitiveness at international level.

Connecting a station to the HSL network may influence the entire urban development of the surrounding district. The district of King's Cross in London will certainly experience far-reaching changes following the inauguration of the international station at St Pancras. Planning permission covering a 75 hectare site was granted in 2006 for the restoration of 20 historic buildings and the construction of 25 office blocks, 20 access roads and 10 public spaces. In France, this has also applied to HST stations opened on the outskirts of cities. They have fostered the creation of satellite cities, such as at the Avignon HST station in Courtine, where a HST business centre is to be developed.

## Security and interoperability

High-speed trains are one of the safest means of transport. Various systems are used to guarantee optimum safety. There are systems to transmit speed limits to the driver (at very high speeds, the driver can no longer read trackside signals correctly). However, in the past, these systems were developed at national level by specific manufacturers and are not compatible with one another.

Therefore, trains need to be fitted with several systems if they are to cross borders. For example, Thalys trains operating between France, Benelux and Germany need to be fitted with seven different signalling systems. As France, Germany and Belgium have sections of conventional lines and sections of high-speed lines in succession, two control systems are needed for each country.

These multiple train control systems underline the importance of the interoperability of the HS network being promoted and implemented by the European Railway Agency (ERA). Directive 2008/57/EC defines interoperability as the ability of the trans-European high-speed rail system to allow the safe and uninterrupted movement of high-speed trains which accomplish the specified levels of performance. This ability rests on all the regulatory, technical and operational conditions which must be met in order to satisfy essential requirements in terms of safety, reliability and availability, health, environmental protection and technical compatibility. In other words, interoperability does not only concern management and signalling systems. All aspects of rail transport are concerned, from infrastructure (e.g. bridge headroom, standardised gauge), through energy (e.g. electrification system) to passenger services (e.g. information systems, reservation methods), maintenance (e.g. system to cut maintenance costs) and rolling stock (e.g. engines).

### The key role of the European Railway Agency

The European Railway Agency (ERA) was set up in 2004 in order to support the development of a safe European rail network, the competitiveness of which would no longer be hampered by technical obstacles. The ERA is mainly concerned with improving network safety and interoperability. It plays a key role because, in a railway area without barriers, a decision taken unilaterally by one country might potentially prevent foreign trains from operating in it. The existence of a European coordination body is, by definition, a key element in guaranteeing the efficiency of the European rail network of tomorrow.

Interoperability also concerns the synergy between HSLs and conventional networks. European rolling stock manufacturers have had to call on all their know-how and technical expertise in order to design high-speed trains that can run on conventional tracks. Some Spanish HSTs (Alaria, Alvia, Talgo) and all French HSTs are able to operate on conventional lines. In Germany and Italy, the network is totally compatible. All categories of trains are able to use HSLs and conventional lines indiscriminately.

## Intermodality and co-modality

### ERTMS

The ERTMS rail traffic management system is one of the tools co-financed by the European Union to meet the demand for interoperability. The ERTMS comprises the wireless global system for mobile communications - railways (GSM-R) and the European train control system (ETCS) and has been designed and implemented under the aegis of the European Railway Agency (ERA, see box on page 14). This unique system helps to make European HSLs interoperable and optimise rail traffic management along international corridors. Rollout of the ERTMS started in 2005 on various HSLs (Rome–Naples, followed by Madrid–Lerida). In time, the ERTMS will be deployed over the entire European network, thereby reducing significantly the costs generated by multiple management and signalling systems.

Intermodality means the use of several means of transport during a single journey. This concept applies to both passenger and freight transport and includes rail, road, air and urban transport.

The environmental impact of aircraft and saturation of the major European airports is leading towards limitations on air traffic within the Union. This creates a favourable situation for fostering synergies between the rail and air networks. Airlines can therefore make use of HSL networks to channel passengers from various regions to a central airport. The Thalys trains have already created this sort of synergy between Brussels and Paris Charles-de-Gaulle Airport.

Co-modality means the use of each mode of transport for the most suitable purpose and, where appropriate, the use of a combination of modes of transport. Applied to the railway sector, this principle infers that the capacity freed up by HSLs can be used for long-distance goods traffic, which is the preferred means of transporting rail freight. The gain in capacity translates into infrastructure availability, be it virtual (free train paths) or physical (dedicated infrastructure). However, where train paths are simply freed up, this gives rise to a number of technical and operational challenges. The difference in speed between a (slower) goods train and a high-speed train impacts on rail traffic management for the simple reason that freight trains spend longer on the track and therefore use up more traffic capacity (train paths). This difference in speed may also cause safety problems when these two types of train pass.

This makes safeguarding infrastructure availability, while guaranteeing optimum capacity and security, an extremely difficult task. Physically freeing train paths simply means dedicating HSLs solely to passenger traffic and giving freight a higher priority on conventional lines. This is an option being explored by Sweden in particular.

### HSLs and airports: intermodality in action

There are some particularly remarkable examples of HS stations operating along intermodal lines with airports. Frankfurt International Airport is a pioneer in this. Opened in 1972, traffic increased considerably following the introduction of the Frankfurt– Cologne HSL in 2002. According to Deutsche Bahn, two thirds of train passengers are either leaving or have arrived by plane.

In France, the station at Paris Charles-de-Gaulle Airport is located at the interconnection between the North HSL and the South-East HSL. It is served by 52 HSTs a day, linking the main towns in France, and by five HSTs serving northern Europe (Brussels and Amsterdam).

In Belgium, Brussels National Airport will be linked to all the main Belgian cities and to several European cities, such as Paris, Amsterdam, Cologne and Frankfurt, by 2012.

## Making transport more ecological

At a time when climate change is high on the political and social agenda, the attraction of rail transport is even greater, due to its low environmental impact. Out of 25.1 % of CO2 emissions attributable to transport in the EU-27 in 2007, only 0.6 % were from rail, which carried over 6 % of all passengers and nearly 11 % of freight.

High-speed trains are powered by electricity and their carbon footprint is therefore almost zero in their operating zones, although the CO2 emitted during electricity generation does need to be taken into account. This rate varies depending on the primary energy used to generate the electricity consumed by HSLs. If it is generated from solid fossil fuels (coal), as in Poland or Germany, HSLs obviously have a bigger carbon footprint. However, the development of renewable and/or nuclear energy will allow this impact to be reduced in future.

Although the environmental impact of HSLs can also be reduced by improving the energy efficiency of trains and working on other elements of the vehicle, the carbon footprint of rail travel is still much smaller than that of air or road travel. In the case of a journey from Paris to Marseilles, CO2 emissions in grams per passenger-kilometre (g/pkm) are just 2.7 g/pkm by HS train, compared with 153.0 g/pkm by air and 115.7 g/pkm by car. From the point of view of energy efficiency, HSTs also perform better, using 12.1 grams of petrol per passenger-kilometre, compared with 17.6 for conventional trains, 18.3 for a coach, 29.9 for a car and 51.5 for an aircraft.

## Competitiveness and standard of service

HSL passengers enjoy numerous advantages in terms of speed, frequency, accessibility, reliability, price and safety. Rail companies now pitch their prices on the basis of the model used in air transport, by applying 'yield management' techniques designed to maximise income for the carrier and improve available capacity management.

This means that passengers can take advantage of promotional offers for certain times and journeys. The most loyal customers are also offered additional services, such as the facility to cancel, change or fast-track their reservation. New promotions similar to 'low-cost' alternatives, such as iDTGV in France, also offer different packages, depending on the passenger's specific requirements.

If the HSL network is deployed as planned, it will allow savings of the equivalent of 22 million tonnes of CO2 between now and 2020 and 34 million tonnes per annum once the network has been fully deployed in 2030.

Research is already under way with a view to minimising the environmental impact of high-speed trains by reducing their dependency on fossil fuels. Numerous projects funded by the EU framework research programme have also focused on reducing noise pollution from HSLs. Mention should also be made of the European Noemie campaign, the aim of which was to evaluate the noise impact of high-speed trains.

For its part, the European Commission issued a communication in July 2008 on rail noise abatement, which made provision for measures to be adopted to halve the noise from freight trains. Thus, by 2014, the noise caused by the rail fleet should be reduced significantly for 16 million citizens.

# A technological and commercial success

## Speed records and technology applied

In April 2007, TGV-POS 4402 beat the rail speed record, reaching 574.8 km/h on a section of the East HSL. Even though speeds in commercial operation are around 60 % of this, European progress in this area is helping to develop the whole range of HSL-related technologies.

This European record is the result of highly advanced research. The engines of the V150 are far more powerful than the standard models. The total output of the V150 has been increased to 19.6 MW, compared with 9.6 MW for a conventional HST.

The strain on the catenary power transmission cables has been increased to 4 tonnes, in order to make them as rigid as possible, reduce the size of the wave caused by passing trains and prevent any power cuts. The track cant has been increased in the curves, enabling commercial trains to operate at 320 km/h, rather than the usual 300 km/h on this line.

## Research and development at the service of HSLs

High-speed trains are a remarkable technological success, the outcome of government-funded research and development (R & D) and the innovation of European industry, working closely with the railway companies, equipment manufacturers and civil engineers.

As Claude Soulié and Jean Tricoiret write in their Grand livre du TGV, 'The HST evokes the image of a train, of stock, coupled not just with high speed, but also with the innovation of the articulated rake. The HST is a system made possible by formidable progress in all rail techniques, especially track and power capture'.

Technological innovation encompasses all elements of the system: platforms, bridges and tunnels, track and power supply, as well as management and signalling systems.

The ERTMS standard has propelled Europe to the cutting edge of rail management and signalling systems. The EU framework research and development programmes have contributed enormously to this development, thanks to the remarkable partnership between research centres and industry.

In its strategic agenda for 2020, the European Rail Research Advisory Group (ERRAC) identifies seven priority research areas for the future development of the European rail sector:

* intelligent mobility: implementing a passenger information system which is harmonised at European level;
* environment and energy: increasing the energy efficiency of trains, reducing environmental impacts (CO2 emissions, noise) and researching alternative fuels, in order to minimise the dependency on fossil fuels during electricity generation;
* safety: improving safety for passengers and staff;
* homologation, testing and safety: speeding up product approval procedures and minimising risks through better safety management;
* competitiveness and technology: improving the interoperability and attractiveness of products for customers;
* economy and strategy: developing new network infrastructure, related cost management and forecast models;
* infrastructure: developing less costly maintenance methods and maintenance-free interoperable infrastructure systems.

Researchers are already devoting all their attention to these improvements, which give a glimpse of the numerous new efficient European technologies which are likely to emerge in future.

### The success of European technology

The European rail traffic management system (ERTMS) is gradually being installed on high-speed and conventional lines. There are currently six railway equipment suppliers in Europe. The vitality of the European market has put EU industry at an advantage when it comes to exporting this type of product and the ERTMS is now the global industry standard. This system is also in use in non-European countries, such as Taiwan, South Korea, India and Mexico. These countries have chosen this system for its cost, its excellent performance and its important advantages in terms of reliability, enhanced line capacity and increased speeds.

## Commercial expansion

Numerous improvements and new technologies have been conceived in order to allow commercial exploitation of high-speed rail transport. These innovations are highly visible in the infrastructure, which has been modified considerably in order to cope with the constraints of high speeds. For example, ballast (the bed of stones used to support the rails) has been improved or, in some cases, replaced altogether by concrete, as in Germany. In order to guarantee better running, which is essential at high speeds, and slash maintenance costs, long welded rails were introduced as far back as the 1960s, thanks to the development of a system of elastic rail clips. These have also limited wheel wear from passing over fragile weld zones and lowered noise levels (the familiar 'di-dum' on conventional tracks), which increase as the speed increases. The points used to branch from one line or track to another have also been totally modified. For example, movable-point diamonds have been developed to stop the train 'jumping' as it passes from one track to another and the points have been elongated to limit braking during rerouting or when entering a station.

As far as rolling stock is concerned, the introduction of high speeds has basically been possible thanks to improvements to a plethora of tiny details, rather than to the introduction of radically different technologies. European engineers have improved the aerodynamics of vehicles, for example by modifying the front of the locomotives or linking carriages in order to limit friction and resultant speed losses. A great deal of work has also been done to the bogies, the running device beneath the train which contains the wheels, the axles, the transmissions and the braking devices. All this has provided more stable carriages at high speed and allowed their vibration and noise dampening properties to be improved. Finally, the additional braking systems needed at high speed, be they electric (disc brakes) as in France, or magnetic (eddy current brakes) as in Germany, have been improved considerably.

Obviously all these technical advances made by European engineers have ensured and will continue to ensure that HSLs are deployed on the continent. They also place the European rail industry at an advantage on the world market. Numerous countries are planning to develop HSLs on their territory, thereby generating a great deal of opportunity to export European expertise in this sector (cf. next paragraph).

This leading position now needs to be maintained. New operators, such as China and Korea, are now breaking into this market of the future, meaning that R & D efforts in Europe will need to be stepped up if Europe wants to maintain the leading position it currently enjoys in this sector.

## A world market

Numerous countries are developing or plan to develop HSLs and European industry is well placed to succeed in these markets. China has just ordered 100 HS trains from a European manufacturer for the 1 300 km line between Beijing and Shanghai. In Taiwan, HS trains have linked the north and south of the island (Taipei–Kaohsiung) since November 1996 and, according to estimates by the Taiwan High Speed Rail Corporation (THSRC), it is used by some 187 000 passengers a day. In South Korea, the KTX (Korean Train Express) celebrated its fifth anniversary in 2009. Based on European technology, it has already transported 170 million passengers (105 000 persons per day).

Although Asia is without doubt the continent with the most dynamic HSL sector, initiatives are also being taken on the other side of the Pacific. Brazil plans to install an HSL between the cities of Campinas, Sao Paulo and Rio de Janeiro. This project will cost an estimated EUR 13 billion and is expected to enter into service in 2014. In the United States, HSLs are expected to gain new momentum under the combined effect of the economic recovery plan and environmental policies. California has just released USD 4.7 billion under the economic recovery plan in order to develop a 1 280 km HSL network. This project will cost an estimated EUR 50 billion and should enable California to save 5.5 million tonnes of CO2 per annum.

In Africa, the first HSL is to be built in Morocco, linking Tangiers and Kenitra. The works, which are being funded with support from the EIB, are due to start in 2010 and reach completion in 2013.

# The future

## Market developments

Historic operators, such as Deutsche Bahn in Germany, Renfe in Spain, SNCF in France, Trenitalia in Italy and SJ in Sweden, play a decisive role in preserving European excellence in the HSL sector. These companies often work together through subsidiaries in order to operate international lines. Examples are:

* Thalys, set up in 1996 by the French, Belgian, German and Dutch railways to operate the HSLs between Paris, Brussels, Cologne and Amsterdam;
* Lyria, set up in 2002 by SNCF and CFF to operate highspeed links between France and Switzerland;
* Eurostar, set up in 1994 by SNCF, SNCB and British Rail (now replaced by Eurostar UK Ltd) to link Paris and Brussels to London;
* Artesia, a subsidiary of SNCF and Trenitalia, set up to operate trains between France and Italy;
* Alleo, a subsidiary of SNCF and Deutsche Bahn, set up in 2007 to operate the international trains on the East European HSL;
* Cisalpino, a company affiliated with Trenitalia and CFF, which operates all international rail links between Italy and Switzerland.

These subsidiaries, which aim to develop a European HSL network to facilitate travel within the Union, form a basic hub for the development of a European HSL network.

A European directive set 1 January 2010 as the date for the liberalisation of the international passenger rail transport market. This liberalisation will invigorate the sector by enabling existing operators to offer their services abroad and by fostering the emergence of new operators on the market. Thus airlines will be able to start operating HS trains to and from the airports which they serve. Increased competition and a diversified supply will reduce HS transport costs to passengers and help to promote more considered mobility choices.

There has already been a strong upswing in the demand for high-speed rail services and this is expected to rise even faster between now and 2020. In fact, if the supply of services remains constant, long-distance rail traffic will increase by two thirds in Europe, from 189 billion passenger-kilometres (pkm) in 1999, to 315 billion pkm in 2020. If environmental policies are tightened up, the figures should be higher (416 billion pkm in 2020, an increase of 120 % compared with 1999).

## Network expansion

According to forecasts in the TEN-T programme, the trans-European HS network (category I and II lines) should be 22 140 km long overall by 2020, compared with 9 693 km in 2008. By 2030, once the high-speed TEN-T has been completed, the network will comprise 30 750 km and traffic will have risen to 535 billion passengers per kilometre per annum.

In order to fully develop a trans-European HSL hub, several priority projects are devoted to the north-south link between networks. The south-west Europe high-speed rail axis will link the Iberian peninsula to the rest of Europe in a fully interoperable network. The vital north-south corridor through the Alps (Berlin–Verona–Milan–Bologna–Naples–Messina–Palermo axis) will link major German and Italian cities. The Lyon-Trieste–Divaca/Koper–Divaca–Ljubljana–Budapest–Ukrainian border axis, which crosses this corridor at right angles, will be able to absorb some of the constantly increasing traffic between the south-east, the centre and the south-west of Europe. Network extension projects are also being planned in Poland, Sweden and the United Kingdom. Poland has already announced a new HSL, linked to the European network, between Warsaw, Wrocław and Poznan.

The network will also need to be extended to third countries, in order to cope with the increase in passenger and freight volumes forecast for between now and 2020. Thus, Russia will be linked to Finland by a 415 km upgraded line, which will provide the first fast rail link between Russia and the EU.

The number of passengers between Helsinki and St Petersburg is expected to reach 481 200 in 2014, compared with 229 600 in 2007, while speeds will increase from 160 km/h to 220 km/h. This will reduce the journey time between the two cities from 5 hours 30 minutes to 3 hours 30 minutes.

To the south-east, Turkish State Railways are receiving EU support to develop their own high-speed network. The first 200 km section linking Ankara to Eskisehir was opened in March 2009, reducing the journey time between the two cities from 3 hours to 1 hour 20 minutes. In time, this line will extend as far as Istanbul (533 km), cutting the journey time from Ankara to Istanbul from 6 hours 30 minutes to 3 hours.

Another three lines are already being planned: Ankara–Konya, Ankara–Sivas and Istanbul–Bulgarian frontier. The first phase cost EUR 628 million. It is planned to invest USD 20 billion in the Turkish railways over the next 15 years.

Fighting climate change, by developing a trans-European HSL network, is one of the European Union's main objectives.

High-speed passenger transport will allow high levels of mobility to be maintained, while guaranteeing the sustainability of the European transport system.

White Paper on transport - Roadmap to a single European transport area - Towards a competitive and resource-efficient transport system

# Preparing the european transport area for the future

Transport is fundamental to our economy and society. Mobility is vital for the internal market and for the quality of life of citizens as they enjoy their freedom to travel. Transport enables economic growth and job creation: it must be sustainable in the light of the new challenges we face. Transport is global, so effective action requires strong international cooperation.

The future prosperity of our continent will depend on the ability of all of its regions to remain fully and competitively integrated in the world economy. Efficient transport is vital in making this happen.

European transport is at a crossroads. Old challenges remain but new have come.

A lot needs to be done to complete the internal market for transport, where considerable bottlenecks and other barriers remain. We need to readdress these issues - how to better respond to the desire of our citizens to travel, and the needs of our economy to transport goods while anticipating resource and environmental constraints. The transport systems of the eastern and western parts of Europe must be united to fully reflect the transport needs of almost the whole continent and our 500 million citizens.

Oil will become scarcer in future decades, sourced increasingly from uncertain supplies. As the International Energy Agency has recently pointed out, the less successful the world is in decarbonising, the greater will be the oil price increase. In 2010, the oil import bill was around 210 billion EUR for the EU. If we do not address this oil dependence, people's ability to travel - and our economic security - could be severely impacted with dire consequences on inflation, trade balance and the overall competitiveness of the EU economy.

At the same time, the EU has called for, and the international community agreed on, the need to drastically reduce world greenhouse gas (GHG) emissions, with the goal of limiting climate change below 2 grades. Overall, the EU needs to reduce emissions by 80–95 % below 1990 levels by 2050, in the context of the necessary reductions of the developed countries as a group, in order to reach this goal. Commission analysis shows that while deeper cuts can be achieved in other sectors of the economy, a reduction of at least 60 % of GHGs by 2050 with respect to 1990 is required from the transport sector, which is a significant and still growing source of GHGs. By 2030, the goal for transport will be to reduce GHG emissions to around 20 % below their 2008 level. Given the substantial increase in transport emissions over the past two decades, this would still put them 8 % above the 1990 level.

Since the first big oil crisis 40 years ago - despite technical progress, potential for cost-effective energy efficiency improvements and policy efforts - the transport system has not fundamentally changed. Transport has become more energy efficient, but EU transport still depends on oil and oil products for 96 % of its energy needs. Transport has become cleaner, but increased volumes mean it remains a major source of noise and local air pollution.

New technologies for vehicles and traffic management will be key to lower transport emissions in the EU as in the rest of the world. The race for sustainable mobility is a global one. Delayed action and timid introduction of new technologies could condemn the EU transport industry to irreversible decline. The EU's transport sector faces growing competition in fast developing world transport markets.

Many European companies are world leaders in infrastructure, logistics, traffic management systems and manufacturing of transport equipment - but as other world regions are launching huge, ambitious transport modernisation and infrastructure investment programmes, it is crucial that European transport continues to develop and invest to maintain its competitive position.

Infrastructure shapes mobility. No major change in transport will be possible without the support of an adequate network and more intelligence in using it. Overall, transport infrastructure investments have a positive impact on economic growth, create wealth and jobs, and enhance trade, geographical accessibility and the mobility of people. It has to be planned in a way that maximises positive impact on economic growth and minimises negative impact on the environment.

Congestion is a major concern, in particular on the roads and in the sky, and compromises accessibility. In addition, transport infrastructure is unequally developed in the eastern and western parts of the EU which need to be brought together. There is increased pressure on public resources for infrastructure funding and a new approach to funding and pricing is needed.

Since the 2001 White Paper on transport, a lot has been achieved. Further market opening has taken place in aviation, road and partly in rail transport. The single European sky has been successfully launched. The safety and security of transport across all modes has increased. New rules on working conditions and on passenger rights have been adopted. Trans-European transport networks (financed through TEN-T, Structural Funds and the Cohesion Fund) have contributed to territorial cohesion and the building of high-speed railway lines. International ties and cooperation have been strengthened. A lot has also been done to enhance transport's environmental performance.

Still, the transport system is not sustainable. Looking 40 years ahead, it is clear that transport cannot develop along the same path. If we stick to the 'business as usual' approach, the oil dependence of transport might still be little below 90 %, with renewable energy sources only marginally exceeding the 10 % target set for 2020. CO2 emissions from transport would remain one third higher than their 1990 level by 2050. Congestion costs will increase by about 50 % by 2050. The accessibility gap between central and peripheral areas will widen. The social costs of accidents and noise would continue to increase.

Building on the lessons learnt, this roadmap takes a global look at developments in the transport sector, at its future challenges and at the policy initiatives that need to be considered. The Commission's vision of future transport is presented in Part 2. Key measures to achieve it are outlined in Part 3, summarised in the annex, and described in more detail in the accompanying staff working document.

# A vision for a competitive and sustainable transport system

## Growing transport and supporting mobility while reaching the 60 % emission reduction target

There is a large pay-off in taking decisive policy action. The transport industry in itself represents an important part of the economy: in the EU it directly employs around 10 million people and accounts for about 5 % of GDP.

The EU and governments need to provide clarity on the future policy frameworks (relying to the greatest extent possible on market-based mechanisms) for manufacturers and industry so that they are able to plan investments. Coherence at EU level is vital - a situation where (for example) one Member State opted exclusively for electric cars and another only for biofuels would destroy the concept of free travel across Europe.

The challenge is to break the transport system's dependence on oil without sacrificing its efficiency and compromising mobility. In line with the flagship initiative 'Resource-efficient Europe' set up in the Europe 2020 strategy and the new 'Energy efficiency plan 2011', the paramount goal of European transport policy is to help establish a system that underpins European economic progress, enhances competitiveness and offers high-quality mobility services while using resources more efficiently. In practice, transport has to use less and cleaner energy, better exploit a modern infrastructure and reduce its negative impact on the environment and key natural assets like water, land and ecosystems.

### Curbing mobility is not an option

New transport patterns must emerge, according to which larger volumes of freight and greater numbers of travellers are carried jointly to their destination by the most efficient (combination of ) modes. Individual transport is preferably used for the final miles of the journey and performed with clean vehicles. Information technology provides for simpler and more reliable transfers. Transport users pay for the full costs of transport in exchange for less congestion, more information, better service and more safety. Future development must rely on a number of strands:

* improving the energy efficiency performance of vehicles across all modes; developing and deploying sustainable fuels and propulsion systems;
* optimising the performance of multimodal logistic chains, including by making greater use of inherently more resource-efficient modes, where other technological innovations may be insufficient (e.g. long-distance freight);
* using transport and infrastructure more efficiently through use of improved traffic management and information systems (e.g. ITS, SESAR, ERTMS, SafeSeaNet, RIS), advanced logistic and market measures such as full development of an integrated European railway market, removal of restrictions on cabotage, abolition of barriers to short sea shipping, undistorted pricing, etc.

Action cannot be delayed. Infrastructure takes many years to plan, build and equip - and trains, planes and ships last for decades - the choices we make today will determine transport in 2050. We need to act on a European level to ensure the transformation of transport is defined together with our partners rather than determined elsewhere in the world.

Solving the problems identified above means meeting very difficult goals by 2050 - and challenging ones by 2020–30 to ensure we are moving in the right direction. The scope for changing the way transport operates varies across transport segments, as the technological options for each segment are different. In the following, the Commission's vision therefore considers three major transport segments: medium distances, long distances and urban transport. Delivery of this will rely on many actors - the EU, Member States, regions, cities, but also industry, social partners and citizens will have their part to play.

## An efficient core network for multimodal intercity travel and transport

In the intermediate distances, new technologies are less mature and modal choices are fewer than in the city. However, this is where EU action can have the most immediate impact (fewer constraints from subsidiarity or international agreements). More resource-efficient vehicles and cleaner fuels are unlikely to achieve on their own the necessary cuts in emissions and they would not solve the problem of congestion. They need to be accompanied by the consolidation of large volumes for transfers over long distances. This implies greater use of buses and coaches, rail and air transport for passengers and, for freight, multimodal solutions relying on waterborne and rail modes for long hauls.

Better modal choices will result from greater integration of the modal networks: airports, ports, railway, metro and bus stations should increasingly be linked and transformed into multimodal connection platforms for passengers. Online information and electronic booking and payment systems integrating all means of transport should facilitate multimodal travel. An appropriate set of passengers' rights has to accompany the wider use of collective modes.

Freight shipments over short and medium distances (below some 300 km) will to a considerable extent remain on trucks. It is therefore important, besides encouraging alternative transport solutions (rail, waterborne transport), to improve truck efficiency, via the development and the uptake of new engines and cleaner fuels, the use of intelligent transport systems and further measures to enhance market mechanisms.

In longer distances, options for road decarbonisation are more limited, and freight multimodality has to become economically attractive for shippers. Efficient co-modality is needed. The EU needs specially developed freight corridors optimised in terms of energy use and emissions, minimising environmental impacts, but also attractive for their reliability, limited congestion and low operating and administrative costs.

Rail, especially for freight, is sometimes seen as an unattractive mode. But examples in some Member States prove that it can offer quality service. The challenge is to ensure structural change to enable rail to compete effectively and take a significantly greater proportion of medium- and long-distance freight (and also passengers - see below). Considerable investment will be needed to expand or to upgrade the capacity of the rail network. New rolling stock with silent brakes and automatic couplings should gradually be introduced.

On the coasts, more and efficient entry points into European markets are needed, avoiding unnecessary traffic crossing Europe. Seaports have a major role as logistics centres and require efficient hinterland connections. Their development is vital to handle increased volumes of freight both by short sea shipping within the EU and with the rest of the world. Inland waterways, where unused potential exists, have to play an increasing role in particular in moving goods to the hinterland and in linking the European seas.

## A global level playing field for long-distance travel and intercontinental freight

The maritime and aviation sectors are inherently global. Improving the efficiency of aircraft and traffic management operations has to be pursued in the air sector. It will secure a competitive advantage on top of reducing emissions; attention is needed however to avoid imposing excessive burdens on EU operations which could compromise the EU role as a 'global aviation hub'. Airport capacity needs to be optimised and, where necessary, increased to face growing demand for travel to and from third countries and areas of Europe otherwise poorly connected, which could result in a more than doubling of EU air transport activities by 2050.

In other cases, (high-speed) rail should absorb much medium-distance traffic. The EU aviation industry should become a front-runner in the use of low-carbon fuels to reach the 2050 target.

In maritime, the need for a global level playing field is equally pronounced. The EU should strive - in cooperation with IMO and other international organisations - for the universal application and enforcement of high standards of safety, security, environmental protection and working conditions, and for eliminating piracy. The environmental record of shipping can and must be improved by both technology and better fuels and operations: overall, the EU CO2 emissions from maritime transport should be cut by 40 % (if feasible 50 %) by 2050 compared to 2005 levels.

## Clean urban transport and commuting

In cities, switching to cleaner transport is facilitated by the lower requirements for vehicle range and higher population density. Public transport choices are more widely available, as well as the option of walking and cycling. Cities suffer most from congestion, poor air quality and noise exposure. Urban transport is responsible for about a quarter of CO2 emissions from transport, and 69 % of road accidents occur in cities. The gradual phasing out of 'conventionally fuelled' vehicles from the urban environment is a major contribution to significant reduction of oil dependence, greenhouse gas emissions and local air and noise pollution. It will have to be complemented by the development of appropriate fuelling/charging infrastructure for new vehicles.

A higher share of travel by collective transport, combined with minimum service obligations, will allow for increasing the density and frequency of service, thereby generating a virtuous circle for public transport modes. Demand management and land-use planning can lower traffic volumes. Facilitating walking and cycling should become an integral part of urban mobility and infrastructure design.

The use of smaller, lighter and more specialised road passenger vehicles must be encouraged. Large fleets of urban buses, taxis and delivery vans are particularly suitable for the introduction of alternative propulsion systems and fuels. These could make a substantial contribution in reducing the carbon intensity of urban transport while providing a test bed for new technologies and opportunity for early market deployment. Road pricing and the removal of distortions in taxation can also assist in encouraging the use of public transport and the gradual introduction of alternative propulsion.

The interface between long-distance and last-mile freight transport should be organised more efficiently. The aim is to limit individual deliveries, the most 'inefficient' part of the journey, to the shortest possible route. The use of intelligent transport systems contributes to real-time traffic management, reducing delivery times and congestion for last-mile distribution. This could be performed with low emission urban trucks. The use of electric, hydrogen and hybrid technologies would not only reduce air emissions, but also noise, allowing a greater portion of freight transport within the urban areas to take place at night time. This would ease the problem of road congestion during morning and afternoon peak hours.

# The strategy - what needs to be done

Implementing the above vision requires an efficient framework for transport users and operators, an early deployment of new technologies and the development of adequate infrastructure.

* Obstacles to a smooth functioning of and effective competition in the internal market persist. The objective for the next decade is to create a genuine single European transport area by eliminating all residual barriers between modes and national systems, easing the process of integration and facilitating the emergence of multinational and multimodal operators. A vigilant enforcement of the competition rules across all transport modes will complement the Commission's actions in this area. A higher degree of convergence and enforcement of social, safety, security and environmental rules, minimum service standards and users' rights must be an integral part of this strategy, in order to avoid tensions and distortions.
* Innovation is essential for this strategy. EU research needs to address the full cycle of research, innovation and deployment in an integrated way through focusing on the most promising technologies and bringing together all actors involved. Innovation can also play a role in promoting more sustainable behaviour.
* The efforts towards a more competitive and sustainable transport system need to include a reflection on the required characteristics of the network and must foresee adequate investments: EU transport infrastructure policy needs a common vision and sufficient resources. The costs of transport should be reflected in its price in an undistorted way.

A list of initiatives foreseen is provided in the annex to this communication, the Commission working document that accompanies the communication provides further details.

## A single European transport area

A single European transport area should ease the movements of citizens and freight, reduce costs and enhance the sustainability of European transport. The single European sky needs to be implemented as foreseen, and already in 2011 the Commission will address the capacity and quality of airports. The area where bottlenecks are still most evident is the internal market for rail services, which must be completed as a priority in order to achieve a single European railway area. This includes the abolishment of technical, administrative and legal obstacles which still impede entry to national railway markets. A further integration of the road freight market will render road transport more efficient and competitive. For maritime transport, a 'blue belt' in the seas around Europe shall simplify the formalities for ships travelling between EU ports, and a suitable framework must be established to take care of European tasks for inland waterway transport. Market access to ports needs to be further improved.

Market opening needs to go hand in hand with quality jobs and working conditions, as human resources are a crucial component of any high-quality transport system. It is also widely known that labour and skill shortages will become a serious concern for transport in the future. It will be important to align the competitiveness and the social agenda, building on social dialogue, in order to prevent social conflicts, which have proved to cause significant economic losses in a number of sectors, most importantly aviation.

Transport security is high on the EU's agenda. The EU's comprehensive approach of policy, legislation and monitoring of air and maritime transport security should be further consolidated and strengthened through cooperation with major international partners. For passenger security, screening methods need to be improved in order to ensure high security levels with minimum hassle. A risk-based approach to the security of cargo originating outside the EU should be considered. There is also a need to find an appropriate European approach to land transport security in those areas where EU action has an added value.

Setting the framework for safe transport is essential for the European citizen. A European strategy for civil aviation safety will be developed, which includes adaptation to new technologies and, obviously, international cooperation with main partners. In maritime transport, passenger ship safety needs to be proactively addressed. The vessel traffic monitoring and information system SafeSeaNet will become the core of all relevant maritime information tools supporting maritime transport safety and security, as well as the protection of the environment from ship-source pollution. It will thus provide the essential contribution to the establishment of a common information-sharing environment for the surveillance of the EU maritime domain and support the creation of a common maritime space. For rail transport, the harmonisation and supervision of safety certification are essential in a single European railway area. In these three transport sectors, the European aviation, maritime and rail safety agencies which were set up in the last decade play an indispensable role.

Even though the number of road fatalities in the EU was almost halved in the past decade, 34 500 people were killed on EU roads in 2009. Initiatives in the area of technology, enforcement, education and particular attention to vulnerable road users will be key to drastically reduce these losses of life even further.

The quality, accessibility and reliability of transport services will gain increasing importance in the coming years, inter alia due to the ageing of the population and the need to promote public transport. Attractive frequencies, comfort, easy access, reliability of services and intermodal integration are the main characteristics of service quality. The availability of information over travelling time and routing alternatives is equally relevant to ensure seamless door-to-door mobility, both for passengers and for freight.

The EU has already established a comprehensive set of passengers' rights which will be further consolidated. Following the ash cloud crisis and the experience of extreme weather events in 2010, it has become evident that mobility continuity plans may be required to preserve the mobility of passengers and goods in a crisis situation. These events also demonstrated the need for the increased resilience of the transport system through scenario development and disaster planning.

## Innovating for the future - technology and behaviour

'Growing out of oil' will not be possible relying on a single technological solution. It requires a new concept of mobility, supported by a cluster of new technologies as well as more sustainable behaviour.

Technological innovation can achieve a faster and cheaper transition to a more efficient and sustainable European transport system by acting on three main factors: vehicles' efficiency through new engines, materials and design; cleaner energy use through new fuels and propulsion systems; better use of network and safer and more secure operations through information and communication systems. The synergies with other sustainability objectives such as the reduction of oil dependence, the competitiveness of Europe's automotive industry as well as health benefits, especially improved air quality in cities, make a compelling case for the EU to step up its efforts to accelerate the development and early deployment of clean vehicles.

Transport research and innovation policy should increasingly support in a coherent way the development and deployment of the key technologies needed to develop the EU transport system into a modern, efficient and user-friendly system. To be more effective, technological research needs to be complemented with a systems approach, taking care of infrastructure and regulatory requirements, coordination of multiple actors and large demonstration projects to encourage market take-up. The Commission will devise an innovation and deployment strategy for the transport sector, in close cooperation with the strategic energy technology plan (SET-plan), identifying appropriate governance and financing instruments, in order to ensure a rapid deployment of research results.

This will also concern the deployment of smart mobility systems developed through EU-funded research, such as the air traffic management system of the future (SESAR), the European rail traffic management system (ERTMS) and rail information systems, maritime surveillance systems (SafeSeaNet), river information services (RIS), intelligent transport systems (ITS) and interoperable interconnected solutions for the next generation of multimodal transport management and information systems (including for charging). It will also require an investment plan for new navigation, traffic monitoring and communication services. Of equal importance is research and innovation in the field of vehicle propulsion technologies and alternative fuels (green car initiative, clean sky).

Innovation and deployment need to be supported by regulatory framework conditions. Protection of privacy and personal data will have to develop in parallel with the wider use of information technology tools.

Standardisation and interoperability requirements, including at international level, will avoid technological fragmentation and enable European businesses to fully benefit from the entire European transport market, and to create worldwide market opportunities.

New mobility concepts cannot be imposed. To promote more sustainable behaviour, better mobility planning has to be actively encouraged. Information on all modes of transport, both for travel and freight, on possibilities for their combined use and on their environmental impact, will need to be widely available. Smart intermodal ticketing, with common EU standards that respect EU competition rules is vital. This relates not only to passenger transport but also freight, where better electronic route planning across modes, an adapted legal environment (intermodal freight documentation, insurance, liability) and real-time delivery information also for smaller consignments is needed. ICT has also the potential for satisfying certain accessibility needs without additional mobility.

In the urban context, a mixed strategy involving land use planning, pricing schemes, efficient public transport services and infrastructure for non-motorised modes and charging/refueling of clean vehicles is needed to reduce congestion and emissions. Cities above a certain size should be encouraged to develop urban mobility plans, bringing all those elements together. Urban mobility plans should be fully aligned with integrated urban development plans. An EU-wide framework will be needed in order to make interurban and urban road user charging schemes interoperable.

## Modern infrastructure, smart pricing and funding

### A European mobility network

Europe needs a 'core network' of corridors, carrying large and consolidated volumes of freight and passengers traffic with high efficiency and low emissions, thanks to the extensive use of more efficient modes in multimodal combinations and the wide application of advanced technologies and supply infrastructure for clean fuels.

Despite EU enlargement, large divergences in terms of transport infrastructure remain between eastern and western parts of the EU, which need to be tackled. The European continent needs to be united also in terms of infrastructure.

Within this core network, information technology tools should be widely deployed to simplify administrative procedures, provide for cargo tracking and tracing, and optimise schedules and traffic flows (e-Freight). Their uptake should be encouraged by requiring their deployment on TEN-T infrastructure and a gradual integration of modal systems.

The core network must ensure efficient multimodal links between the EU capitals and other main cities, ports, airports and key land border crossings, as well as other main economic centres. It should focus on the completion of missing links - mainly cross-border sections and bottlenecks/bypasses - on the upgrading of existing infrastructure and on the development of multimodal terminals at sea and river ports and on city logistic consolidation centres. Better rail/airport connections must be devised for long-distance travel. The 'motorways of the sea' will be the maritime dimension of the core network.

The selection of projects eligible for EU funding must reflect this vision and put greater emphasis on European added value. Co-funded projects should equally reflect the need for infrastructure that minimises the impact on the environment, that is resilient to the possible impact of climate change and that improves the safety and security of users.

A well-performing transport network requires substantial resources. The cost of EU infrastructure development to match the demand for transport has been estimated at over EUR 1.5 trillion for 2010–30. The completion of the TEN-T network requires about EUR 550 billion until 2020 out of which some EUR 215 billion can be referred to the removal of the main bottlenecks. This does not include investment in vehicles, equipment and charging infrastructure which may require an additional trillion to achieve the emission reduction goals for the transport system.

Diversified sources of finance both from public and private sources are required. Better coordination of the Cohesion and Structural Funds with transport policy objectives is needed, and Member States need to ensure that sufficient national funding is available in their budgetary planning, as well as sufficient project planning and implementation capacities. Other sources of funding to be considered include schemes for the internalisation of external costs and infrastructure-use charges, which could create additional revenue streams making infrastructure investments more attractive to private capital.

Unlocking the potential of private finances equally requires an improved regulatory framework and innovative financial instruments. Project assessment and authorisation must be carried out in an efficient and transparent manner that limits time, cost and uncertainty. New financing instruments, for example the EU project bonds initiative, can support private–public partnerships (PPPs) financing on a bigger scale. Getting prices right and avoiding distortions

Price signals play a crucial role in many decisions that have long-lasting effects on the transport system. Transport charges and taxes must be restructured in the direction of wider application of the 'polluter pays' and 'user pays' principles. They should underpin transport's role in promoting European competitiveness and cohesion objectives, while the overall burden for the sector should reflect the total costs of transport including infrastructure and external costs. Wider socioeconomic benefits and positive externalities justify some level of public funding but, in the future, transport users are likely to pay for a higher proportion of the costs than today. It is important that correct and consistent monetary incentives are given to users, operators and investors.

The internalisation of externalities, the elimination of tax distortions and unjustified subsidies and free and undistorted competition are therefore part of the effort to align market choices with sustainability needs (and to reflect the economic costs of 'non-sustainability'). They are also necessary to establish a level playing field between modes which are in direct competition.

As regards GHG emissions, two main market-based instruments are being used: energy taxation and emission trading systems. Taxation is currently applied to fuels used in land transport, while the ETS applies to electricity use and, as of 2012, to aviation. The revision of the energy taxation directive will be an opportunity to ensure better coherence between the two instruments. At the same time, the EU urges a decision in IMO on a global instrument to be applied to maritime transport, where climate change costs are currently not internalised.

The cost of local externalities such as noise, air pollution and congestion could be internalised through charging for the use of infrastructure. The Commission's recent proposal to amend the so-called 'Eurovignette directive' represents a first step towards a higher degree of internalisation of costs generated by heavy goods vehicles, but disparities in national road charging policies will remain. Further action will examine the gradual phasing in of a mandatory harmonised internalisation system for commercial vehicles on the entire interurban network, putting an end to the current situation whereby international hauliers need the Eurovignette, five national vignettes and eight different tags and tolling contracts to drive unhindered on Europe's tolled roads.

For passenger cars, road charges are increasingly considered as an alternative way to generate revenue and influence traffic and travel behaviour. The Commission will develop guidelines for the application of internalisation charges to all vehicles and for all main externalities. The long-term goal is to apply user charges to all vehicles and on the whole network to reflect at least the maintenance cost of infrastructure, congestion, air and noise pollution.

In parallel, and before 2020, the Commission will develop a common approach for the internalisation of noise and local pollution costs on the whole rail network.

Many branches of transport are treated favourably in terms of taxation, in comparison to the rest of the economy: tax treatment of company cars, VAT and energy tax exemptions on international sea and air transport, etc. Generally, these arrangements provide conflicting incentives with respect to the efforts to improve the efficiency of the transport system and reduce its external costs. The Commission will examine proposals to achieve greater consistency between the various elements of transport taxation and to encourage the rapid introduction of clean vehicles.

## The external dimension

Transport is fundamentally international. Because of this, most actions in the roadmap are linked to challenges related to the development of transport beyond the EU borders. Opening up third-country markets in transport services, products and investments continues to have high priority. Transport is therefore included in all our trade negotiations (WTO, regional and bilateral). Flexible strategies will be adopted to ensure the EU's role as a standard setter in the transport field.

To that end, the Commission will focus on the following areas of actions.

* Extend internal market rules through work in international organisations (ICAO, IMO, OTIF, OSJD, UNECE, the international river commissions, etc.) and where relevant attain full EU membership. Promote European safety, security, privacy and environmental standards worldwide through bilateral and multilateral cooperation. Reinforce the transport dialogue with main partners.
* Extend our transport and infrastructure policy to our immediate neighbours, including in the preparation of mobility continuity plans, to deliver closer market integration. A cooperation framework similar to on the Western Balkan Transport Treaty could be used to extend EU rules to other neighbouring countries. Complete the European common aviation area of 58 countries and 1 billion inhabitants. Cooperate with the Mediterranean partners in the implementation of a Mediterranean maritime strategy to enhance maritime safety, security and surveillance. Promote SESAR, ERTMS and ITS technology deployment in the world, and establish research and innovation partnerships also at international level.
* Promote our approach globally: opening up transport markets to free and undistorted competition and environmentally sustainable solutions. Continue to aim at greater market access in transport in all relevant international negotiations.

# Conclusion

A transformation of the European transport system will only be possible through a combination of manifold initiatives at all levels. The various actions and measures indicated in this roadmap will be further elaborated.

The Commission will prepare appropriate legislative proposals in the next decade with key initiatives to be put forward during the current mandate. Each of its proposals will be preceded by a thorough impact assessment, considering EU added value and subsidiarity aspects. The Commission will ensure its actions increase the competitiveness of transport while delivering the minimum 60 % reduction of GHG emissions from transport needed by 2050, orienting itself along the 10 goals which should be seen as benchmarks.

The Commission invites the European Parliament and the Council to endorse this 'Roadmap to a single European transport area - Towards a competitive and resource-efficient transport system' and the attached list of actions.