



## **European Rail Research Advisory Council**

*To: Mr. Fotis Karamitsos  
DG MOVE  
European Commission  
B-1049 BRUXELLES*

Date: February, 14, 2011

*Cc: M Rommerts, C. Schubert, P. Crawley, L. Breslin*

### **Answer to the questionnaire for STTP Stakeholders' Hearing on Rail Transport.**

ERRAC comprises 45 representatives from each of the major European rail research stakeholders: manufacturers, operators, infrastructure managers, the European Commission, EU Members States, academics and users' groups, ERRAC covers all forms of rail transport: from conventional, high speed and freight applications to urban and regional services. ERRAC is currently chaired by me, Professor Andrew McNaughton (Network Rail). The Vice-Chairmen are Dan Otteborn (Bombardier Transportation) and Manuel Pereira (University of Lisbon).

For more information, we invite you to visit our Website: [www.errac.org](http://www.errac.org)  
We hope this contribution will be of interest and help to the European Commission.  
ERRAC remains at your disposal for any further information you may need.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'A. McNaughton', is written over a light blue horizontal line.

**Prof Andrew McNaughton  
ERRAC Chairman**

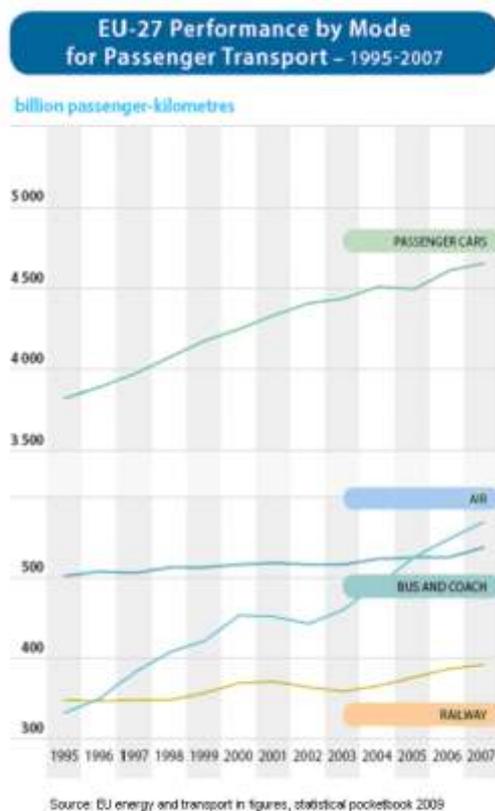
## 2. GENERAL QUESTIONS

### 2.1. Transport Vision and Activities

#### 2.1.1. Current state of play within transport?

Indicate: market readiness/penetration of the different technologies within the activity area for each mode or cross-modal issues; on-going or planned public, public-private or private initiatives relevant for the STTP; type and scale of initiatives at which level -International/EU/MS/Regions

Transport plays a vital role within the economy and society: transport systems are of crucial importance for the competitiveness of any nation or regional economy as well as for the mobility of its citizens. However, while they bring significant benefits to society there are also a substantial cost. **The current growth of the transport sector is far from being sustainable.**



This graph clearly shows an increase in overall passenger numbers with cars and aviation attracting most of the additional volume. However, this also represents a clear opportunity for modal shift to rail in the regional and long distance travel sectors. Sustainability and the ability to bring regional cohesion (particularly improved connectivity and faster journey times) are some of the key benefits that rail can deliver most effectively.

Rail has the capability to play a key role in any sustainable transport system by offering efficient transport with low environmental impact, and these strengths need to be articulated in the political decision-making process as well as promoted in society. **Through the use of**



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**mechanisms such as fairer pricing and the internalisation of external costs but also any other European initiative promoting the competitiveness of the rail sector, modal shift to rail and innovative co-modality concepts become more achievable and offer sustainable solutions for the various challenges in the transport sector. (e.g. the Eurovignette could contribute towards attaining a “level playing field”)**

Rail already has a strong focus on how continuously to improve its sustainability performance. But of course rail is not the only transport mode working on new solutions to reduce its ‘whole-life’ environmental impact from construction, through to operations and end-of-life. Other modes continue to seek improvements to their environmental performance, and **rail manufacturers, infrastructure managers, and operators all have to put strong emphasis on working together and improving performance in order to remain the least polluting major mode of transport. Thus, a long term strategic approach is needed:** one that will deliver an efficient answer to the challenges of the future and that allows a solid base on which to build.

In terms of European initiatives for Research and Development the rail stakeholders decided to team up in 2001 setting to themselves two ambitious goals:

- embracing the 2001 Transport White Paper objectives
- creating a single European body able to contribute to the revitalisation and the competitiveness of the European rail sector through more innovation and more co-ordinated research activities.

ERRAC is the European Technology Platform gathering at European level all the rail stakeholders involved in the research and development of rail products.

ERRAC objective have focused on enhancing collaborative European rail research by:

- Building consensus among stakeholders
- Improving synergies between EU, national and private rail research (identify priorities)
- Strengthening and re-organizing research and development efforts
- Effective pooling of human and material resources
- Launching ambitious co-operative research plans

This initiative created the basis for a successful European cooperation on pre-competitive R&D for rail through the various calls of the EU Framework Programme.

But the European rail industry faces increasing competition from the industries of other countries, in particular China, Japan and South Korea. Massive investments and state aid combined with a lax protection of intellectual property rights allowed Chinese companies to catch up with European companies very rapidly. They are now starting to challenge European companies internationally. The European rail industry, however, will not be able to compete with rivals from developing countries on the basis of price. **Only continuous innovation and quality improvement can enable European companies to compete successfully.**

### **2.1.2. Likely evolution of transport?**

Indicate: major trends in the transport sector (technology and actors); evolution of transport needs (volume and quality); likelihood of structural changes as a result of new business models, globalisation, competition; influence of the market structure on future market potential; possible effects of legislation etc

The coming years and decades will see some developments that will heavily impact European societies and economies. This will have its corresponding effects on the transport and the rail sector in particular.

#### Rail indicators

ERRAC has made a comprehensive list of the present state of rail transport in Europe of relevance to future rail technology, and has identified a number of megatrends important for the use and development of the rail sector:

##### **Present situation – “Where we are now”**

- Following the liberalization of the European rail system, the number of independent actors has increased significantly; many of the new actors are private commercially-driven entities.
- Simultaneously the former state monopolise have focussed increasingly on improving their business performance (profitability/less subsidies) has also increased among.
- Competition for funds is increasing continually.
- Increased competition within the sector has increased the customer focus leading to an end of the constant long term loss of market share, except in the former east European countries where market share for rail was exceptionally high during the Soviet time.
- In the long distance passenger market the market share has been rather stable and many good signs of improvement are visible particularly in the high speed field.
- The urban and suburban passenger traffic is growing with renewed focus on tramways in many cities.
- The freight market is very fragmented and competitive with generally low profitability and very low investment outside what is required for maintaining the day to day business.
- The sector is very much dependent on political support for financing and the planning horizons are often very long.
- The European rail equipment manufacturers account for about 70% of the whole world market.
- The sector is for many reasons relatively slow to adopt new ideas and technologies
- It is difficult to secure market-uptake for EU funded research.
- The amount of information and regulation is very vast.
- The big companies have generally a sector-oriented approach but new R&D cooperation activities among them are emerging.
- The concentration of freight companies into big international logistic players.
- The industry improvements in engaging with customers at an early stage of the products development.

##### **ERRAC Mega-trends**

- The overall need for transport, both passenger and freight will continue to grow.
- The focus on environmental issue will continue to grow
- Europe has an ageing society
- Uncertainty about immigration policies and new EU Member States accession
- The competition for public funds will increase, public funds will not be sufficient for all needs. Loss making entities will face increasing difficulties.
- Knowledge will increase and the knowledge distribution worldwide will be faster
- Limitations of the infrastructure



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- Work force skills will become scarcer and people unwilling to work on antisocial hours
- Consumer expectation will be more and more demanding: i.e. the demand for instant information through IT systems will increase
- Globalization will continue
- Climate change will continue
- The world economic centre will gradually split around regional areas (China and India will play a bigger role)
- Production will still be done on a local base
- The mobility of the workforce will increase, less people will make their entire career with one company or one sector
- The cost of energy will increase
- Cars and heavy goods vehicle will progressively become smarter and cleaner
- Power regeneration and energy efficiency will improve
- Higher integration of different transport modes to respond to a comprehensive mobility demand by users
- Influence of political decision (stronger or weaker?)
- Urbanisation and metropolitan areas development will continue and the rail metro area will become wider

The European rail industry identified and published in the UNIFE World Rail Market Study the following eight megatrends that are already or will be impacting the rail industry within the next 10 years:

- Customisation
- Urbanisation
- Increased mobility
- Energy Scarcity
- Environment concerns
- Increased political support
- Rise of RDE (Rapidly Developing Economies) markets
- Supremacy of RDE (Rapidly Developing Economies) challengers

### **2.1.3. Key technology penetration targets (2020, 2030, and 2050)? What are the main assumptions underlying these estimates? What are the main barriers to overcome to achieve them?**

Indicate: main constraints and showstoppers, risks, needs for technological breakthroughs, resource/feedstock availability, consequences for the current infrastructure, etc

If long distance passenger services are to increase their competitive advantage, they must deliver increased customer satisfaction: they must be attractive, efficient and affordable. They must integrate with local services, including other modes, to provide ‘seamless’ end-to-end journeys. This is vital if we are to meet ever more-demanding sustainability goals and to promote sustainable economic growth and the integration of Europe’s regions.

For shorter journeys, more and more large and medium-sized European cities are introducing extending metro and/or light rail systems. These represent a very large –and growing– market in Europe and worldwide. In Europe, the systems are mostly operated under public service contracts. In that regard, integration between rail modes and road based public transport modes (buses, shared taxis...) (and sometimes also waterborne services like city ferries) will



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be a key for success. “Seamless” public transport, improved cost effectiveness and increased attractiveness will be the most important objectives through an increased accessibility, increased regularity or punctuality, increased comfort and security, better information before and during travel within vehicles, stations and connecting spaces, and reduced and guaranteed door-to-door travel time.

Concerning the developments of the suburban and regional rail services based on conventional (interoperable) rail systems, two situations have to be faced:

- in the remote low density areas, regional rail services have to be operated and designed in order to make them attractive enough to avoid them being withdrawn (e.g. through the creation of new regional train services or of tram-train services, as it has been successfully achieved in Western Europe in recent years);
- in the densely populated regions and/or around the larger cities, suburban and regional rail systems need to be further extended and improved in terms of frequency, user-friendliness, reliability, seamless ticketing and pre-trip, during trip and after trip information. Co-modality with other transport modes – and especially urban public transport - will need to be better co-ordinated.

Moreover, technology will need to enable the railways to guarantee a high level of perceived personal security in these ‘open’ systems.

For freight deliveries, rail transportation of today is often reduced to only a fractional part of the logistics chain. It is, therefore, imperative that European freight mobility systems and logistic chains are developed from a co-modal transport perspective where the ultimate competitiveness results from the combination of the best performance that each mode is capable of delivering.

Today Europe is still relying on road based distribution. Road transport accounts for over 70% of land transport inside the EU. Road congestion is growing to unacceptable levels. The congestion cost is often underestimated, but is stated as around 0.5% -1% of EU GDP. Statistics do not take into consideration both the remedial measures necessary for maintaining logistics chain reliability and the external costs for the citizens. What is required is a co-modal approach where each mode can be developed in a sustainable and competitive manner, both separately and jointly. Rail needs to develop as an integrated partner in supply chains, bringing its strengths alongside maritime, road and inland waterways; competing and co-operating where appropriate, often at the same time.

Rail freight has also a unique opportunity to exploit its “transport industrialisation” possibilities particularly valuable in infrastructure congestion times.

The European need for safe, reliable and sustainable transport systems continue to point in favour of rail transport and an expansion of it might be expected throughout the first half of the twenty-first century. The greatest barrier to this expansion is cost, whether this is met by the traveling public or the tax payer. As an incentive to reduce cost, governments set long range targets for increased number of passenger journeys at the same time as substantial cost reduction.

But research and development can also play a role in this regard: identifying what are the specific constraints of the rail sector, and what kind of pre-competitive research can help at EU level for maintaining and improving the passenger and freight transport rail market share in Europe (including on technical harmonization and necessary priorities for supporting rail) is the **work carried out within the ERRAC-Roadmaps project.**



Research can also help to increase the European competitiveness and innovation of its rail industries.

Examples of the possible technology penetration targets to deliver innovation to European products, given the high level objectives and constraints analysed before, could be: the Improvement of the rail industry competitiveness ; going beyond interoperability with technological solutions for a better integrated European railway system ; develop innovations for intelligent mobility ; green transport (based on economics and legislation demands).

**2.1.4. If these targets are met, what will be the contribution to EU policy goals in the field of transport?**

Indicate: Contribution to (1) achieving low-carbon transport (reducing CO<sub>2</sub> emissions and dependency on imported oil), (2) achieving seamless mobility in a Single European Transport Area (establishment of a seamless European TEN-T network that is intelligent, efficient, and green, single European 'transport ticket' for passengers and freight), (3) competitiveness and innovation (e.g. future market sizes for a given technology, European share of new market, additional jobs, export revenues), (4) other policy goals (such as reduction of congestions, local/urban pollution, noise reduction, damage to cultural heritage, etc.)

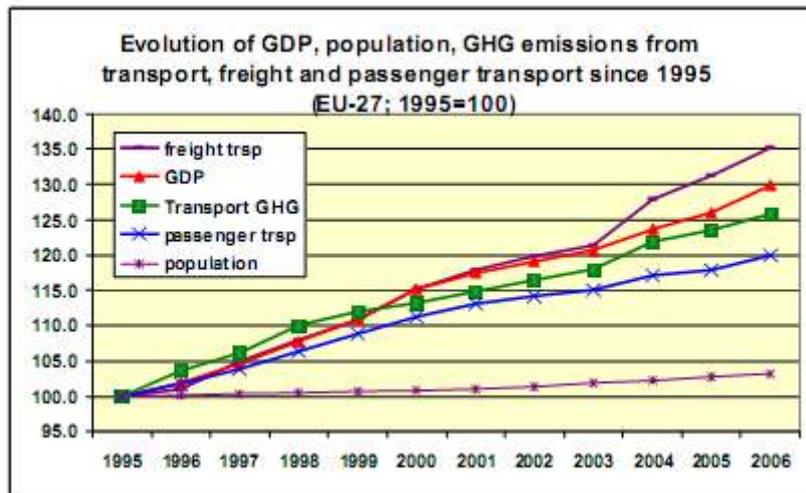
Long term and structured initiatives at EU level that help to enhance the rail competitiveness would meet the European objectives of the “Sustainable Growth” target and of the flagship initiative “Resource Efficient Europe”. Economic growth is closely linked to an increase in demand for transport. This is likely to remain the case in the foreseeable future. It is therefore important to green transport systems and disconnect transport from its adverse effects. Here, rail has great potential. It can contribute to the decarbonisation of transport which Transport Commissioner Siim Kallas calls the “ultimate goal” of European transport policy, given the threat of accelerated climate change. Furthermore, R&D investments into more energy efficient trains will help reduce Europe’s dependence on resources.

The flagship initiative “An industrial policy for the globalisation era” calls for a “strong, competitive and diversified industrial base in Europe”. **The implementation of the ERRAC-Roadmaps R&D priorities on pre-competitive research funded through the calls of the Framework Programme but also through public private partnerships help achieve this objective by supporting the competitiveness of the SMEs of the European rail sector.**

Europe 2020 makes out low levels of investment in R&D as one of the structural weaknesses of the European economy. By combining public and private funds for a common sector-wide R&D effort, it is needed to seriously address these shortcomings, working towards the objective of “Smart Growth”.

Significant R&D investments in the rail sector could help combine innovation, competitiveness and sustainability. It is fully in line with Commissioner Tajani’s analysis that “[t]here will be no sustainability without competitiveness, and there will be no long-lasting competitiveness without sustainability. And there will be none of them without a quantum leap in innovation!” Rail has the potential to deliver sustainable transport and to represent a competitive industry.

From the standpoint of environmental policy and transport policy, additional innovation brought by rail R&D can contribute to the greening of the economy and to the creation of a sustainable, less congested, and safer transport system. Transport is likely to grow in the decades to come. If the objective of decarbonising the sector is to be achieved, and a collapse of the transport system due to congestion is to be avoided, this growth has to take place in the rail sector.



Source: DG TREN (2008), EU energy and transport in figures. Statistical pocketbook 2007/2008

The transport sector accounted for 23.8% of all greenhouse gas (GHG) emissions and for 27.6% of CO<sub>2</sub> emissions in 2006. In the past decade, freight transport has grown faster than the GDP. No other sector has experienced such a high growth rate of emissions as transport between 1990 and 2006.

Therefore, if the EU is serious about meeting its emission targets for 2020, it will thoroughly have to reconsider its transport policies. This involves more than anything promoting a modal shift from road and air- the largest and fastest growing emitters of CO<sub>2</sub> - to rail as the most environmentally friendly mode of transport. Adequate charging schemes for all modes of transport, including their external costs will have to be devised so as to reflect the real cost of transport.

Also additional means and the implementation of instruments at EU level to improve existing rail technology is of vital importance to foster the market up take of the innovative rail products even more sustainable and competitive. As the life cycles of railway rolling stock and infrastructure are very long, we need to boost innovation today to develop solutions for tomorrow and have an environmentally friendly industry with a position of global leadership.

On 5 March 2010, the European Commissioner responsible for research, Máire Geoghegan-Quinn, stated that she “want[ed] a strong focus on industry-driven, applied research in the next five years. [...] And public private partnerships are often the best means of mobilising resources to meet our objectives. A number are already active in areas such as fuel cells and hydrogen, which can potentially replace petrol in cars, and the next generation of aircraft. I believe we can launch more under my political mandate.” **Rail could and should play a significant role in this regard.**



**2.1.5. Contribution to the overall ('well to wheel') energy efficiency?**

Indicate: Effects on energy efficiency in electricity and fuels supply, as well as in use; evolution over time and depending on market penetration, etc

The European railway networks are spending billions of Euros annually on energy and the energy costs have increased significantly over the last few years (more than 10% per year). The continued increase in oil prices to a level of 100 \$ per barrel underlines the necessity for improved energy efficiency, also because the electricity prices are highly influenced by the prices on coal, crude oil and gas.

Climate change has become a strategic cornerstone for the railways. Railways are fortunate to run 80% on electricity in Europe but it is not possible for all industrial electricity consumers to switch to renewable energy sources at once. Therefore improved energy efficiency is vital when the railways want to achieve their individual CO2 targets.

The energy mix in Europe is highly heterogeneous as the percentage of nuclear power, energy from fossil fuels and regenerative energies vary very much from country to country.

- R&D projects proposing solutions close the market can contribute to the necessary innovation to further optimise the well to wheel energy efficiency for the rail system. It is important to differentiate between research into energy efficiency measures between long distance rail and urban rail. In the field of urban rail we have submitted the proposal OSIRIS which we hope will be selected as it is regarded as an ERRAC priority.

**See the ERRAC Roadmaps on Greening that can be downloaded from [www.errac.org](http://www.errac.org) under the publication section.**

**2.1.6. Are there any interactions with other community policies and initiatives?**

Indicate: Potential contribution of the technology to other EU policies; need for measures and initiatives in other policy areas to support the market penetration of the technologies

A unified, system-wide perspective resulting from the ERRAC-roadmaps works and any future public private partnerships, coupled with a clear and stable initiative with budgetary resources for innovation will allow long-term technology planning along the entire rail supply chain.

It is important to highlight the need to maintain the resources and factory capability in Europe in a global market where delocalisation appears to be becoming synonymous of competitiveness.

Technology innovation can bring better rail products on the European market and will drive the fulfilment of a real sustainable transport system for the European future generations also contributing to the objectives of the Europe 2020 strategy: smart, sustainable and inclusive growth.

**2.1.7. Which are the main competing or synergetic technologies within the activity area? (in relation to the indicated market penetration targets)**

Other transport modes are competitors to the rail sector and with a lot of help of the European Commission they are investing significant amount of R&D for technologies breakthrough, aiming at increasing the attractiveness of their transport mode.

- The automotive sector is developing solutions with the help of PPPs with the European Commission to decrease the pollution of current engines and at the same time developing electric solutions mainly for urban products. It is also significantly investing in ITS technologies aimed at increasing the journey safety and services.
- The aeronautical sector is developing solutions with the help of PPPs with the European Commission to decrease the pollution with new engines concepts and product design and at the same time decreasing costs to become more competitive in the medium distance journey (400-500km).

But even with these technologies developments none of these transport modes can finally be defined sustainable: the only transport mode that have a long term life, a very low pollution ability, a high safety concept and can really reduce the transport congestion is the rail mode!

However, rail competitiveness is not only a matter of long distance rail. Long distance rail systems are competing with short distance air transport and long distance road transport, but local rail also plays a very important role in the overall rail competitiveness: local rail is competing with road transport and especially private car, and it is an essential component of the seamless travel chain: it complements the long distance transport for the “last mile”, but before all it is a basic alternative to the use of private car in dense areas. All efforts made at European level for the promotion of electric private vehicle shall achieve at the best a private car consuming per passenger x km in dense areas in thirty years more than what is achieved everyday now by local rail systems

## **2.2. Achieving the Vision**

**2.2.1. Is your vision achievable under a 'business as usual' scenario?**

Indicate: Current support programmes and policy measures and their expected impact

The currently used FP7 instrument to perform joint R&D in cooperation with the European supply industries, operators, infrastructure managers and universities is somehow today limited.

Firstly we recommend that EU funded research in FP8 should reflect the ETP Roadmaps and Stakeholders suggestions and not only following the Commission political orientation like it has been done in some occasion during the FP7 annual calls. The increased role of the ETPs and thereby the sector stakeholders, would lead to an EU funded R&D that could really make a difference in innovation and implementation on the real market.

Additionally, ERRAC suggests inserting in the FP8 legal documents measures that:



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- Call for a compulsory an interaction between the Transport Programme Committee, the Transport Advisory Group and the ETPs. The discussion should be focused on the roadmaps produced.
- Support better coordination between ETPs for multimodal issues.
- Recognize that ETPs should be the instrument to be used for an integrated EU research policy to support innovation coving the gap between European, national and regional levels.
- Set up a framework for calling for discussion of ERA-NET and regional/national research programmes within the different ETPs in order to align single researches with the wider European objectives.

Given also the limitation of the annual calls the FP8 legal framework should be compatible with other instruments for research and innovation, as for instance, the EIB funding instruments and the different forms of Public-Private Partnerships in order to respond the best way possible to the changing nature of innovation and the need of product innovations. These additional also need to be more flexible, much quicker and more market-oriented.

### **2.2.2. Are there barriers to innovation? Is there a need for change in the innovation system?**

Indicate: For the mode in question any weaknesses in the current system

See answer above

### **2.2.3. Does the considered mode/sector already benefit from or plan to set-up initiatives to bridge the gap between the current state of technology and a cost-effective market entry? What would be the critical mass (e.g. investment) needed for such initiatives? What new approaches could be considered to accelerate innovation?**

Indicate: i.e. how could the STTP help the sector; which actions of it would be most effective; what impact could be expected with respect to 'business as usual (i.e. No STTP)?

No, see answer above.

In addition of the needed support and enhanced role of the European Technology Platform for the identification of the topic priorities within the annual calls, the STTP should also favour the possibility to have additional instruments available for rail in the FP8 framework, with a significant budget dedicated to rail innovation.

Other transport modes already benefit of initiatives with significant investments from the manufacturers to bridge this gap, the STTP should allow the rail sector to build up something effective based on the experience of the different forms of Public Private Partnerships already in place.



**2.2.4. What actions need to be carried out at European level? What actions would be better implemented at national and or regional level? Is there a need, or a potential benefit, to integrate or to better coordinate action carried out at different levels?**

The STTP should pave the way for the setup of a framework for discussion of ERA-NET and regional/national research programmes within the different ETPs/PPPs in order to align single researches with the wider European objectives.

**2.2.5. International Dimension - Is there a potential for international cooperation? What type of cooperation?**

Indicate: Major initiatives in other countries; assessment of specific opportunities for international cooperation

International cooperation should be sought when the cooperation benefit to both parties. The potential is there but decisions on cooperation should be taken with case by case analysis. The ERRAC-Roadmaps priorities look also into the possibility of international cooperation and they recommend it whenever an opportunity is identified.

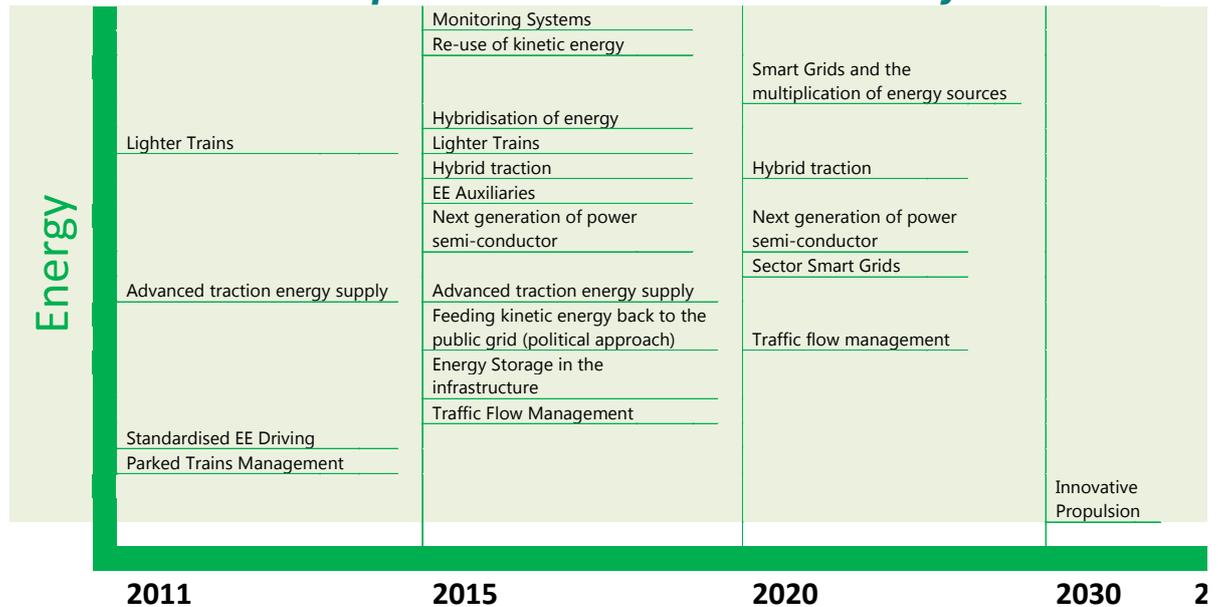
### **3. SECTOR/ISSUE SPECIFIC QUESTIONS**

#### **Rail transport:**

1. With respect to competitiveness and clean & efficient rail transport: should on the propulsion side most emphasis be given on cleaner and more efficient combustion engines, including alternative drive trains, hybrids and alternative fuels, or on the efficiency improvement of electric engines and components?

This is only one (important) part of the needed innovation in the rail system for its competitiveness and efficiency.

Accordingly to the work conducted by the WP01 of ERRAC-Roadmaps on energy efficiency the following technologies should be investigated:



The Rail sector believes that priority should be given to the “efficiency improvement of electric engines and components” as outlined in the ERRAC Energy Efficiency Roadmap.

It is important to differentiate between research into energy efficiency measures between long distance rail and urban rail. In the field of urban rail we have submitted the proposal OSIRIS which we hope will be selected as it is regarded as an ERRAC priority.

2. What areas need improvement to increase rail competitiveness with inland waterway transport, short distance air transport, long distance road transport? What are the main technologies needed for these improvements?

The already good efficiency and sustainability of the rail sector can still be increased in comparison to the other transport modes, for instance through IT applications, by increasing permissible axle loads, and by lowering the impact on tracks through mechatronics and composite materials. Hybrid systems, recycling processes and technologies to reduce noise and vibrations can help make rail transport even greener. The competitiveness of rail vis-à-vis other modes of transport must be improved for instance through the development of new approaches to multimodality. Innovation in these fields can contribute to creating the low-carbon transport system of the future.

**These are just examples, but only the work resulted from ERRAC-Roadmaps and future innovation oriented will and can provide detailed answers to the question.**

See the ERRAC Roadmaps that can be downloaded from [www.errac.org](http://www.errac.org) under the publication section.

3. What are the main (rail) interfaces to be improved for seamless transport of goods and people?

The “seamless” trip can be achieved by:

- Giving attention to several physical conditions in the infrastructure:
  - Accessibility
  - Relief of infrastructure bottle necks and international coordination of Combined Transport terminal development (see CER Corridors Study 2007 and DIOMIS requirements attached to this questionnaire)
  - Upgrading of infrastructure to allow for longer trains of 1.500 m (track for passing, signaling)
  - Orientation systems
  - Personal safety and security
  - Stations, station waiting areas and platforms (major long distance rail stations, but also local, suburban and regional rail stations, metro stations and even light rail stations or stopping areas.
- Supporting the development of industrial solutions for the rolling stock, signalling and communication system for example helping the realisation of seamless ticketing and pre-trip, during trip and after trip information.
- Fleet management system, technical interoperability between on board/way side communication systems but also between transport modes is also an area to be investigated for the seamless transport of goods and persons.
- Industrialisation of Combined Transport (see for more information the Agenda 2015 for Combined Transport in Europe)
- Competitive international wagonload services (analogue X-Rail)
- Moreover, technology will need to enable the railways to guarantee a high level of perceived personal security in these ‘open’ systems.
  - Seamless transport has to be considered on the one hand from a macro-economic perspective, and on the other hand from a local and regional perspective.
  - The local rail sector is a dynamic one, and a growing one – especially for metro and light rail in Europe – and the regional rail segment is probably, among all passenger rail segments, the one which has the highest potential for growth in many parts of Europe and which can most efficiently service the GHG emission reduction if made more attractive and a real substitute to the car. Interfaces in such a case have to be designed with considerations of all transport modes, and even of non-motorised modes.