European Road Transport Research Advisory Council

ERTRAC Road Transport Scenario 2030+ "Road to Implementation"

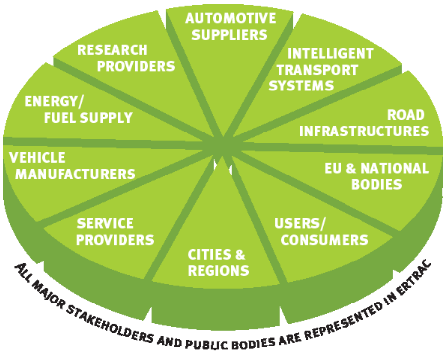
Executive Summary

October 2009

This document is an executive summary of the ERTRAC Road Transport Scenario 2030+.
The full document is available for download on the ERTRAC website.
www.ertrac.org

MAJOR STAKEHOLDERS AND PUBLIC BODIES REPRESENTED BY ERTRAC

The European Road Transport Research Advisory Council (ERTRAC) represents a diverse group of contributors to a successful European road transport system: consumers, vehicle manufacturers, component suppliers, road infrastructure operators and developers, service providers, energy suppliers, research organisations, and cities and regions as well as public policy experts and authorities at both European and national levels.



The European road transport industry spends more than 30 billion on research and development (R&D) every year. In addition, much of the research and technological development (RTD) is financed in the EU through national and regional funds. A better alignment of European and national, as well as private and public, research activities would provide major benefits in terms of economic efficiency, quality of results and shorter timescales for the application of new innovations.

It is ERTRAC's mission to explore these opportunities and make specific recommendations for implementation. ERTRAC's inclusion of all major road transport actors makes it unique and allows a holistic and integrated view of road transport issues.

The aim of the ERTRAC initiative has been to develop a common vision, to identify research priorities and to establish a Strategic Research Agenda for the next decades, and to stimulate its implementation. The ERTRAC approach is key to addressing Europe's road transport challenges successfully and effectively, both today and tomorrow. ERTRAC's aspirations include:

- **Defining priorities agreed by all stakeholders**
- **Aligning European and national research agendas and programmes**
- **Monitoring progress and adjusting research road maps accordingly**
- **Providing a platform for ongoing research alignment and co-operation**
- **Making specific recommendations for large cross-stakeholder research**
- **Identifying needs for international and global co-operation**

As a multi-stakeholder technology platform, ERTRAC provides road maps for cross-cutting research that will guide the development of RTD and provide a primary reference in the future planning of European and national road transport programmes. In addition, it is hoped that this reference provides an overarching framework for research and technological development as well as guidance for individual research planning.

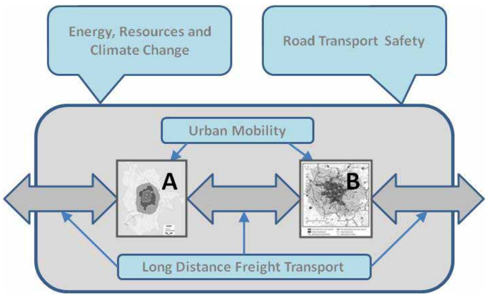
ERTRAC will continue to support Europe on its path towards a greener, smarter and safer road transport system. If you would like to be informed about ongoing and future ERTRAC activities, please visit the ERTRAC website at **www.ertrac.org.** Your feedback is always welcome!

CONTENT

EXECUTIVE SUMMARY

This brochure presents the result of ERTRAC's work to develop a 'road transport scenario' and follows the ERTRAC Research Framework: Steps to Implementation publication (published in March 2008). The 2008 Research Framework presented an overview of the major technological challenges that lie ahead, and which must be addressed in order to ensure that society's expectations continue to be realised for a greener, safer, and smarter European road transport system. On this basis, ERTRAC identified four 'Strategic Research Priorities' and established Working Groups in each area to address major challenges for the future:

1. **Energy, Resources and Climate Change**: to provide environmentally friendly road transport systems and a secure, renewable energy supply.
2. **Urban Mobility**: to achieve sustainable mobility for passengers and freight in the urban environment.
3. **Long-distance Freight Transport**: to provide (energy) efficient transport solutions (and vehicles) contributing to a reduced environmental footprint for the freight logistics chain, outside the urban environment.
4. **Road Transport Safety**: to reduce road transport injuries, fatalities, and accidents.



The combined efforts of these four Working Groups provide an 'integrated systems approach' to tackling these challenges. Such approach will be also aimed at the early identification and mitigation of barriers to the commercial introduction of new technology, to ensure that implemented technologies not only meet public policy objectives (including those that are not directly related to transport, such as on environment and energy as well as taxation policies of the member states) but are cost-competitive, meet consumer expectations, and avoid premature technology lock-in.

ERTRAC's Road Transport Scenario 2030+ presents a forward-looking guide to these challenges, together with the opportunities that will arise for research, development and innovative technologies through 2030 and beyond. The primary purpose of the scenario is to provide a basis to update ERTRAC's extensive R&D agenda that will extend to 2030 and beyond, and in some areas, to 2050. The scenario building process also provides a basis to translate these needs and objectives into realistic R&D road maps that distinguish between nearer-term priorities, such as the electrification road map to 2020, recently published by ERTRAC, and longer-term priorities for the coming decades.

In the scenario, the future of European road transport is presented from three points of view: (i) the most likely outcome, called the 'common sense' scenario; (ii) a more 'enthusiastic' alternative; and (iii) a more 'pessimistic' alternative. In each case, these scenarios address the key factors for each of ERTRAC's four Working Groups. The scenarios were prepared by ERTRAC stakeholders and other technical experts, and are based on a comprehensive review of previously published information related to energy, environment and mobility. As this document reflects ERTRAC's opinion of the future of European road transport, it may be different in some aspects from the published scenarios and papers that were analysed in the course of this assessment. In spite of this, ERTRAC believes that this assessment is robust and will allow a reliable prioritisation of cross-cutting research needs and objectives.

ERTRAC's Road Transport Scenario 2030+ was developed parallel to the ERTRAC European Industry Road map – Electrification of Road Transport, which in turn treats a particular facet of the Road Transport system in more extension and on a nearer term (2020). Special care was taken to harmonise between both parallel documents.

Common Observations

The following observations for 2030 and beyond are common to all four Working Groups.

By 2030, a harmonised policy framework concerning the European transport sector will be needed to achieve sustainable transport in the two decades leading up to 2050.

- By 2030, global framework agreements on trade, energy/resources, climate change and environment will have set clear objectives for the European Union to meet over time. This policy framework will result in specific sectoral policies that will be underpinned by thorough and transparent systems analyses to enable each sector to be allocated with its proportional share of responsibilities in meeting the objectives and targets. These agreements are likely to impact the challenges presented to all four Working Groups.
- The early standardisation of requirements and specifications will also be important in order to achieve successful and cost-effective transitions.
- This framework would have to be in compliance with other, 'non-transport' policies as well, such as European environment and energy policies, taxation policies of the Member States, as they can create market provisions, positive or negative, for new solutions on the market.
- Strategies will be needed to have the growth in energy and transport demand in a slower pace than the economic growth; this will be especially important to prepare for challenges beyond 2030. Such strategies must consider the demand for personal mobility within the limits of a sustainable society and avoid social segregation between urban and rural communities and could be for instance based on creative applications of ICT (e-commerce, 'e-freight', etc.) .

Perhaps the most important common element will be the ability to adapt the road transport system to meet society's needs within the constraints of available finances. Some of the innovative technologies that will be important for future road transport will cost substantial amounts of money, and wise decisions will be needed when considering such investments. It is also important that these decisions are implemented in a coherent way, so that investments are not wasted, but build on each other. This must be done through public-private partnerships and a commonly implemented framework for financing the development of the transport infrastructure to optimise capacity, improve road safety, and integrate the infrastructure into the urban and suburban environments.

The introduction of industrially-oriented ICT applications will greatly increase the economic and environmental efficiency of transport operators and the manufacturing industry in terms of their design, planning, operation and control processes. This will, in turn, lead to the production and transport industries becoming increasingly integrated. Such tools would include sophisticated, predictive simulation and design tools that will help to minimise empirical testing while still producing reliable systems and components as well as a variety of global, logistical network-oriented applications, e.g. to facilitate the tracking and tracing of freight modules to enable the optimal planning and control of transport flows, and to minimise delays and avoid load carriers returning empty. Reliable and validated data and databases will be needed to drive these applications.

By 2030, a highly integrated and service driven information society will have emerged in which the mobility consumer takes part actively and continuously regardless of his/her location (home, work, commuting, leisure). Especially in the urban areas, where by then more than 80 per cent of the European population will live, a wide variety of online services provided by advanced, cheap digital outlets, will bring on dramatic changes in consumer awareness, attitude and behaviour towards transport in general and personal mobility in particular.

- Available information will be updated in real time, based on consumers' active responses or feedback to services being used. For example, a consumer may choose to relay information to the service concerning a traffic situation on a particular section of the infrastructure, or may provide valuable real-time feedback by the simple act of choosing a particular mode of travel in reaction to a change in tariff. In addition to such 'active' personal responses, a supply of 'passive' information will also be relayed to the service provider, e.g. through the usage patterns of various items of digital equipment used by the consumer, including mobile telephones, computers, vehicles etc. Thus, service providers will receive a wide variety of data and information from many sources, allowing them to provide a tailored, real-time service to each consumer.
- Mobility operators will be able to use the same information services, for example to optimise the efficiency of the network infrastructure, or to limit the environmental impact of mobility patterns, by offering travel incentives to specific consumer groups or to customers on preferred travel modes and routes, or even by implementing controls to speed limits—all in real time. For those living in rural environments, the same development will reduce social exclusion and ensure consumer access to information and cost-effective mobility options, comparable to those living in urban environments.

Energy and Environment

By 2030, concerns about global climate change, combined with increasing demand for energy, will force public policy on a global and regional level, while environmental concerns related to air, water, and noise pollution will be prominent on a regional, country and local level. Energy conservation and diversification and materials recycling will be well-advanced, driven by climate change, energy security concerns and public policy. Energy consumption and greenhouse gas (GHG) emissions from road transport will stabilise due to efficiency improvements in the engine, vehicle and transport system and to the replacement of non-renewable fuels by renewable fuels. The biggest gains will be in the light-duty vehicle fleet.

The energy efficiency of the personal and freight transport system will continue to improve through the application of diverse technological and non-technological measures. Energy supplies will continue to evolve to enable more efficient vehicle technologies. Climate change and competitiveness concerns will encourage greater inter-modality of freight transport. For personal mobility, consumer expectations for transportation will be increasingly aligned with public policy directions, while financial and other incentives will encourage changes in consumer choices and behaviour.

Non-renewable fuels will continue to dominate the total energy demand, but global availability and climate change concerns will increase costs and drive innovation for renewable fuels and alternative energy sources. Electrification will become more important in urban transportation, benefiting from improvements in the electric grid and the increasing contribution from renewable energy sources.

Economic growth will continue to depend on a complex, diversified and highly integrated transport system, and will be shaped by the continuing growth and decline in different business sectors. Business will be increasingly motivated to develop and implement new and cost-effective energy and transport technology options that are aligned with enabling legislation and regulations. The cost of energy will be a critical factor for driving investments in renewable and alternative energy technologies, and a stable investment climate will be required to exploit new hydrocarbon reserves and develop alternative and renewable energy resources. Energy demand and supply will increasingly be coordinated on a global scale.

▶ Improvements in fuel efficiency from the on-road fleet will continue to reduce GHG and tailpipe emissions from passenger cars and freight transport through advances in internal combustion engine and vehicle design.

▶ Growing contributions to GHG reduction will come from the introduction of hybrid-electric, fully electric, and fuel-cell powered vehicles, although advanced combustion engines will continue to dominate the vehicle fleet through 2030.

▶ The availability and cost of other non-renewable resources critical to road transport, such as precious metals and lithium, will drive recycling and the development of alternative technologies using more abundant materials and resources.

▶ Further reductions in energy and GHG emissions will come from fuel production and distribution through manufacturing efficiency, fuel diversification, and the longer-term use of carbon sequestration.

▶ There will be a greater diversification in the energy and fuel mix, including renewable and alternative fuels in the near term and greater use of electrification from renewable resources in the longer term, with an on-going need for pan-European vehicle and fuel specifications.

▶ 'Non-technological' improvements will additionally add to transport fuel efficiency, ranging from subtle changes in engine and vehicle design to improvements in vehicle maintenance, changes in consumer driving habits, and improved traffic management and logistics.

▶ Improvements in transport mobility modes enable energy and GHG reductions through better choices and better network management for personal and freight transport. This development is propagated by the expanded use of economic incentives and information technology to improve decision-making and reduce congestion and journey times.

Urban Mobility

By 2030, urban mobility will have changed due to socio-demographic evolution (ageing and immigration), urbanisation, the increase of energy costs, the implementation of environmental regulations, and the further diffusion of sophisticated Information and Communication Technology (ICT) applications in virtually all aspects of life. The result will be a complex, integrated mobility system, managed with greater efficiency to answer the challenges of reducing environmental impact and minimising urban congestion, while providing comfortable mobility to the traveller.

▶ Personal mobility demand will diversify as a consequence of a greater choice of comfortable mobility solutions, often multimodal, and new information services made readily available to the consumer. Conveniently located hubs will provide the urban traveller with easy transfers between transport modes.

▶ The demand for public and collective modes of transport will increase considerably, as a consequence of socio-demographic changes, urbanisation and continued urban sprawl. Part of the answer will be provided by public transport (urban rail and bus systems). This will create financial pressure on the mobility system as a whole and on public transport services in particular, while at the same time public finances will have to cope with an increase of social spending, also due to socio-demographic changes.

▶ Urban development and environment policies, land use and sustainable urban mobility planning will become increasingly integrated. Pan European efforts to generalise approaches for sustainable urban mobility plans will further support this trend. This will only partly contain urban sprawl and it will encourage an evolution towards polycentric urban areas. Public transport systems (bus and rail) will contribute to shape the future urban environment.

▶ Although the urban transport infrastructure will be optimised to the very limit of its capacity, financial and spatial constraints will prohibit the full accommodation of the increase in (private) mobility demand. Hence, demand management, including pricing policies, will be implemented on a large scale in European cities as part of their mobility network management strategies, and as a way to influence consumer behaviour. Priority will be given to sustainable transport modes and services, including walking and cycling, which will be encouraged and considered as alternatives for certain trips. The use of personal cars in urban environments will nevertheless not decrease significantly.

- New services and business models will emerge for urban mobility, encouraging public and collective services, journey sharing, and shared ownership of vehicles. These will address the increase in mobility demand to mitigate the impact of mobility on the environment and address the challenges presented by the evolution of energy supply and the rising cost of energy. Access to these services will be made much easier, e.g. by single ticketing concepts, allowing the urban consumer to travel leisurely and seamlessly from door to door.
- Information services and e-commence services will become fully integrated in the everyday life of the urban consumer to the extent that he/she will be online continuously and will take part actively in a vibrant virtual community.
- The increasing availability of mobility information combined with ITS will play a major role in optimising network efficiency and allow the traveller to select the optimal combination of travel modes for a specific destination. Traffic and Travel Information (TTI) will support the implementation of advanced management systems (through cooperative systems) and mobility demand management.
- The demand for advanced (home) delivery of goods and services will increase as the urban consumer continues to have access to an increasing variety of online information and e-commerce services. In response, urban logistics strategies will aim for greater integration of urban freight challenges in urban planning. This will allow for the consolidation of freight delivery and the optimum use of the infrastructure. Transfer hubs will provide a smooth and efficient interface between long-distance freight transport and urban freight deliveries.

- The urban vehicle fleet (both passenger and goods delivery) will undergo a transition towards energy-efficiency, electrification and diversification in design (e.g. modular), that ensures that vehicles are more suited to the urban environment and the diversified mobility demand. Especially in the urban environment electrification of the transport fleet will pick up, as up to 15% of the new sold vehicles will be plug-in hybrid and fully-electric. Electrification will also apply to the use of bicycles, mopeds and motorcycles in the urban environment. The diversified demand for public transport and urban goods delivery will have a strong influence on new vehicle design.

Long-distance Freight Transport

- By 2030 the (freight) transport system will be highly integrated and able to balance energy efficiency and flexibility using ICT based logistic solutions and business models.

- Policy measures on the internalisation of external costs will have an impact on freight transport considerations, such as the distances over which goods are moved as well as on the current just-in-time principles and modal choice. New business models for logistics will have an impact on efficiency and flexibility such as transport capacity being offered on demand and enhanced cooperation between different organisations involved in the transportation of goods.

- Road (and rail) transport between Europe and Asia will increase considerably as a consequence of the shift in Europe's global trading partners towards those in much closer 'low wage' regions. However, this represents strong growth from a very low starting point and would require significant (expensive) improvements in infrastructure and removal of regulatory or institutional barriers that prevent the development of efficient transport services, such that ocean freight shipping will continue to dominate European-Asian freight transport. Different gateways to, and from, southeast Asia (ASEAN) will develop, concentrated in the eastern European Member States and connecting to the corridors to Asia.

- European road infrastructure capacity will be stretched to its absolute limit. While rail and waterway systems will have grown substantially and increased their market share, rail infrastructure constraints and the economics of short-haul freight movements will mean that road remains the dominant freight mode.

- Short-term relief to the growing transport demand will be provided by full-scale and comprehensive traffic management of the congested corridors interconnecting the economic/metropolitan regions as well as those connecting these regions to the important intra continental corridors. In addition the introduction of new, more durable materials, construction and management concepts will help to reduce maintenance 'down time' of the capacity.

▸ Additional long-term relief will be provided by 'debottlenecking' of the congested sections of the road infrastructure (e.g. short cuts, bridges and viaducts, the use of ICT based systems). It is likely that legislation will be introduced to streamline the procedures for civil participation and ensure that such projects are completed in the least possible time.

- Additional measures, including new pan-European transport strategies will need to be introduced in the decades following 2030, to minimise the risk of a breakdown in the transport system. Government policies will aim to maximise socio-economic benefits and limiting external costs per unit of freight moved.

- The majority of EU Member States will voluntarily adopt new policies and standards on weight, dimensions and ICT that will allow for the development of new vehicle designs with significantly improved aerodynamics, fuel consumption, safety performance and driver comfort—features that will be employed in almost all long-distance freight transportation by 2030.

- The concept of modularisation will be implemented by 2030 and will bring increased efficiency and flexibility to freight transport system as all freight transport modes can share the same interfaces and will be able to use the same freight modules. Depending on the need and transport assignment, small freight modules (goods containers) that will typically be used for urban transport can be combined into bigger ones for long-distance transport and vice-versa.

- Longer and heavier vehicles (LHVs) with significantly higher load capacity will be widely used along with measures to mitigate or prevent any consequential mode shift. The acceptance of these developments is to be considered a critical factor, but the trend shows acceptance by the public for LHV's as viable solutions to congestion and environmental constraints, especially in North-Western Europe.

- By 2030 vehicles will be smart enough to 'sense' their surroundings and navigate through traffic safely and efficiently, while providing their occupants personalised comfort and convenience. The vehicle will be a 'node on the internet', and will be 'online' with other vehicles (V2V), with the transport infrastructure (V2I), and with homes, businesses and other sources (V2X). Support systems will assist the driver by offering automated responses to developing traffic situations, by coaching the driver to operate the vehicle in the most energy efficient way etc.

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- Additional measures, including new pan-European transport strategies will need to be introduced in the decades following 2030, to minimise the risk of a breakdown in the transport system.

- The 'green corridor' concept will have been introduced and will be used for highly populated highways throughout Europe. The criteria for access to these corridors will be related to new vehicle concepts and transport and energy efficiency. In these corridors, longer and heavier vehicles will be the majority, and 'platooning' (electronic coupling of trucks) will be widely used. Transport modes complementing each other will be used on the basis of optimal resource utilisation.

- The concept will include infrastructure dedicated to freight transport but the cost of this will be minimised by ensuring that new roads/tunnels etc. are constructed for light vehicles only and the old facilities will be dedicated to heavy vehicles.

In 2030, tri-modal land hubs will provide fast (i.e. efficient) transhipment of people and goods between rail, inland waterways and road services. Especially in and around urban areas, these hubs will attract other commercial activities such as shopping, finance and office facilities. Conventional inland terminals, as exist today, will still be operating, serving regional traffic and local distribution.

The important interconnection between long-distance transport (longer vehicles) and urban distribution (smaller trucks) represents a big challenge and will be handled by terminals and vehicle concepts that accommodate the interface at an extreme minimum of efficiency loss to the overall chain.

Automatic locking on container castings and tray castings, in combination with the automatic positioning will be standard as will enhanced communication technology to enable cargo and pallets to remotely communicate their status, and 'smart dust' providing physical security for loading units.

The fuel pool for long-distance freight transport will consist predominantly of fossil distillates while the share of renewables and synthetics in the fuel pool will be small compared with urban freight transport.

The typical power train system will be an integrated unit, tolerant to alternative fuels and multi-fuel blends and will use advanced control systems for optimised operation and fuel efficiency, such as integrated waste heat recovery systems combined with efficient exhaust after treatment systems securing low emissions, whereas auxiliary systems will typically be powered by low-carbon technologies such as fuel cells.

A certain degree of hybridisation is expected in long-distance transport enabling e.g. downsizing of the engine and thereby reducing fuel consumption. However, ongoing electrification of the power train will be confronted by unrealistic costs and standardisation issues, e.g. power storage and recharging requirements. Battery cost and weight will probably be a limiting factor for the foreseeable future.

Road Transport Safety

By 2030, road transport safety will still be an important social problem in spite of the wide introduction of sophisticated safety measures to the user, the vehicle and the infrastructure. Factors that are likely to contribute to an increase in road transport safety risks include the increasing number of vulnerable road users, an increase in accident incompatibility between vehicles, the increasing number of elderly people and an overall increase in mobility demand, particularly in the more critical context of urban road use. On the other hand, the introduction of safety systems, e.g. Advanced Driver Assistance Systems (ADAS) and cooperative systems, in vehicles and transport infrastructure, as well as increased consumer awareness and acceptance of these safety systems, will offset the aforementioned impacts on safety risk, but it is not clear whether the overall result will be positive, i.e. a net reduction of the safety risk.

- Consumer awareness of road safety issues will have led to the general acceptance of advanced safety technologies (e.g. anti-lock braking systems, electronic stability controls, emergency call facilities, etc.) and safer conduct. Policies on, for example reducing speed limits and the adoption of eco-driving strategies (e.g. smoother acceleration and deceleration), as well as on continuous education of the road user and the provision of discounts on insurance premiums or taxes, will further enhance this trend.
- Safety systems will be implemented on the vast majority of vehicles, but the sophistication of the individual systems will depend on the class and age of the vehicle.
- The rising number of vulnerable road users, together with the introduction of more small, new vehicles and the growing number of trucks combined with developments such as vehicle 'platooning' which allows for better aerodynamics and thus for improved fuel efficiency, will increase vehicle incompatibility in relation to accidents, and therefore will also increase safety risks. This will be addressed by a completely new approach to vehicle and infrastructure design, which will be aimed at maximising both the passive and active safety of vehicle occupants and other road users.

- The next generations of 'elderly' people will not change their mobility behaviour, and this will lead to an increase in safety risk due to their enhanced vulnerability and reduced driving proficiency.
- Although the congested sections of the European road infrastructure will be 'debottlenecked' to accommodate the increased volume of personal and freight transport, capacity will still be stretched to its limits and sensitive to disturbances, therefore creating a relatively high safety risk for the road user.
- The costs for maintaining and developing the road infrastructure will increasingly be financed by private capital; hence the balance between costs, benefits, user needs and safety requirements will be the subject of ongoing public debate.
- Policy and measures, adopted either at European or at Member States level, will continue to have an important role in the improvement of Road Transport Safety.

ERTRAC's guiding ambition for Future Research Priorities

As stated, the primary purpose of the scenario presented in this document is to provide a basis to update ERTRAC's extensive R&D agenda that will extend to 2030 and beyond, and in some areas, to 2050.

In view of the observations that are common to all four working groups as well as their specific scenario elements, the R&D agenda will be structured around three crucial applications in the road transport system, being:

- Passenger and freight transport/delivery inside the urban areas, where over 80% of the European population will reside.
- Freight transport outside the urban areas, that services the connection between Europe's urban areas and between Europe and the world
- Interconnection between both, that allows for a clear but unhindering separation between the two transport subsystems

The R&D agenda will have to enable a leap in efficiency for all three applications, implying that they have to become much smarter, safer and greener than now. As a guiding direction ERTRAC's update of its R&D agenda is set out on following ambition:

In 2050 the road transport system will be 50% more efficient than in 2010.

The required R&D will be structured in cross-cutting themes and systems approaches that reflect the major elements in the common sense scenario, concerning obviously the kernel for Road Transport consisting of the user, the vehicle and the infrastructure but also the more systemic aspects of the road transport system, such as urban planning & design, energy & resources supply, manufacturing & production, logistical and mobility services, consumer awareness, as well as the enabling policy framework and strategies.

These themes, driven by the findings from the scenario analysis, will enable a comprehensive re-evaluation of ERTRAC's future research priorities. This additional work will be completed in 2009-10.

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