Project FUTRE

FUTURE PROSPECTS ON TRANSPORT EVOLUTION AND INNOVATION CHALLENGES FOR THE COMPETITIVENESS OF EUROPE

Support Action
Grant Agreement No: 314181

Final Report

FUTRE FINAL REPORT

Grant Agreement number: 314181

Project acronym: FUTRE

Project title: FUture prospects on TRansport evolution and innovation challenges for the competitiveness of Europe

Funding Scheme: Support Action

Period covered: **from** October 2012 **to** September 2014

Name, title and organisation of the scientific representative of the project's coordinator[1]:

Dr. Maria Boile

Main Researcher

CERTH/HIT

Tel: 0030 211 1069 591

Fax: 0030 210 6533 031

E-mail: boile@certh.gr

Project website[2] address: http://www.futre.eu/

[1] Usually the contact person of the coordinator as specified in Art. 8.1. of the Grant Agreement.
[2] The home page of the website should contain the generic European flag and the FP7 logo which are available in electronic format at the Europa website (logo of the European flag: http://europa.eu/abc/symbols/emblem/index_en.htm logo of the 7th FP: http://ec.europa.eu/research/fp7/index_en.cfm?pg=logos). The area of activity of the project should also be mentioned.

Table of Contents

List of Figures

List of Tables

1. Final publishable summary report

1.1 Executive Summary

FUTRE Project studies the transport system as a complex socio-technical system with factors influencing each other. It is argued that innovations and development in society influence each other; the term "co-evolution" is used for the mutual relationship between developments on the supply side and developments on the demand side of socio-technical systems. Transport demand is also strongly influenced by factors outside the transport system. In order to increase analytical clarity, the future competitiveness of the transport sector is analysed from two different angles:

- A demand-oriented perspective, where the focus is on demand needs and behaviour, as influenced by related market drivers and external factors
- A supply oriented perspective, where the focus is on upcoming technological and organisational innovations, on constraints and market barriers related to established and emerging technologies.

The findings from the demand-oriented and the supply-oriented analysis are merged in the development of scenarios. These scenarios consist of qualitative framings complemented by model-based quantification for illustrating to what extent they are able to fulfil different policy targets for Europe.

Key project deliverables outline potential scenarios of transport innovations, analyzing the dynamics between demand and supply, which result from the innovations' implementation and their resulting impacts on the competitiveness of the European transport industry. Based on these findings, options for the EU research policy are developed and presented. General guidelines and strategic options of European transport policy are detailed and recommendations on the design of future R&D strategy are developed. An electronic publication summarizing key findings of the project is produced with the main aim to inform the general public.

1.2 Project Context and Objectives

The transport sector plays a fundamental role in the European economy. The quality and efficiency of transport services have a direct impact on economic growth, competitiveness and quality of life. It is widely acknowledged that innovations and targeted research activities are key factors for fostering global competitiveness of the transport sector. Innovation and related research agendas are targeted on future challenges, market drivers and technologies that will become effective in the future. Therefore, the design of research agendas needs to take into account potential future developments and challenges.

A long-term perspective in the transport sector is crucial, due to the implications of present decisions on future performance and the nature of investments, such as transport infrastructure, that require forward planning and decision-making based on future requirements. Furthermore, it is important for the EU to identify and assess its competitive advantages and examine how it positions itself in order to maintain and even enhance existing strengths in the future.

The European transport sector faces several challenges for which innovation may play an important role. The current economic downturn imposes a reduction of transport demand thus increasing the costs incurred by companies. Innovations that improve the cost efficiency and productivity of the transport sector may reduce the impact of the current economic situation. In terms of environmental challenges, national and international regulations such as the reduction of the transport sector's emissions have created potential markets to green innovations, such as electric vehicles. On the other hand the increasing number of people living in urban areas constitutes a challenge for the transportation system organisation and mobility management innovations. Against this background, FUTRE presents an assessment of the effects of future challenges, demand drivers and upcoming innovations, which have a considerable impact on the global demand patterns in the passenger and freight sector, on the competitiveness of the European transport sector, including related industries and service providers. It aims to bridge the gap between the manifold studies on the future of the European transport system and its subsections, and the issue of competitiveness that needs to be supported by targeted research strategies.

FUTRE takes into account existing knowledge and material relevant to the future of European transport and its influencing factors. It also integrates knowledge from the industry and the relevant technology platforms (ACARE, ERRAC, ETRAC, WATERBORNE) with individual expert knowledge.

Following a structured approach, five key elements are analyzed, each comprising a respective Work Package. Figure 1 illustrates the project's structure.

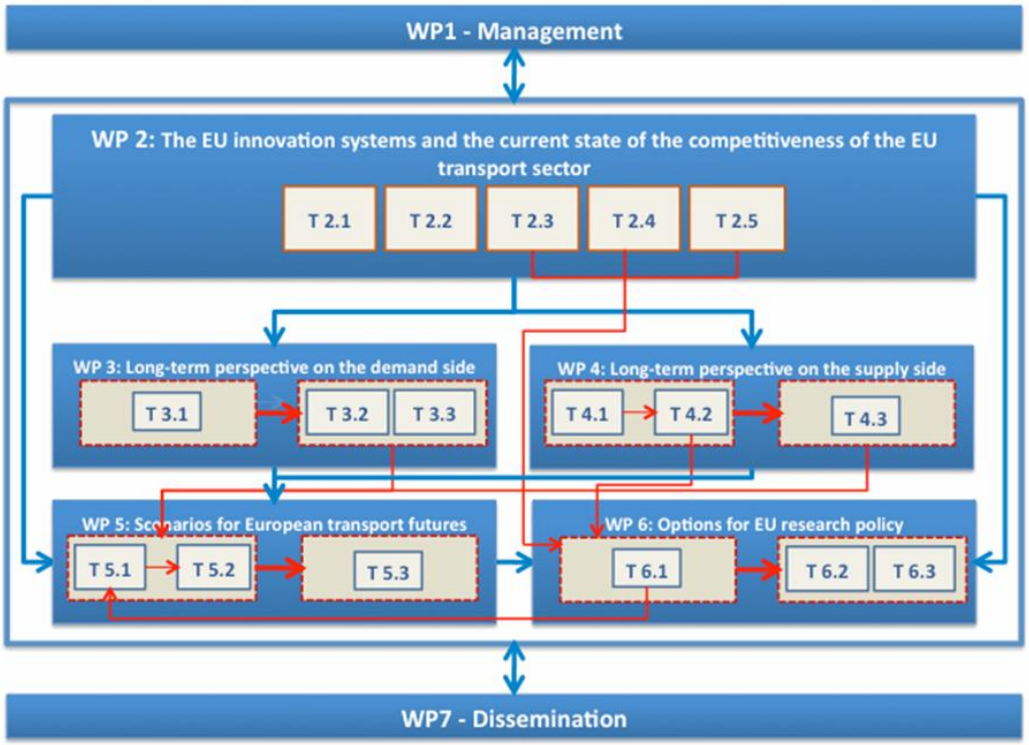

Figure 1- Structure of the project

As part of the WP2 activities, the concepts of innovation and competitiveness are specified and criteria for their assessment are developed. An understanding of the present competitiveness of the European transport sector is presented. WP 3 analyses the future competitiveness of the transport sector from a demand-oriented perspective. The focus is on the demand needs and behaviour, as influenced by related market drivers and external factors of influence. WP 4 analyses the future competitiveness of the transport sector from a supply-oriented perspective, where the focus is on upcoming technological and organisational innovations, on constraints and market barriers related to established and emerging technologies. In WP 5, findings from the demand-oriented and the supply-oriented research are merged in scenarios, consisting of qualitative framings complemented by model-based quantification, illustrating the extent to which they are able to fulfil different policy targets for Europe. WP6 elaborates consequences for transport related research and formulates strategic options for the corresponding research programmes, which may help the transport sector to increase its competitiveness in face of different future challenges.

1.3 Main S&T Results/foregrounds

1. The European innovation systems in transport and the current state of competitiveness of the EU transport sector

One of the main aims of the project was to develop a better understanding of the present innovation and competitiveness of the European transport sector. The analysis showed that the transport industry is experiencing a time of change. In most transport modes the European industry has a global competitive position to defend and there is a clear sense that the best way to do so is by investing in research and innovation. In most analysed modes of transport the challenge is twofold: ensure competitiveness of the European industry while reducing the societal impacts (especially environmental) of that mode of transport. These two objectives are not contradictory in nature: if legislation and regulation is properly designed at European and international level, addressing societal challenges would pay-off in terms of competitiveness.
A quick identification of barriers and drivers for market uptake of transport innovation was also performed. This showed that most barriers are market and finance related. One may draw two conclusions from this observation:

- First, it may show that technological platforms are/have been effective networks for promoting research agendas that help to address the technological and organisational aspects of transport research;
- Second, that the focus of policy makers on transport research and innovation shall shift towards incentivising market experimentation and exploitation on the one hand, and adopting regulation and legislation that rewards innovative transport solutions on the other.

Innovation capacity of the European transport industry
The business sector is the main R&D investor in the EU. The Manufacture of motor vehicles trailers and semi-trailers in the EU is responsible for the highest share of expenditure, followed by the manufacture of air and spacecraft and related machinery.
Across member states, four countries spend the highest share of R&D in transport-related sectors. These are Germany, France, the United Kingdom and Italy. By transport sub-sectors, Germany dominates the R&D expenditure on manufacture of motor vehicle trailers and semi-trailers, railway

locomotive and rolling stock. France is the main contributor on the manufacture of ships and boats as well as air and spacecraft, and related equipment.
R&D investments made by the key European companies are significantly high in the automotive and civil aviation industry. In terms of R&D intensity, the air industry followed by the ITS sector are the sectors investing a higher share of their net sales on R&D.
Patent analysis revealed that, within the EU, Germany and France have the highest shares of patent applications on mobility. Germany has a larger share of applications in rail-bound, hybrid-drive, electric drive and navigation, while France has a higher share of patents in aviation technologies. In other EU countries, other prominent areas with respect to patent shares are bio-fuel for the Netherlands, navigation for Italy, Sweden and Finland, aviation for Great Britain and mobility concepts for Austria.

Competitiveness of the European transport industry
Within the EU two sectors present the highest value added, turnover and production value. These are the 'Transportation and storage' and the 'Manufacture of motor vehicles, trailers and semi-trailers'. The automotive manufacture together with the air industry are characterised as specialized sectors, offering high quality jobs, which is reflected in higher average personnel costs and apparent labour productivity as well as high R&D

2. Long-term perspective on the demand side

One of the main FUTRE project aims was to study the factors of evolution of transport demand. Specifically, this task aimed to identify factors of evolution of demand behaviour and describe a range of plausible global futures affecting transport demand. This work was used as a frame for the identification of specific pathways on passenger and freight transport demand.

The methodology used was scenario analysis, with inputs from a literature review on futures studies on transport and related fields, a stakeholder consultation, and a consistency check based on a systems thinking approach. More specifically, the scenarios analysis followed these steps:

1. Identification of possible **mega-trends** with impacts on transport
2. Identification of key **factors** of evolution of transport demand
3. Derivation of specific possible future **insights** on the world and transport demand
4. Drawing of possible **global pathways** with relevance to transport

Megatrends are stable trends driven by global forces that impact several societal areas. By considering megatrends it is possible to try to assess how they will influence aspects of transport needs. The following megatrends were selected as the most relevant in the scope of transport:

- Globalization
- Urbanization
- Ageing
- Knowledge society
- Individualism
- Migration
- Connectivity
- Immediate needs: here & now
- Slow Movement
- Empowerment of Women
- Awareness / consciousness
- Consumption 2.0 – use, not own

- Ever Young
- Seeking for experiences
- Do it yourself

Based on the megatrends, related insights and an identification of aspects relevant for mobility systems, a set of **key factors** for the evolution of transport demand was identified. The key factors are related to different spheres of life and where arranged in the areas defined by the *STEEP* approach: Social, Technological, Economical, Environmental and Political factors. The factors are outlined in the Table 1 below:

Table 1 – Factors of evolution of transport demand

Social
Demography: Population growth Ageing Global migrations Living place flexibility **Education and social capital:** Level of education Equality of cultural capital **Preferences and awareness:** Consumerism (VS spiritual needs) Environmental awareness Propensity to own VS share use Social significance of travel choices (status) Value of doing tasks while travelling Rationality of choices Value of safety Value of health Value of free time and leisure More virtual than physical relations / communication
Technological
Ability to address energy, environmental and ageing challenges by technical developments
Economical
Economic development: Level of economic growth Economic stability Volume of international trade Economic equality **Production and consumption patterns:** Share of knowledge based work Purchasing channel paradigms (P2P and e-commerce VS local commerce...) Scale of production: mass VS customised Paid work time reduction **Energy:** Fossil energy scarcity – prices

Urban development:
Urbanisation
Urban density
Congestion
Environmental (perceived problem of...)
Climate change
Biodiversity and other environmental issues
Local pollution (air, noise)
Political
Global cooperation on global issues
Power of the State
Power of the people and civil organizations
International conflicts
Security concerns
Market liberalization
Infrastructure development

Following the megatrends and key factors considered, a number of **insights** was identified on specific trends or events that are somewhere between possible and likely to come in the future. The consideration of insights provided were, together with the megatrends and key factors, an input to the development of future pathways. Some potential wild cards – low probability, high impact events – were also identified.

The final step before the development of global pathways was the analysis of interrelations and **systemic behaviour** of the set of key factors. To this end, a systems thinking approach framed the analysis. The development of causal loop diagrams allowed showing the main relations between the factors in question and the direction of those relations. It also showed the existence of several relevant feedback loops. For example, it was seen that people's preferences are influenced and reinforced by external conditions, whereby e.g. consumerism is made possible when there is abundance (economic growth) and environmental awareness is reinforced by the manifestation of environmental problems.

Different **pathways** were then iteratively developed and discussed. The final aim was to develop a set of pathways, which better defined a range of plausibility with interest for the study of transport demand futures. The development of the pathways was strongly related to the results taken from FUTRE's **Workshop "Transport Needs 2050"** with members of the consortium and a group of experts.

The steps taken in the development of pathways included the identification of a short list of main driver factors, the identification of pathways based on possible trends and systemic coherence, and assessment of their level of coverage of plausible outcomes. This process was done iteratively until a satisfactory range of plausibility with interest to transport demand futures was achieved. The short list of main driver factors was composed of Climate change, Energy scarcity and price, Economic performance, Global cooperation and Social preferences (consumerism Vs spiritual needs).

The four global pathways developed are briefly described as follows:
Unlimited: In this pathway technology is able to solve the crucial environmental and energy problems. Without any constraint on them, current social practises may continue and even follow a

path of increased consumerism and thirst for travel. Global economic competition is the most important driver of societies.

Passivity and collapse: This pathway describes a world where society was not able to address the impending environmental and energy problems. Societies ultimately fall economically and politically. It emphasises the consequences of a collapse of every type and the inherent uncertainty and need to quick adaptation in an unstable world.

Cooperation and degrowth: In this pathway the prospect of environmental and economic collapse leads people and countries to cooperate to properly manage the global commons. This necessarily involves drawing back the economic output to a level consistent with sustainability. People consume and travel less, driven by various policy incentives concerted at international level.

Smart & Spiritual: This pathway emphasises the consequences of a shift of social preferences and culture towards different values, less focused on material things and more focused on immaterial spiritual satisfaction of all kinds. It is a more rational world, where people highly value long-term issues like health and safety.

The key factors, insights and global pathways developed were inputs for the development of transport demand specific pathways and the identification of related challenges.

3. Long-term perspective on the demand side

As described in the previous section **four pathways** were developed. Their development aimed at serving as a basis for a future analysis on factors of change for future transport demand related to passenger and freight transport. The structure of the work was based on four specific objectives that helped cover the scope:

1. Identification of possible key issues that affect passenger and freight transport demand.
2. Analysis of the four pathways (scenarios) using the issues – factors as focal points, in order to derive trends and challenges. Sub scenarios were built based on the characteristics of the pathways that described how future demand will be shaped for passenger and freight transport.
3. Overall assessment of the derived trends and challenges in order to identify patterns and sub trends.
4. Assessment and evaluation of the challenges the European Union will face in every one of the four pathways and proposal of solutions.

<u>The key factors – issues that were used to analyse the passenger side, were the following</u>:

1. Issues regarding the general framing of transport-related developments:
   - Ongoing globalisation / protectionism
   - Growth in passenger volumes
2. Issues regarding land-use patterns and related mobility patterns
   - Urbanisation
   - Difference in behaviour between urban and rural populations
3. Issues regarding transport- related attitudes and preferences
   - Pace of change and characteristics of lifestyles / lifestyle preferences
   - Change in factors influencing mode choice / preferences (incl. travel time use)
   - Behaviour of different age groups / cohorts
   - Openness towards innovation
4. Issues regarding the purpose of trips

- Relevance and characteristics of commuting
- Importance / characteristics of leisure trips, e.g. distances/destinations, frequencies
- Growth in online shopping

The key freight issues identified were the following:

- Freight volumes in general in relation to global economy
- Openness of global international trade markets (Protectionism vs Globalisation in production & consumption)
- Global supply chains vs. 'regionalism'/regional production
- Higher / lower transportation costs
- Consumption behaviour in relation to ethical values
- Development of alternative lifestyles
- Factors preferences in relation to owning - Switch from "Ownership" to "Sharing"
- Behaviour of different societal groups due to economic inequalities
- (Technological and organizational) Changes in Supply chain operations for safety and security reasons
- Innovative technologies for logistics (including city logistics)
- New technologies for Energy saving and environmental awareness

A summary of the passenger transport analysis of the four pathways in terms of main trends and challenges is given below in Table 2 and Table 3:

Table 2: Summary of trends for passenger transport

Pathway	Summary of passenger trends
Unlimited	• Market driven development of land-use patters together with "nomadism" and extreme globalisation maximise passenger travel demand • The global increase in passenger travel is immense. Being fast and/or the option of making more use of travel time is a key-factor for transport related choices • Cars are seen as a fast and convenient way of transport, in particular for shorter distances; there is a huge market for highly efficient zero-emission cars. New forms of mixtures between cars and e-bike are gaining market shares, but also cars in traditional style are popular • In urban areas, apart from cars and e-bikes, underground systems are very popular and offer a perfect environment for work-related activities and virtual communication.
Passivity and chaotic collapse	• Because of protectionism and the danger of terrorist attacks, there is not much international transport • Most trips are work-related and for getting things done. • Because of high energy costs, lack of investment in infrastructure and security concerns many longer distances business trips are substituted by phone and video conferences • The national states are dominating European policy, but flexibility and resilience are the only policy strategies that find broader support. • Most striking development in the transport sector is the new dominance of all kinds of bus service for longer and for short trips. Rail-bound forms of transport are given up in many regions.
Cooperation and degrowth	• Because of scarcity in resources efficiency is an overarching paradigm. • Small and medium sized cities are perceived as the most sustainable urban structure. • Rate in car ownership is low; people use public transport, car sharing and e-bikes. • Rail linkages between the cities flourish since rail offers and energy-efficient connection in the dense network of cities. The entire rail system profits from this development, only high speed rail is losing in importance, because there is less demand for longer distances. • Driven by the increase in tele-working and the "cities of short distances" commuting is losing in importance.
Smart and spiritual	• People live very conscious and reflexive; they work less and spend more time for leisure and spiritual exercise. Decisions are based on clear norms and values. • Private cars are banned in most cities.

Pathway	Summary of passenger trends
	• Integrated solutions of public transport, car-sharing, cycling and walking are the backbone of urban transport systems. Urban areas are attractive and are growing – but there is some interest in rural areas where there are not much alternatives to privately owned cars and e-bikes. • Because of tele-working and online shopping there is a strong decrease in commuting and a continuous growth in leisure related trips.

Table 3: Summary of challenges for passenger transport

Pathway	Summary of Passenger challenges
Unlimited	• New demand patterns for cars emerge with "pragmatic-cars" for just travelling fast and "fun-cars" that are designed and used for leisure purposes. • The extreme progress in development and implementation of green technologies has strongly reduced the transport-related emission of pollutants, climate gases and noise. But congestions is a major challenge in urban areas. • Infrastructures are needed to make urban areas attractive for highly skilled nomads. • Urban areas absorb public and private funding and not much is left for rural areas; public transport is getting too expensive in areas with low and density in population • Huge demand for e-bikes and mixtures between cars in both rural
Passivity and chaotic collapse	• It is difficult to get funding for the maintenance and extension of infrastructures. The transport related market that is growing most is the one for busses. • There is still a small demand for luxury cars but the majority of sold cars are small, efficient and robust vehicles • Only in the bicycle sector, there is some interest in robust and durable e-bike, since these are the cheapest and most convenient alternative to busses.
Cooperation and degrowth	• The high cost for resources and the limited private and public budgets for transport are a major challenge. • The main challenge of rural areas is the high fluctuation in transport volumes, in particular in areas which are attractive for leisure activities and tourism. • A further challenge for European transport industries is the decrease in cars sales and the reduced importance of long-distance trains. At the same time, the demand for inner- and intercity connections is increasing. • In the automotive sector highly efficient cars are required. Car makers offer car-sharing and related services and become mobility providers.
Smart and spiritual	• It is difficult to sell cars and building of car-friendly roads is old fashioned. Industry need to adapt to this situation by changing to products and services that are in line with the highly demanding societal preferences. • There is a high need for profound technology assessment to support processes that are labelled as responsible innovations. • People want to be strongly integrated into political decision making. Together with tight budgets this leads to long lasting planning processes

A summary of the freight transport analysis of the four pathways in terms of main trends and challenges is given Table 4 and Table 5 below:

Table 4: Summary of trends for freight transport

Pathway	Summary of freight trends
Unlimited	• Globalisation becomes the dominant trend. • Emerging economies catch up with the rest of the world and play a significant role creating extra demand as new consumer markets but also become producers. • Cross border customs agreements allow the ease of freight transport. • Nomadism becomes a mainstream lifestyle that creates shift patterns in traveling population and big dispersion of consumer markets. It will drive a sharing attitude for freight serves due to consumer needs.

Pathway	Summary of freight trends
	• Technological advances in green and reverse logistics, green modes of transport, aerodynamics and propulsion methods, new lightweight materials. Production methods such as Just In Time, mass production and agile.
Passivity and chaotic collapse	• Protectionism becomes the main trend and leads to the creation of regional economies that focus on the primary sector. • Countries that still have energy and natural reserves, which might have not been heavily affected by climate change and have kept a good level of transport infrastructure, will drive demand and production leading to the creation regional hubs. • Climate change and sea level rise will affect certain parts of the world giving rise for alternative modes of transport, i.e. see and waterbone freight transport. • Reduction of freight services due to economic crisis and global instability, limited & expensive energy resources, wars and terrorist attacks and crumbling transport networks. • Mass migration towards other countries or rural areas where people will focus on the primary sector
Cooperation and degrowth	• Natural resources and energy reserves are monitored globally by governments, ensuring sustainable usage and extraction. • Through government initiatives manufacturers will become responsible for the entire lifecycle (cradle to grave) of certain products i.e. electrical, electronic or mechanical. • New emerging economies become new markets for production and consumption despite not reaching previous western world levels. • Due to the externalisation of technology, transport and energy costs, product prices will increase, leading to lower consumption and reduction of transported goods. • New business models for sharing transport freight services will emerge, in order to bring down energy and environmental compliance costs. • Technology will focus towards efficient means of transport based on energy efficiency, new lightweight & stronger materials, improved aerodynamics & propulsion methods and more environmentally friendly manufacturing processes. • The use of 3D printing will only achieve to capture a specific segment of the overall market, while conventionally manufactured products will still dominate.
Smart and spiritual	• Global spiritualism where societies become anti-materialistic and give emphasis on spiritual experiences rather than obtaining wealth and consumer products. • Societies demand more environmentally friendly, smaller flexible means of mass transport for rail seas and air. • Mixed passenger and freight solutions become mainstream in order to compensate the smaller volumes of transported goods, fully utilising the existing infrastructure. • Shared freight services play a considerable role in keeping transport costs low. • The demand for open spaces and free from traffic city centres, will give rise to city logistics and new infrastructure that allows the usage of environmentally friendly means of transport • 3D printing becomes mainstream and provides a form of on the spot manufacturing providing highly customised products that meet customer needs.

Table 5: Summary of challenges for freight transport

Pathway	Summary of Freight challenges
Unlimited	• New demand and the creation of global supply chains mean that existing infrastructure will require additional capacity and improvement of the existing one. • Nomadism will cause housing demand and freight related to construction equipment and materials. • Despite the advent of technology the major issue will be to achieve all the objectives of fast, reliable, safe, energy efficient transport services at lowest possible cost. • New manufacturing processes and production methods might face difficulties in making the use of new advanced materials largely available in products. 3D printing customised logistics will also be difficult to achieve.
Passivity and chaotic collapse	• The few remaining global supply chains will have to show resilience and adaptiviness in an extremely challenging environment. • Countries that will become regional supply hubs will need to show flexibility in order to in the

Pathway	Summary of Freight challenges
	long term to integrate with the global supply chains. • The limited technological investments will have to focus on energy saving technologies, while the few remaining manufacturers/ shippers will have to invest on the infrastructure they use. • Safety & security issues of freight transport will cause changes in route planning, while precautionary measures will need to be taken on route to protect the cargo.
Cooperation and degrowth	• Companies/ manufacturers/ freight companies have to comply with the increasing environmental legislation. • Manufacturers will face difficulties in becoming responsible for the entire product life cycle from cradle to grave, thus requiring additional freight services. • Governments will face the challenge of creating global policy agreements for a single cross border tariff. Specifically, proper allocation of revenue between freight companies might prove to be more difficult that initially thought. • The ease of government taxation will be crucial for the struggling freight companies /shippers already operating with small profit margins, caused by high transport costs and consumption penalties • The advent of 3D printing will require customised logistics and monitoring of this market, so printing does not become unregulated while conventional means of manufacturing face heavy regulations and taxation.
Smart and spiritual	• The main overall challenge would be to achieve city centres that are free of traffic leading to the development of city logistics solutions such as small, light, flexible and environmentally friendly freight means. • Production will need to be able to quickly respond to demand of population who will migrate to the country side. • Migration will require the creation of a platform that allows people to share the transportation of their belongings to the same destination. Planning such logistics might prove to be a challenge. • The shift from consumerism and old human habits, to anti-materialism might not prove to be easy for everyone

After presenting the overall freight trends and challenges it was evident that some solutions had to be proposed in order for the EU to be able to tackle these challenges within the context of each pathway. Focus was given on how the EU could remain competitive in future challenging environments. The following Table 6 presents the related suggested solutions for overcoming challenges in the EU freight transport.

Table 6: E.U. Proposed solutions for overcoming EU freight challenges

Pathways	Proposed solutions
Unlimited	• European governments and manufacturers will need to create cooperative agreements in order to create business models that at will compete against global corporation. The focus will be on creating strong non-competitive relationships in a European level. • Utilisation of geographical, technological and environmental advantages of EU member states/corporations against other states. • Provide economic incentives to European corporations for remaining on EU territory as well as for those willing to move their manufacturing activities inside the EU. • Focus on creating strong bonds between suppliers, shippers and manufacturers within the EU in an effort to create fast & flexible regional supply chains.
Passivity and chaotic collapse	• European governments and manufacturers will need to create cooperative agreements in order to create business models that will focus on the survival of the continent. Trade or exchange of energy, land, resources, technology between the state members. • Cooperation between the state members in order to create low technology and cost solutions that will help all countries to overcome the issue of limited resources (i.e. think tanks, innovation groups). These solutions might be as simple as new management methods and better planning and organisation of resources. • Unite regional supply chains within EU making the continent a global supply hub. • Focus on EU political stability as a whole and creation of common EU policies on terrorism, crime and planning for extreme weather effects.

Pathways	Proposed solutions
Cooperation and de-growth	• European governments and manufacturers will need to cooperate in order to create an environmental policy and legislative framework for environmental protection and preservation of energy and natural resources. • Creation of a platform that focuses on exchange of technology and innovation within EU in an effort to comply with increasing global environmental legislation quickly, thus becoming more competitive. • Creation of a single tier EU zone where all emerging economies would have finally caught up with the rest of the EU developed member states. • Creation of a single EU regulator responsible for managing and planning all freight transport within EU. • Creation of environmental campaign focusing reduction at source, re-use, recycling both on manufacturing and consumer level.
Smart and Spiritual	• EU governments will need to create a common policy framework for the development of new city logistics, in order to promote open spaces and free of traffic city centres. The development of infrastructure that will facilitate these city logistics will also be necessary. • Development of means of transport that can carry both freight and passengers. • These new mixed freight and passenger movement might prove to be a challenge during customs checks. Hence, EU member states will need to create frameworks that will allow such means to pass through customs without long waiting times for passengers. This mean that extra security measures will be required before freight is loaded onto these means. • Development of an EU policy for enabling teleworking to be easier i.e. taxation issues, infrastructure, company initiatives for the promotion of teleworking. • Provide initiatives for the EU automotive industry to change its business towards new green alternative modes of transport, due to the gradual phase out of the car.

4. Long-term perspective on the global supply-side

Another aspect of FUTRE project was to study the supply side of the transport system, on emerging or anticipated technical and organisational innovations and their potential impacts on the competitiveness of the European transport sector.

Identification of relevant transport innovations

Part of the work involved the description of upcoming transport-related products, services, and infrastructure innovations until 2030 and beyond, which are considered as being relevant for FUTRE. The process of selecting relevant innovations started by compiling a long list of upcoming innovations in the transport sector. The long list entails innovations that are described in several FP-7 projects and in other documents. Based on expert judgment this long list was cut down to a short one.

Innovation fields

Automation of road transport

Autonomous driving systems have the potential to reposition the road transport within the overall transport landscape, but not on a short term-basis. Beyond 2030, however, the introduction of full autonomous driving in road transport is considered to be of potentially disruptive character. Driverless cars could dramatically change perceptions and attitudes towards this new kind of road transport. Still, there is a high degree of uncertainty as regards fundamental issues such as the degree in automation that will be achieved.

Fuels and propulsion technologies
It seems to be highly likely that alternatives to oil based fuels will experience a far-reaching market penetration in the next decades. But it is not clear yet, what exactly will be the fuel of the future in the different segments of the transport sector. It is still open whether electric drives will be fuelled by batteries or by hydrogen and fuel cells. Further progress is expected in both fields and further progress is as well expected for hybrid technologies, which will surely become a more important technology in the next decades. Also, for biofuels and gaseous fuels further progress is likely, which might improve their competitiveness compared to other options.

Improving the means of transport
This includes e.g. lightweight materials, improved aerodynamics and new construction technologies. Until 2030, developments can be expected to focus on incremental improvements of existing technologies. Aviation and rail-bound innovations show high shares of patent applications coming from European countries, with a German focus on rail-bound innovations and a French focus on aviation.

Intelligent transportation systems
ITS is ranking high on the agenda of European transport policy. It can be assumed that ITS will play a significant role in improving and supporting transport and in contributing to a cleaner, safer and more efficient and accessible transport system.

Services & organizational innovations
This entails approaches which bring together supply and demand in a new and innovative manner. In particular the shift from vehicle ownership towards vehicle usage is rather radical and can be expected to become systemically relevant in the future. Significant developments can also be expected for integrated ticketing. Also in the freight sector, new logistics concepts will be a significant challenge for the respective industries to adapt logistic chains and their business organizations.

Infrastructures
This considers innovations that contribute to the improvement, adjustment and extension of infrastructure of existing transport modes as well as to the introduction of new kinds of transport infrastructure. Different approaches have been described such as the (rather incremental but effective) extension of the rail network or complex approaches such as the introduction of dynamic pricing. Due to the long time horizon of infrastructure investments, mainly improvements of existing infrastructures can be expected until 2030.

Out-of-the-box transport innovations

An overview on selected candidates is given, including urban cable cars, personal rapid transport, CargoCaps, inductive charging for electric vehicles and personal air vehicles.

Constraints on innovations

This task involved an analysis of potential future constraints for the previously mentioned innovations. Since more than a decade, growing scarcity of fossil fuels and energy in general was

considered to be a constraint on innovation. A shift from a fossil fuel based transport system towards a system mainly driven by renewable energy carriers significantly changes the demand for specific raw materials. Elements like copper, lithium, rare earths and scandium will be required to enable the transition towards a sustainable transport system.

Therefore, an estimation of the future level of criticality of a raw material is crucial to identify bottlenecks and intensify research for substitutes. In FUTRE a qualitative assessment of the implications of 15 key transport innovations on critical raw materials was carried out for the time horizon until 2030. In a second step, two diffusion scenarios focusing on road mode were set in order to quantify the impacts on some exemplary raw materials.

Impacts of transport innovations on competitiveness

This third step focused on identifying factors leading to a comparative advantage or disadvantage in relation to the collected major innovations until 2030 and beyond. The evaluation of the technologies is very important to estimate the competitiveness that will be configured in the European transport sector until 2030. For this reason, the main part of the task was to have a contact with some transport experts and gather their opinion about each innovation technology and the impact that probably will have on transport sector competitiveness.
The workshop was organized on 28-29 November 2013 in the premises of the European Council of Transport Research Institutes (ECTRI) in Brussels, Belgium under the topic: '**Emerging Transport Innovations & Technologies'**
The conclusions which arose after the completion of the workshop are the following:

- Enhancing the role and the importance of ICT systems and technologies to the transport services.
- Full autonomous driving is expected to be mainstream in the next 20-30 years. More and more efficient driver assistance systems will be implemented in road vehicles.
- Technologies related to energy (e.g. renewable energy technologies) are one of the most important innovation fields in the transport system. There is a need for cheaper solutions or people become less dependent on energetic imports.
- There should be a focus on the creation of persistent and cheap materials for roads. Since the EU is implementing the "Pay per use" philosophy for the road transport sector, it is essential to find more resistant materials for roads, so that maintenance shall be cheaper in the long term.

The conclusions which emerged from the comments that the experts wrote in the questionnaire are the following:

- Shift from rail, buses and bikes to individual motor – vehicles.
- Strong development in electric vehicles (e-cars and e-bicycles). Rise of the role of e-mobility to the global transportation system.
- Research will be intensified in the field of lightweight materials, because less weight means less energy consumption and this is a very important factor for freight transport.
- Ubiquitous internet access to harmonized traveler information (passenger) and tracking information (freight) will be part of any transport system.
- Major developments in warehouse logistics (intra-logistics). This type of logistics will evolve into a new strength for European logistics systems manufacturers.
- Major development in innovative sharing services (car sharing, bike-sharing etc.). There will be a strong "sharing" attitude at the "ownership" of vehicles especially in urban areas.
- Use of innovative transshipment technologies for rail, inland waterways and shipping on seamless intermodal freight.

In the end the results from the questionnaire and the workshop were combined and some conclusions were drawn regarding the best technologies from each innovation field. Specifically, the conclusions are the following:

- From the field of automation of road transport the chosen technology is "advanced driver assistance systems".
- From the field of fuels and propulsion technologies, "Hybrid technology (allowing pure electric drive for a certain distance)" has been selected.
- From the field of improving the means of transport, "Lightweight materials (e.g. carbon fibers)" has been selected.
- From the field of intelligent transportation systems, "internet access to harmonized traveler information (passengers) and tracking (freight)" was chosen.
- From the field of the services and organizational, "smart ticketing schemes" has been selected
- From the field of the Infrastructures the chosen technology "Innovative transshipment technologies".

5. Scenario-based assessment of the competitiveness of the European transport sector

FUTRE developed potential future pathways for passenger and freight transport until 2030 and beyond, as described in sections 2 and 3. The next step was to combine the pathways for future travel patterns with the knowledge gained on potential key innovations in transport. The target of the scenario framing was to set up three scenarios providing a consistent picture composed out of a set of key innovations and trends for consumption and travel patterns. Finally, these so-called storylines needed to be translated into quantitative inputs for an integrated modelling approach. To analyse the dynamics between the key transport innovations provided by the European transport industry and the changing travel patterns for passenger and freight is the main objective of the application of the modelling toolset consisting of ASTRA-EC and TRANS-TOOLS. It should provide an understanding of the market reactions on major upcoming transport-related innovations under the framework of changing demand needs on a European scale. ASTRA-EC is a dynamic, integrated transport, economic, environmental and technology model based on the System Dynamics methodology. It can simulate changing travel patterns in a bottom-up way following the first three stages of the classical four stage passenger and freight transport modelling approach consisting of generation, distribution, modal split and assignment. For the last stage, a detailed transport network is required which can only be provided by a network-based transport model like TRANS-TOOLS. In order to enable the simulation of congestion effects a linkage between ASTRA-EC and TRANS-TOOLS was planned, designed and developed. TRANS-TOOLS follows a standard transport modelling approach, the widely accepted 4-step one encompassing trip generation, trip distribution, mode choice and network assignment. It builds on different modules that maintain a coherent structure that allows future improvements and connections with other tools and models.

Due to similarities of the four pathways that were described in section 2, the last two have been combined into one to make the quantification with the modelling toolset easier. Specifically, the revised scenarios are the following:

Scenario I "Unlimited": In this scenario, with the help of technological progress, it is possible to control the crucial environmental and energy problems. Current social practises may continue and even follow a path of increased consumerism and thirst for travel. Global economic competition is the most important driver of societies.

Scenario II "Passivity and Collapse": This scenario describes a world where society was not able to address the impending environmental and energy problems. Societies ultimately fall economically and politically. The scenario emphasises the consequences of a collapse of every type and the inherent uncertainty and need of quick adaptation in an unstable world.
Scenario III "Responsible Growth": In this scenario the prospect of environmental and economic collapse leads people and countries to cooperation, in order to properly manage the global commons in a responsible way. Since the pace in (responsible) innovation is not high enough to cope with the grand challenges, this necessarily involves drawing back the economic output to a level consistent with sustainability. People consume and travel less, incentivised by various policy incentives concerted at an international level. Sustainability and also safety become overriding paradigms.

The table below presents the specific fields and trend factors that have been considered in the ASTRA-EC model for all three FUTRE Scenarios.

Table 7: Summary of key elements of the three FUTRE Scenarios

	Scenario I	Scenario II	Scenario III
Economy	Globalised, +2.0%	National, +0.2%	Control, +1.0%
Climate	Small problem	Huge problem	Challenging
Lifestyle	Nomadic	Working	Leisure
Innovation	Extreme progress	Slow progress	Responsible Innovation
Land use	Megacities	Urban sprawl	Medium-sized cities
Passenger volumes	Increase	Decrease	Like BAU
Freight	Increase	Decrease	More regional
Cars/1000 inhabitants in the EU15	650	400	250
Fuels for cars	Non-fossil	Fossil (some BEVs)	Mixtures
Long-distance trucks	CNG/LNG	Diesel	Methane/diesel/H_2
Car usage	Owning/leasing	Owning/sharing	Sharing
Urban transport	Cars	Buses	No cars
Energy price	Low	Medium (oil: 200$/barrel)	High (oil: 300$/barrel)

The following figures present the main ASTRA-EC model results. Figure 2 shows the projections of modal share of passenger transport modes for the **year 2050**, while Figure 3 shows the equivalent for freight transport. For passenger transport the car remains the dominant mode for all scenarios, while the second position is taken by Air under the Unlimited scenario, Bus in Passivity and Train in Responsible growth scenarios. On the other hand in Freight transport Truck is the dominant mode across all scenarios, while Maritime takes the second position. Trains seem to be the third choice in each case. Figure 4 shows that under the Unlimited scenario the dominant technologies for 2050 will be FCEV, BEV, Gasoline and Diesel. For Passivity Scenario the dominant technologies will be Gasoline, Diesel and CNG, while for Responsible Growth FCEV, Gasoline and Diesel are the dominant ones.

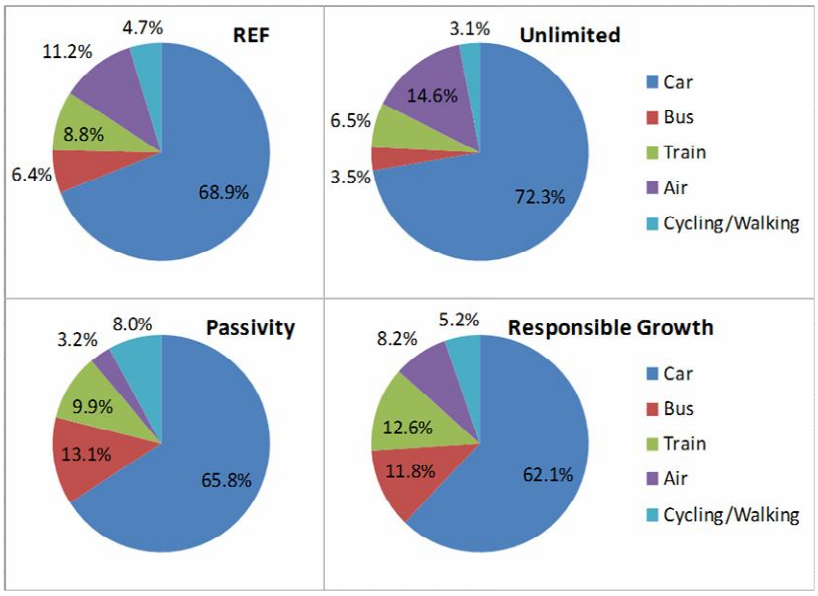

Figure 2 – Comparison of passenger modal share (in terms of pkm) in EU27 for year 2050 in all FUTRE Scenarios

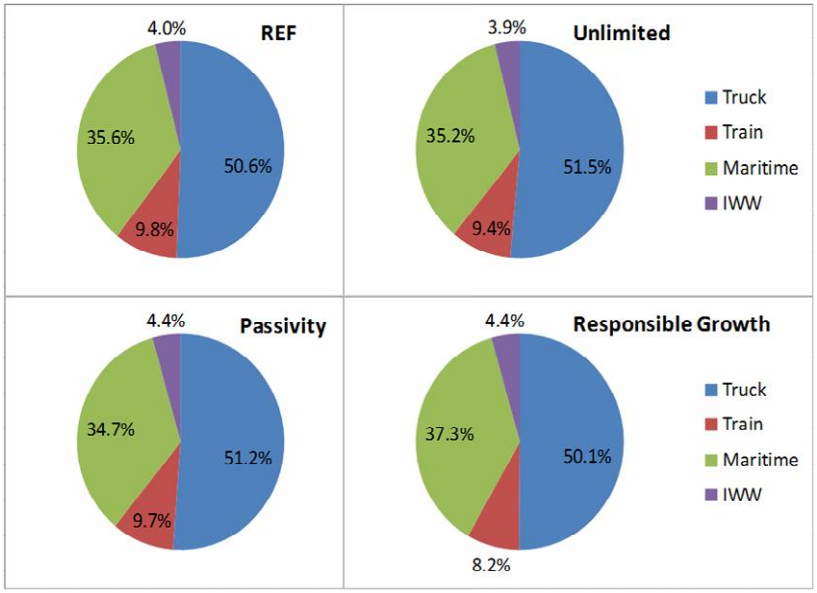

Figure 3 – Comparison of freight modal share (in terms of tkm) in EU27 for year 2050 in all FUTRE Scenarios

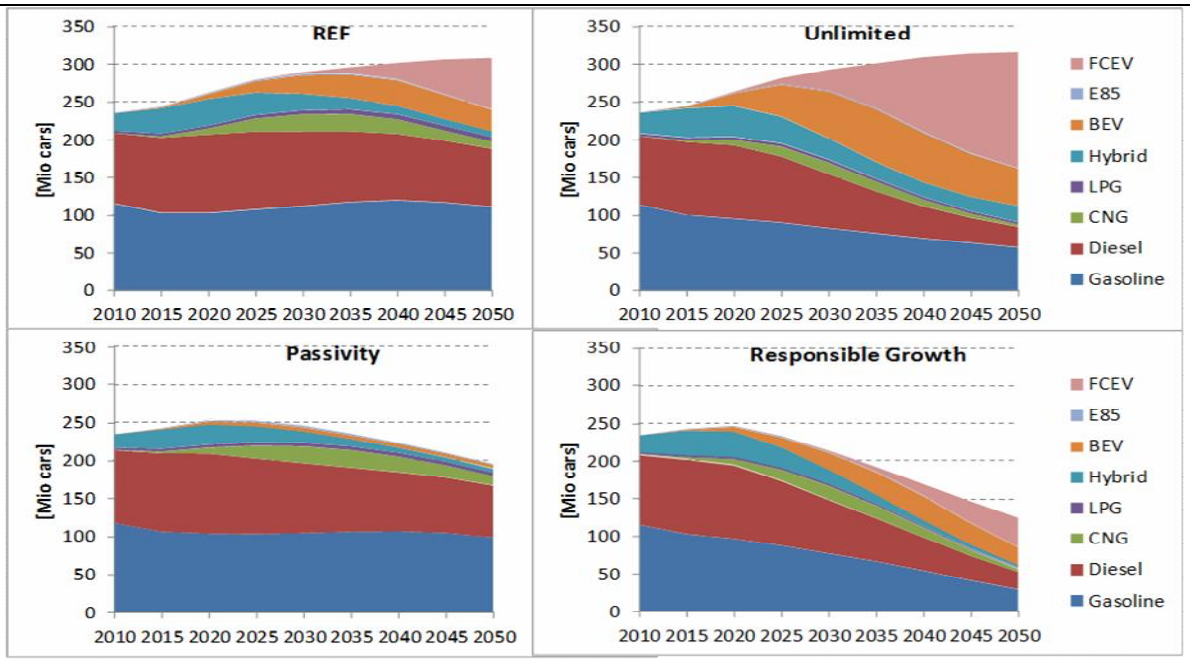

Figure 4 – Diffusion of fuel technologies in EU27 car fleet in all FUTRE Scenarios

Figure 5 demonstrates the impact of the changing transport patterns and technological composition of vehicle fleets on tank-to-wheel CO_2 emissions in EU27 differentiated by passenger and freight transport. While technology in terms of alternative fuel vehicles or energy efficiency for road modes offers large reduction potentials, the reduction potential for air transport is rather limited. The strong decrease of passenger-km in the Responsible Growth and the Passivity Scenario in combination with a modal shift towards less CO2 intensive modes leads to a reduction of passenger transport related CO_2. In contrast to passenger transport the stronger increase of freight ton-km already in the REF Scenario leads to a stagnation of freight CO_2 emissions in 2050. High investments in R&D in the Unlimited Scenario boost a diffusion of energy efficient freight vehicles which enables a reduction of CO2 emissions by nearly 50% until 2050 compared with REF. As expressed in relative savings of direct CO_2 emissions compared with levels of 2010, a reduction of 40% can be achieved in the Responsible Growth Scenario, of 34% in the Passivity Scenario and 27% in the Unlimited Scenario. Therefore, the storylines do not exactly fit to the simulated reality as long as there will be technologies developed and will experience a breakthrough enabling a significant reduction of carbon intensity of air and maritime transport.

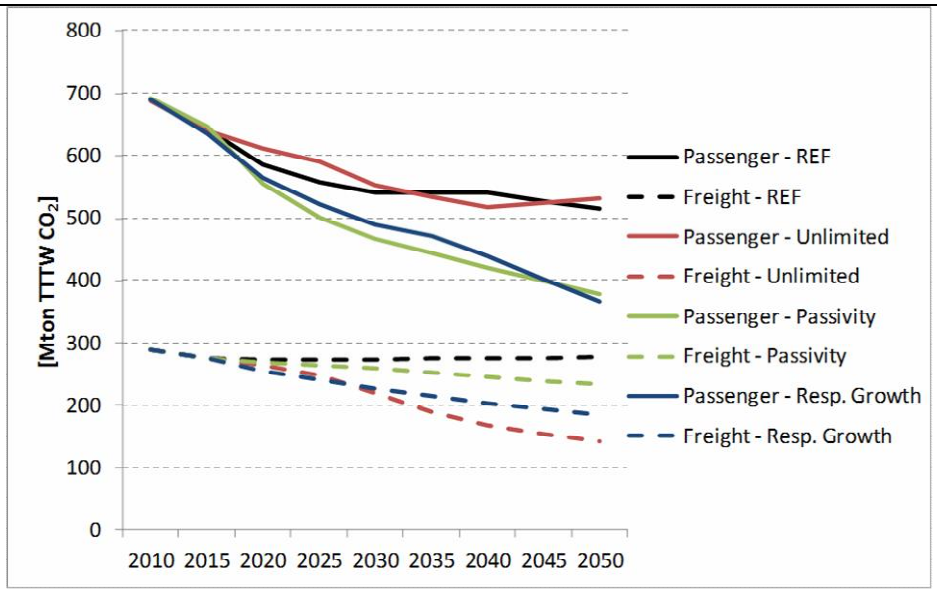

Figure 5 – Passenger and freight transport CO2 emissions (tank-to-wheel) in EU27 in all FUTRE Scenarios

Assessment of Competitiveness

Another task that was strongly based on the results of section 1 was to assess competitiveness under the three FUTRE scenarios with the use of different indicators. These indicators reveal the drivers for the competitiveness of the sector which are related with mobility patterns and the innovation capacity of the different transport subsectors. Other indicators show the outcomes of each scenario in terms of economic performances and environmental and social costs. The set of indicators that were used were characterized as: 1) labour cost and productivity; 2) innovation; 3) output measures and; 4) international competition. The results of TRANSTOOLS modelling task are given below (Figure 6-8) for each FUTRE scenario.

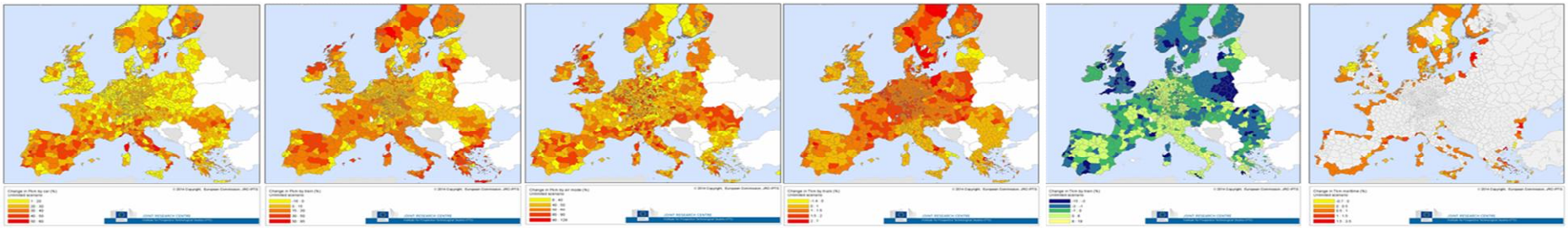

Figure 6 - Regional distribution of changes in passenger (pic 1-3- car/train/air) and freight (pic 4-6- truck/train/maritime) transport activity levels for the Unlimited scenario in year 2030 (% in relation with the Reference scenario).

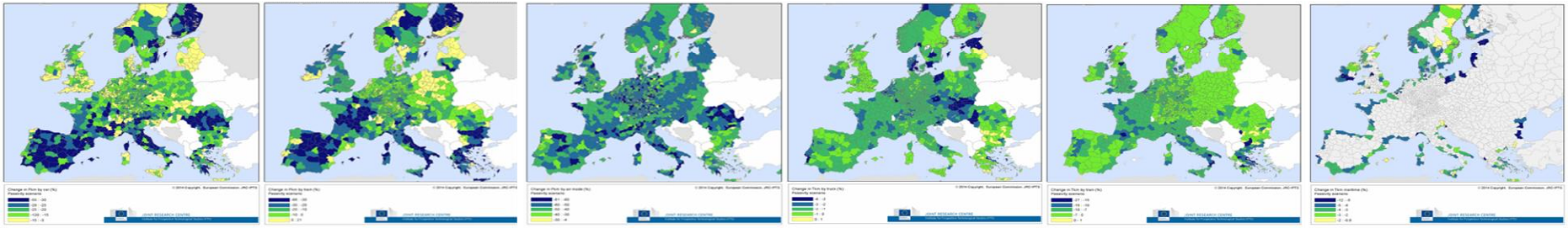

Figure 7 - Regional distribution of changes in passenger (pic 1-3- car/train/air) and freight (pic 4-6- truck/train/maritime) transport activity levels for the Passivity and chaotic collapse scenario in year 2030 (% in relation with the Reference scenario).

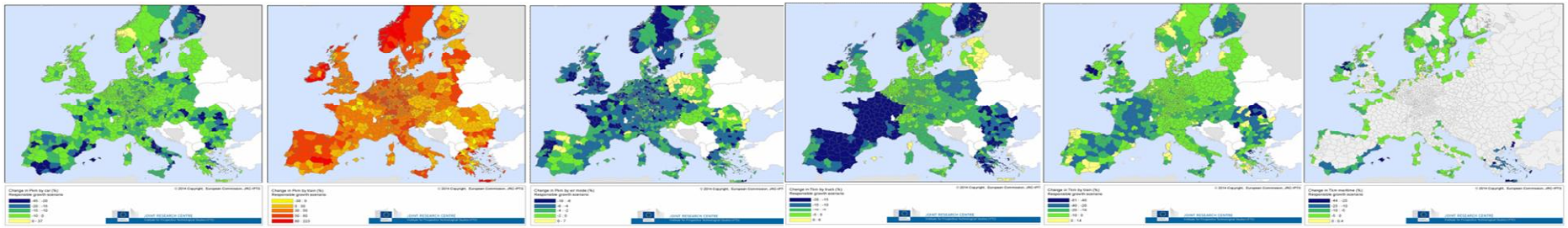

Figure 8 - Regional distribution of changes in passenger (pic 1-3- car/train/air) and freight (pic 4-6- truck/train/maritime) transport activity levels for the Responsible Growth scenario in year 2030 (% in relation with the Reference scenario).

6. Options for the EU research policy

One of the main objectives of FUTRE was to assess the effects of future challenges, demand drivers and upcoming innovations on the competitiveness of the European transport sector as described in section 5. Another one of FUTRE's main and most important objectives was the use of information from section 5 as a basis to develop strategic options for transport-related research activities.

Strategic options for European transport research policy

The first part of the analysis contained suggestions for a strategic EU transport research policy in order to promote important innovation areas and overcome constraints. Furthermore, the proposed policy measures focused on the role of EU transport research policy as a mean to improve competitiveness and increase sales for the industry. Specifically, these policy measures consisted of recommendations on how the EU could help the industry through mechanisms such as funding; promotion of legislation and technologies; provision of support services for companies such as coaching and mentoring; excellence in education as well as access to information and technology for companies. These mechanisms are based on action plans that the EU currently uses within the framework of innovation as well as company support.

Policy measures for the Unlimited scenario

Table 8- EU transport research policy measures for the Unlimited scenario

	Low prospects of sales	High prospects of sales
Strong industry	**Rail** - Financial investment for companies developing innovative high speed infrastructure through direct funds, competitive R&D grants or credit guarantees (in order to make the rail mode more attractive through journey time minimisation). - Investment in research for design and development of innovative systems that will enable intermodal/ comodal integration of the rail mode into seamless transport systems in order to create sales by making the mode more attractive (ITS and integrated ticketing). - European vision and roadmap for door-to-door intermodal passenger travel information service. - Development of legislation allowing information sharing between companies/ countries in order to allow integrated ticketing. - Development of innovative legislation schemes that allows revenue sharing between companies. - Establishment of cooperative platform & single European standards with the aim of cross border interoperability throughout Europe. - Development of a single safety legislation platform allowing the improvement of safety across the EU rail network.	**Automotive (private cars)- small support** - Financial support (competitive R&D support or credit guarantees) to innovative companies that will develop solution on alternative fuels. - Introduction of regulatory regimes and standards for the use of autonomous control technologies, V2X and ITS. - Introduction of cooperative platforms for the creation of single innovation market in order to create a common line for the choice of technologies made by the EU companies. - Promoting excellence and educational skills in promising innovation areas (i.e. electromobility). Vocational training schemes and research initiatives related to this area. - Financial and coaching support to clusters that promote technology exchange between companies in order to create a strong competitive EU industry against rivals. **Aviation- small support** - Promotion and support to aviation special interest groups with the focus on bringing in together customers (airlines), consumers (passengers) and policy makers in order to design future aircrafts meeting everyone's needs. - Financial support through direct funding or competitive R&D grants for manufacturers with the aim of innovative design for green and lighter

	Low prospects of sales	High prospects of sales
		aircrafts - Introduction of regulations/ legislation promoting the use of alternative propulsion and fuels.
Weak industry		**Automotive (alternative fuel technologies)** - Financial support to innovative companies that are related to the manufacturing side of alternative fuel technologies. Direct funding, competitive R&D grants or credit guarantees. - Support in the improvement of refuelling infrastructure taking in consideration sustainable production and storage (i.e. for hydrogen). - Research support for the exploration of alternative funding schemes that can be used by private companies for the creation of alternative fuel refuelling infrastructure. - Standardisation for refuelling infrastructure through restrictive regulations. - Creation of an EU Platform for battery technology platform bringing in all industry stakeholders (i.e. working groups from mining, manufacturing, systems, standardisation, recycling and overall framework). - Promoting excellence and educational skills for production of fuel cells and electric batteries. Vocational training schemes and research initiatives related to this area. **Automotive (commercial vehicles)** - Creation of support services for commercial vehicle automakers such as: o Financial support and risk sharing for innovative companies creating joint ventures in non EU countries i.e. competitive grants, direct support. o EU support through technology showcases and exhibitions for EU commercial vehicle manufacturers. o Consultancy services and coaching for identifying foreign market needs. o Support of the industry through networking services with foreign markets. - EU to assist OEMs by creating technology platforms for information sharing across the EU between research centres, universities and the industry in the field of alternative fuels and other energy saving technologies. **Maritime** - Support clusters offering information exchange between companies and countries.

	Low prospects of sales	High prospects of sales
		- Direct financial support to companies through the creation of pool funds between member states or credit guarantees. - Enhance the awareness among SMEs and inclusion of SMEs into national support frameworks and schemes such as coaching / mentoring. - Improve resource efficiency through the creation of quality assessment schemes for shipyards at world-wide level. - Promote openness and capitalise on Europe's creative potential by sharing the results of EU research across the industry including SMEs where currently only the larger companies tend to benefit from.

Policy measures for the Passivity scenario

Table 9- EU transport research policy measures for the Passivity scenario

	Low prospects of sales	High prospects of sales
Strong industry	**Aviation** - Support research that will promote alternative fuels, energy and emissions efficiency in order to reduce cost and dependency on conventional fossil fuels. - Research support to alternative solution for scarce raw materials and environmental friendly practices in the industry through competitive R&D grants and EU support services such as coaching. - Financial support for the improvement of on board safety and airport security. - Support of aerospace clusters with the aim of sharing technology, information or even patents. - Support services for SMEs in order to reduce the cost of accessing knowledge, research & innovation and technology through participation in networks, joint research as well as mentoring/coaching. - Promotion of standardisation in terms of technologies that will be used by the aviation industry in order to reduce development and manufacturing costs. - Creation of PPP calls as a tool to bring in investors (governments, airlines, aircraft manufacturers and others) in order to design new aircrafts that meet current needs. **Automotive (private cars)** - Support through financing and coaching for the creation of platforms for car pooling and sharing, with the automotive industry taking considerable part as an added value services provider. - Financial support for companies researching on improving energy efficiency of ICE as well as on fuel blends & multifuel engines.	**Automotive (buses)- small support** - Promotion of integration of buses into intermodal/ multimodal traveling. - Public procurement of more efficient ICE, fuel blends & multifuel engines. - EU support in the creation of design & development centres aiming at the collaboration of consumers, universities and automakers aiming at finding optimum solutions for the design and manufacturing of new buses. - Calls for exploring alternative funding schemes with the aim of maintaining road infrastructure at certain areas including those that have been affected by climate change using pool funds.

	Low prospects of sales	High prospects of sales
	- EU support in the creation of design & development centres aiming at the collaboration of consumers, universities, research centres and automakers aiming at finding optimum solutions for the design and manufacturing of new vehicles. - The creation of a single innovation market in terms of vehicle design and propulsion technologies. - Creation of technology exchange & information platforms between EU automakers with the aim of reducing R&D as well as operational costs. **Rail** - Investment in research for design and development of innovative systems that will enable multimodal/intermodal integration of the rail mode with buses and other modes - Support integrated ticketing focusing on cost reduction between train mode and car sharing/pooling. - Development of legislation allowing information sharing between companies/ countries in order to allow integrated ticketing. - New legislation that allows revenue sharing between companies. - Development of a single safety legislation platform allowing the improvement of safety across the EU rail network. - Promote alternative fuel technologies that will reduce fuel costs for the rail industry (i.e. through European Innovation partnerships). - Alternative funding schemes for infrastructure such as PPPs.	
Weak industry	**Automotive (commercial vehicles)- high support** - Financial support through direct funds or credit guarantees for companies researching on efficiency of ICE, fuel blends and multifuel engines or any other energy efficient technologies. - Creation of support services for commercial vehicle automakers such as: o Consultancy services and coaching for identifying foreign market needs. o Support of the industry through networking services with foreign markets. o Promote adoption of environmental friendly practices in the industry through EU support services such as coaching or small financial support such as tax incentives. - Assist the industry in creating cooperative platforms to improve competitiveness towards Asian and US markets **Maritime - high support** - Financial support for companies that research on alternative fuels and more energy efficient and larger vessels. - EU support on the creation of design and development centres aiming at the collaboration of experts, universities, research centres and ship builders aiming at finding optimum solutions for the design and manufacturing of new vessels that will meet the scenario's needs. - Financial support on research for port side operations in order to make the connection between truck/rail and maritime more efficient. - Support clusters offering information exchange between companies and countries (i.e. creation of pool fund between	**Automotive (cheap and slower modes)** - Financial support for research related to the design of new or adaptation of existing infrastructure to the needs of slower modes i.e. bike lanes, rest and parking areas. - Promote integration of slower modes into public transport.

	Low prospects of sales	High prospects of sales
	member states) - Promotion of short sea shipping within the EU member states that are easily accessible by sea or IWW. - Appropriate political and economic framework conditions and creation of port hubs at strategic locations. - Improve resource efficiency through the creation of quality assessment scheme for shipyards at world-wide level. - Promote openness and capitalise on Europe's creative potential by sharing the results of EU research across the industry including SMEs where currently only the larger companies tend to benefit from.	

Policy measures for the Responsible Growth scenario

Table 10- EU transport research policy measures for Responsible Growth scenario

	Low prospects of sales	High prospects of sales
Strong industry	**Automotive (private cars)** - Research on new business models for sharing economy such as carpooling and car sharing. - EU support in the creation of design & development centres aiming at the collaboration of consumers, universities, research centres and automakers aiming at redesigning vehicles to be: bigger, more economical and ecological than the conventional types. - Financial support for joint ventures between OEMs and leasing companies. - Financial support to innovative companies that will adopt and introduce alternative fuel technologies into their vehicles. - EU platforms that will prepare the environment for new technologies involving regulations, verification and standardisation related to safety and operation of autonomous control technologies, V2X and ITS. - Promoting excellence and educational skills in promising innovation areas (i.e. electromobility). Vocational training schemes and research initiatives related to this area. - Mechanisms of generating consumer demand through incentives or innovative marketing techniques for the purchase of new vehicles utilising alternative propulsion systems. **Aviation** - Investment in research for design and development of innovative systems that will enable comodal/intermodal integration of the aviation mode into seamless transport systems in order to create sales by making the mode more attractive. - Platforms to promote commercial agreements	**Automotive (buses)- small support** - Promotion of integration of buses into comodal/intermodal traveling. - Public procurement of more efficient buses utilising alternative fuel technologies and propulsion. - EU support in the creation of design and development centres aiming at the collaboration of consumers, universities and automakers aiming at finding optimum solutions for the design and manufacturing of new buses. - EU financial support for R&D of inductive charging at bus stops or en route charging for public buses. - Promotion and use of ITS to assist in creating demand responsive transport and help improving efficiency of public transport operations. **Rail- small support** - Promotion of the development of high speed electric rail, making this mode more attractive and generating sales. - Investment in research for design and development of innovative systems that will enable comodal/ intermodal integration of the rail mode into seamless transport systems in order to create sales by making the mode more attractive (ITS and integrating ticketing). Strong focus on efficiency will be required. - European vision and roadmap for door-to-door intermodal information passenger travel service. - Development of legislation allowing

	Low prospects of sales	High prospects of sales
	between air and rail carriers for intermodal/comodal services. - Promotion and support to aviation special interest groups with the focus on bringing in together customers (airlines), consumers (passengers) and policy makers in order to design future aircrafts meeting everyone's needs. - Direct funding through competitive R&D grants and credit guaranties for companies developing i.e. greener, lighter aircrafts offering amenities that enhance the flight experience. - Aerospace clusters and special interest groups can be made with the aid of the EU, in an effort of technology and information transfer in terms of sustainable manufacturing and to assist companies dealing with heavier environmental regulations while still being competitive against non EU rivals. - Introduction of regulations/ legislation promoting the use of alternative propulsion and fuels in aviation.	information sharing between companies/ countries in order to allow integrated ticketing. - Development of innovative legislation schemes that allows revenue sharing between companies. - Promotion and financial support for companies that develop energy efficient locomotives either by looking at electric or hybrid propulsion with alternative fuels. Hence, lightweight rolling stock. - EU support in the creation of design and development centres aiming at the collaboration of consumers, universities and locomotive and rolling stock manufacturers aiming at finding optimum solutions for the design and manufacturing of new trains. - Development of a single safety legislation platform allowing the improvement of safety across the EU rail network.
Weak industry	**Automotive (commercial vehicles)- high support** - EU promotion of alternative fuels, energy and emissions efficiency of vehicles, lighter materials and heavy integration of ITS. - Financial support for OEMs developing new innovative technologies (see above) and incentives for companies that will integrate such technologies into their products. - Promotion of V2X and ITS systems in conjunction with green city logistics in order to reduce operative costs. - EU platforms that will prepare the environment for new technologies involving regulations, verification and standardisation related to safety and operation of autonomous control technologies, V2X and ITS. - Creation of support services for commercial vehicles automakers such as: o Financial support and risk sharing for innovative companies creating joint ventures in non EU countries i.e. competitive grants, direct support. o EU support through technology showcases and exhibitions for EU commercial vehicles manufacturers. o Consultancy services and coaching for identifying foreign market needs. o Support of the industry through networking services with foreign markets. - EU to assist OEMs by creating technology platforms for information sharing across the EU between research centres, universities and the industry in the field of alternative fuels and other energy saving technologies. -	

	Low prospects of sales	High prospects of sales
	Maritime- high support - Direct financial support to companies through the creation of pool funds between member states or credit guarantees. - EU support on the creation of design and development centres aiming at the collaboration of experts, universities, research centres and ship builders aiming at finding optimum solutions for the design and manufacturing of new vessels that will meet the scenario's needs. - Enhance the awareness among SMEs and inclusion of SMEs into national support frameworks and schemes such as coaching / mentoring. - Improve resource efficiency through the creation of quality assessment scheme for shipyards at world-wide level. - Promote openness and capitalise on Europe's creative potential by sharing the results of EU research across the industry including SMEs where currently only the larger companies tend to benefit from. - Promotion of short sea shipping within the EU member states that are easily accessible by sea or IWW. - Financial support on research for port side operations in order to make the connection between truck/rail and maritime more efficient. - Appropriate political and economic framework conditions and creation of port hubs at strategic locations.	

Recommendations for a future R&D strategy

Based on the assessment of the scenarios and the strategic options for European transport research, policy recommendations for the future R&D strategy were made. These specified the need for R&D investment in different transport modes and innovation fields in order to improve the competitiveness of the European transport sectors under the conditions of each scenario. Figure 9 wraps-up the main conclusions drawn in the previous section by enumerating those fields with higher need for public R&D support. Some innovation fields are crucial in all scenarios, despite the fact that their application may differ depending on the demand preferences of future societies. This, for example, as shown in Figure 9, is the case of ITS applied to improve multimodality or the efficiency and security of different transport means. On the other hand, ITS applied to autonomous vehicles seems more feasible in a context of high economic growth and increased demand for private vehicles.

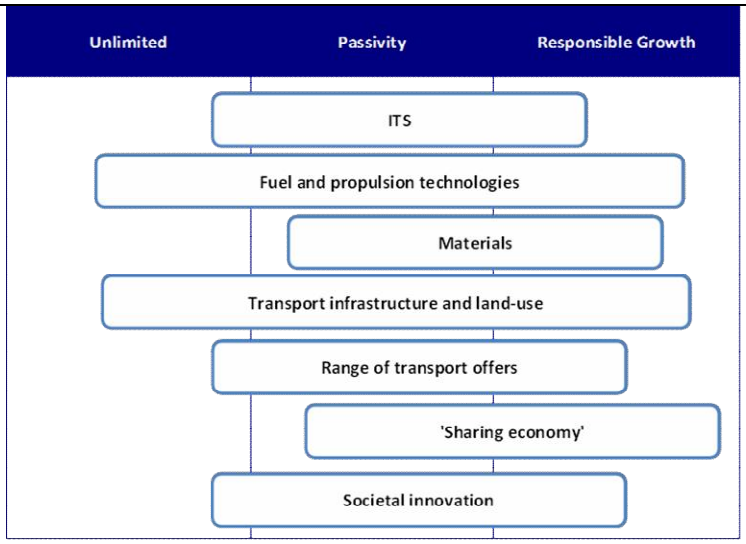

Figure 9– Innovation fields with higher need for public R&D support

Additionally, the following recommendations should be considered in a future EU R&D strategy for transport:

1. Research funding should be aligned with societal challenges and policy objectives.
2. Research priorities should be discussed in a broad context of stakeholders. These fora could follow the logic of the quadruple helix model, engaging academia, industry, government entities and citizens. Nowadays several fora discuss their own research priorities. This is the case of ERAs, the ETPs, JTIs and other PPPs and different committees of academic experts. However, there is a gap of information between stakeholders and challenges are not always tackled effectively. The EU could promote platforms that facilitate the integration and discussion of different points of view about common societal challenges. Innovative communication channels between different actors could promote solutions that are more balanced and provide better policy recommendations.
3. Promote road-mapping on different innovation fields, ensuring the involvement of different stakeholders. These road-maps should identify funding instruments and actors, and foresee monitoring and governance mechanisms.
4. Promote innovation considering the full range of the innovation cycle, from basic research, through advanced technology development and beyond. Horizon 2020 is a good example of innovation policy that covers activities from research to market.
5. Long-term fundamental research, which includes basic and applied research. Fundamental research relies mostly in public guidance and should provide the foundations for future technological development. Public support can be performed either directly by public investments or/and indirectly through policies and regulations that stimulate public and private R&D investments and innovation.
6. Invest in more advanced transport research, especially in those areas with the following characteristics:
    a. Innovation areas that are of public interest and require the coordination between different actors and sectors, such as ITS.
    b. Areas with innovation gaps. This is the case of areas where investments are considered too risky or where other market factors limit private sector investment in more advanced research. These market failures are usually related with benefits occurring far in the future, risks that are too high for non-public participation or benefits that could not be appropriated by a single entity.

c. Horizontal innovations that require the coordination between different sectors with sometimes conflicting interests.
d. Areas that directly support government infrastructure or services.

7. Promote more international collaboration in transport research in topics that are of strategic importance for the EU. This collaboration could be envisaged in different form, such as collaborative research or PPPs. On the same ground, international agreements on common topics (i.e. environmental standards) will provide stable frameworks for the development, commercialization and deployment of innovations.
8. Evaluate the impacts on the EU competitiveness of foreign R&D policies, with the support of ETPs and academia, ensuring that the EU industry is not placed at a competitive disadvantage.
9. Advance on standardized reporting metrics, coupled with clear strategic goals, to prove the effectiveness of the funding programs.
10. Ensure the correct dissemination of results, spreading the benefits of public funded innovation to the whole society.
11. Improve the workforce skills of the European transport industry, with a special focus on revitalizing traditional sector and promoting those skills that will fulfil future industrial needs.
12. Expand the participation of private sector, especially SMEs. This can be done by engaging the private sector in transport research activities that are of public interest. Provide better access to public activities, technology and infrastructure; and engage the private sector in setting the R&D priorities, programs and research planning.
13. Provide support to attract and maintain research and innovation of private companies within the EU boundaries, reversing the trend to delocalize innovation investments towards emerging countries. Foster a vibrant, innovative academic community in transport by improving the research capabilities of academic institutions, promoting partnerships between academia, government and industry and engaging academics in the establishment of R&D priorities, programs and planning processes.

1.4 Potential Impact and Main Dissemination Actions

1.4.1 Potential Impact, use and exploitation of achieved results

The potential impact of FUTRE project is strongly related to the results of each Work Package.

Specifically, WP2 looked at innovation and competitiveness of the EU transport sector. The main results were the following:

- To describe the main concepts and methods related to innovation, the transport sector, market structure and the ways to measure competitiveness.
- To summarise EU & MS transport policies and innovation programmes but also institutional capacities (e.g. institutional set-up).
- To illustrate the European innovation systems in the transport sectors and to identify main drivers of and barriers to innovation.
- To estimate the current R&D efforts in the area of transport based on quantitative indicators (e.g. R&D budgets and/or expenditures).
- To assess the global competitiveness of transport based on output indicators and to investigate how competitiveness was influenced by transport policies and innovation programmes.

Furthermore, WP3 analysed the future competitiveness of the EU transport sector from a demand-oriented perspective by focusing on the demand needs and behaviour. The main results of WP3 are:

- Identified possible mega-trends with impacts on transport
- Identified key factors of evolution of transport demand
- Identified specific possible future insights for transport demand
- Developed global pathways, relevant to transport
- Developed trends and challenges for the passenger and freight sector

WP3 was an important part of FUTRE where the main global pathways were developed. Apart from carrying out a thorough literature review on the subject of Futurology and related studies focusing on transport, it also created four global pathways. The literature review, the methodology used to develop the pathways as well as the pathways themselves can be of great importance for interested parties whether in the academic or the research community. Furthermore, EU policy makers can take into consideration as a guide, the trends and challenges that were identified during the development of the subscenarios for each pathway.

The main results of WP4 are the following:

- To study emerging/anticipated technical and organisational innovations on the supply side and their potential impacts on competitiveness.
- To identify relevant (mode-specific as well as cross-cutting) upcoming transport-related products, service and infrastructure innovations until 2030 on European and global scale.
- To evaluate in a qualitative way possible constraints on these innovations focusing mainly on scarce raw materials but considering also other political, cultural and societal constraints.
- To identify and assess the potential impacts of the supply-side on the competitiveness of the European transport industry and service sectors.

WP4 produced a platform that identified future competitiveness of the transport sector from a supply-oriented perspective, where the focus was on upcoming technological and organisational innovations, on constraints and market barriers related to established and emerging technologies. The identification of upcoming technologies and innovation can provide an insight of the future in terms of how the industry will evolve and what technologies will dominate. The areas that were covered were the following:

- Automation of road transport
- Fuels and propulsion technologies
- Improving the means of transport
- Intelligent transportation systems
- Services & organizational innovations
- Infrastructures
- Out-of-the-box transport innovations

These areas are applicable to various transport modes and therefore can indicate the future direction that these modes will take in the year 2030 and beyond. The evaluation of the technologies is very important to determine the competitiveness of the European transport sector until 2030. It is for this reason that industry experts were invited to participate in this survey.

Moreover, an assessment of constraints to innovations was carried out which is crucial to identify possible bottlenecks and intensify research for alternative measures. The constraints of innovations in this case were mainly related to raw materials. FUTRE carried out a qualitative assessment of the

implications of 15 key transport innovations on critical raw materials for the time horizon until 2030. The identification of copper (Cu), lithium (Li) and scandium (Sc) as potential constraints in sectors such as electric vehicles, battery cell manufacturing and aircraft manufacturing respectively, can be used by both the manufacturing industry as well as transport research policy makers. The later can potentially provide further support through various means to the industry in order to assist with finding alternative materials. The industry itself should take their own actions to ensure that such alternatives can be integrated into products.

Besides constraints on innovations induced by critical raw materials, there are further factors hampering transport innovations. Even if key transport innovations are mainly developed by large companies and global players, financial constraints can affect innovation activity of smaller companies in the transport supply chain. The political framework can also negatively influence innovation process by setting too narrow frameworks or by policies that are designed to achieve only short-term targets.

The target of the scenario framing in WP5 was to set up three scenarios providing a consistent picture composed out of a set of key innovations and trends for consumption and travel patterns. These storylines were translated into quantitative inputs for an integrated modelling approach. ASTRA-EC and TRANS-TOOLS modelling toolsets were used to analyse the dynamics between the key transport innovations provided by the European transport industry and the changing travel patterns for passenger and freight. This analysis provides an understanding of the market reactions on major upcoming transport-related innovations under the framework of changing demand needs on a European scale. ASTRA- EC provided a quantification of three pathways. Some of the main results that the model provided were population projections, economic data, passenger and freight modal share, car fleet dominant fuel technologies with a time horizon until 2050. These results are important for anyone interested in studies on the future of transport as well as for policy makers. The later can gain a further insight through quantitative data of how the future may look like for the transport sector under three different scenarios. Such data not only helps policy makers in decision making for the future but also the transport industry itself.

Furthermore, an analysis of the competitiveness of the EU transport sector was carried out based on the ASTRA-EC model. Specifically, the analysis served as platform for the WP6 where the EU transport research policy recommendations are made. The competitiveness data may potentially help policy makers to identify areas that will require assistance in the future through various means in order to boost the transport sector's competiveness.

WP6 focuses on EU transport research policy measures as well as EU R&D strategy based on the results from WP5. The proposed policy measures focus on the role of EU transport research as a mean to improve competitiveness and increase sales for the industry. Specifically, these policy measures consist of recommendations of how EU transport research could help the industry through mechanisms such as funding, promotion of legislation and technologies, provision of support services for companies such as coaching and mentoring, excellence in education as well as access to information and technology for companies. These policy measures are suggested and adjusted according to the needs of the scenario and for each transport industry. Specifically, each transport subsector was assessed for its competitiveness using their current position in the global market and future prospects of sales according to the characteristics of each scenario. The policy measures could potentially guide the European transport research to help the industry overcome the problems that it will face on each scenario with the aim of enhancing competitiveness. The proposed EU transport policy measures are aimed specifically at EU policy makers in order to provide recommendations for

future policies as well as an insight of the industry's competitiveness under the conditions of the three different scenarios.

The second part of WP6 dealt with R&D needs for each transport subsector based on the current competitiveness and future prospects according to each scenario. Different innovation areas that could receive public R&D support and promote the competitiveness of transport sectors were identified. Some innovation fields are crucial in all scenarios, despite the fact that their application may differ depending on the demand preferences of future societies. This is the case of ITS applied to improve multimodality or the efficiency and security of different transport means. On the other hand, ITS applied to autonomous vehicles seems more feasible in a context of high economic growth and increased demand for private vehicles. Once again these results indicate areas where further R&D support will be needed either by the EU transport policy research or the industry itself.

1.4.2 Main Dissemination Actions

The dissemination actions that were undertaken in the course of the project had as a goal to achieve the wide visibility of the project itself and its results. These actions can be grouped in four major categories:

1. The production of dissemination material
2. The organization of the workshops
3. The development of the FUTRE website
4. Final FUTRE electronic publication

1. Production of dissemination material

The first action before preparing any kind of dissemination material, was the creation of the FUTRE logo. A logo was created in cooperation with a graphics design expert as shown in the following figure. The logo was included in all of the dissemination material that was prepared in the course of the project and that was used in workshops as well as stand-alone documents (newsletters) sent to interested parties in order to ensure the dissemination of the project. Such dissemination activities included the creation of four six-page newsletters, noted in figures 11-14.

Figure 10- FUTRE Project logo

- FUTRE newsletter 1

Figure 11- Newsletter 1 of FUTRE Project

- FUTRE newsletter 2

Figure 12- Newsletter 2 of FUTRE Project

- FUTRE newsletter 3

Figure 13- Newsletter 3 of FUTRE project

- FUTRE newsletter 4

Figure 14- Newsletter 4 of FUTRE project

2. Organization of the workshops

During the course of the FUTRE project three workshops were organised in order to gain insight from various experts and the Advisory Board as well as disseminating the work carried out.

- *Workshop 1 "Transport Needs 2050"*

Workshop "Transport Needs 2050" took place on the 7th- 8th March 2013, in Convento da Arrábida, Portugal and aimed at building scenarios for the demand for transport in 2050. For this Workshop, a panel of specialists from different backgrounds were invited to provide different insights and perspectives on what may unfold in the future. A small group of experts in different areas were invited to the workshop along with a specialist in future studies. The expertise of the participants covered all modes of transport and included policy makers, industry insiders, business strategists and academics from various scientific fields. The workshop was structured in three exercises.

Day 1- 7th March 2013

The first exercise involved the exploration of mega-trends, deriving into a wide range of insights which served mostly as a warm-up to get experts *in the right mood*. A long-list of mega trends had been shared in advance by e-mail and both the Members of the FUTRE consortium and experts were asked to comment on a selection of the most important trends. As a result a list of Mega-trends was selected for discussion. The objective of this exercise was twofold: first it aimed to provide a list of insights for further development in the next methodological steps; second this discussion was a great mechanism for experts to engage in discussion about the future while reducing their focus on previous positions or pre-defined ideas.

Day 2 - 8th March 2013

During the second day, the participants were randomly divided into 4 groups. In the second exercise the insights developed on Day 1 were categorized first into a STEP matrix: Social, Technological,

Economic and Political. The third exercise was the categorization based on probability and impact. The participants were then given the chance to vote on the most important insights. The most voted insights were grouped by the organization team based on coherence criteria. In the final exercise, each group of experts was given one of the sets of insights and elaborated a scenario based on them. The Workshops outcome was the creation of four final scenarios that were then presented by the respective expert groups.

- *Workshop 2 on 'Emerging Transport Innovations & Technologies'*

The 2nd FUTRE project workshop on 'Emerging Transport Innovations & Technologies' took place on 28-29 November 2013 in the premises of the European Council of Transport Research Institutes (ECTRI), in Brussels, Belgium. Specifically, the workshop aimed at gaining an understanding on emerging transport innovations/technologies, on how these are expected to affect transport system efficiency in Europe and on how these are expected to affect the competitiveness of the European transport sector. Key experts were invited to provide input in the framework of a qualitative assessment on the list of key innovations/technologies for the transport sector. Within the workshop, experts filled out an electronic questionnaire and participated in an open discussion in relation to the likeliness of technological breakthroughs in the future in the corresponding field and the potential impacts on the transport system and on global competitiveness of the European transport sector. Also they expressed their opinion about the restrictions and barriers which the technological advancements will face. The scope of the development of the questionnaire was to collect more specific and detailed answers according to the opinions of the transport experts. Specifically, the aim was to develop an overall view about what impacts the transport innovations will have on transport sector competitiveness until 2030. The experts had to evaluate the technology per innovation field and provide relevant comments.

- *Internal expert workshop on innovation fields*

An internal expert workshop was organised and held on May 14th 2013 in Karlsruhe related to innovation fields in transport. The workshop was held between KIT-ITAS and FHG-ISI partners. In this informal workshop colleagues beyond the project team were invited to discuss the project team's preliminary results and to shape the ground for the next steps related to identifying relevant innovation fields for FUTRE project. During the workshop, topics such as the terms like transport sector and transport sector's competitiveness were discussed. Furthermore, the selected innovation fields essentially focused on their usability as building blocks for the integrative scenarios to be built in the ASTRA-EC model simulations. The framing of innovation fields allowed some heterogeneity in order to fulfil the requirement of providing a complete picture about innovations of the future, without skipping such innovations that might otherwise escape predetermined framings. These innovation fields have already been presented in Section 4 earlier. Another topic that has covered during the workshop was automation and autonomous technologies.

- *Workshop 3 on "the competitiveness and innovation policy of the transport sector"*

The third FUTRE Workshop aimed at providing an understanding on the competitiveness and innovation policy of the transport sector. The workshop took place on 2 – 3 July 2014 in Thessaloniki, Greece. Eight experts participated in the workshop activities, which focused on analysing the competitiveness within the context of the future pathways and making recommendations on the necessary innovation policy to be followed by the EU.

The workshop was structured around three Activities. During Activity I the FUTRE scenarios were presented to the experts, along with the main outcomes of the scenarios analysis that were produced by the ASTRA – EC model. The experts were asked to identify priority innovation areas for the different future scenarios as well as their main barriers and constraints. Activity II involved the identification of those innovation areas that require further R&D policy enhancement. Activity III involved the selection of key initiatives/actions that would be required to support the selected innovations. During the workshop the experts had an introduction to the project where aims and objectives were presented. Furthermore, the experts were also presented with results which served as a dissemination and verification activity. One of the expert participants was the coordinator of the RACE 2050, which is a project funded by the EC on the same topic as FUTRE.

3. Development of the FUTRE website

A website has been developed at the beginning of the project introducing its scope, objectives, consortium partners as well as the work plan to all interested web-users. The project website ensures the provision of up-to-date information on the project's progress and informs all interested parties of to date results, news announcements and events. Through the use of open source portal technologies, the website emphasized on means of interaction with web visitors by offering the possibility to contact/ask questions/discuss with consortium partners. This is seen as a continuous service for fostering the communication with all interested stakeholders that wish to touch base with the project consortium and further monitor and support the project activities. Visitors of the website can access public project documents such as the public deliverables, newsletters and information regarding the workshops. Further to the above, useful links relevant to the project's scope and objectives are provided (e.g. links to relevant projects).

Further information regarding the FUTRE website is given in section 1.5.

4. Final FUTRE electronic publication

The Final FUTRE electronic publication has been created in order to present the main project findings in a more detached way from the project's deliverables. The aim was to create an illustrated publication, aiming at the public and other interested parties, written in plain English rather than academic/research language in order to have the maximum outreach. The publication presented an assessment of the effects of future challenges, demand drivers and upcoming innovations, which have a considerable impact on the global demand patterns in the passenger and freight sector, on the competitiveness of the European transport sector, including related industries and service providers. It aimed to bridge the gap between the manifold studies on the future of the European transport system and its subsections, and the issue of competitiveness that needs to be supported by targeted research strategies.

Apart from the three main dissemination activities, several others took place. These included:

- Participation in Conferences either through papers or through posters
- Attendance of relevant to the project's content conferences
- Liaison with other projects and initiatives

- Furthermore, data on innovation for the transport sector produced in FUTRE Deliverable D2.1 was used in the EU transport Scoreboard: http://ec.europa.eu/transport/facts-fundings/scoreboard/compare/index_en.htm?indicators=innovation_transportRD%3Binnovation_innovativeCompanies&modes=

1.5 Project Public Website and Contact Details

In order to ensure wide visibility of the Project's outcomes, an official website was created at the very beginning of the Project. The website has been systematically updated with interesting and useful information regarding the project's progress, the relevant events taking place in the framework of the project or in the framework of other similar actions, the outcomes achieved throughout the various WPs, newsletters, workshop information and useful links.

Project information is available to any interested party at the url http://www.futre.eu/ .

It contains information regarding the project overview, objectives and involved partners. It provides up-to-date information on the project's progress, results, news announcements and events. Information is provided for parties interested in contacting consortium partners for the purpose of obtaining further information on the project.

Through the website a Workspace is available, which is accessible only by the project partners. The Workspace has been developed in order to foster the direct cooperation and collaboration of the project partners for the efficient and timely undertaking of project activities. It allows for confidential documents to be uploaded and downloaded by all project partners. Public documents are becoming available for any interested web-user along with project's dissemination material. Further to the above, useful links relevant to the project's scope and objectives are also provided.

The structure of the website is as follows:

- Home page
- Project
  - Overview
  - Description
  - Output
- Consortium
- Events
  - Workshops
  - Relevant Events
- Publications
  - Deliverables
  - Newsletters
  - Press Releases
  - Reports
  - Other Documents
- Links
- Contact
- Workspace

Workspace

In the course of the Project it is very common for large files to be exchanged among the involved partners. Apart from that, these files are also very often modified and updated. Therefore, in order to ensure the efficient exchange of documents and other files, the Workspace has been created. The Workspace can be accessed only by the Project Partners who have been provided with the necessary user name and password. The structure of the Workspace is shown in Figure 16.

Figure 15- FUTRE website

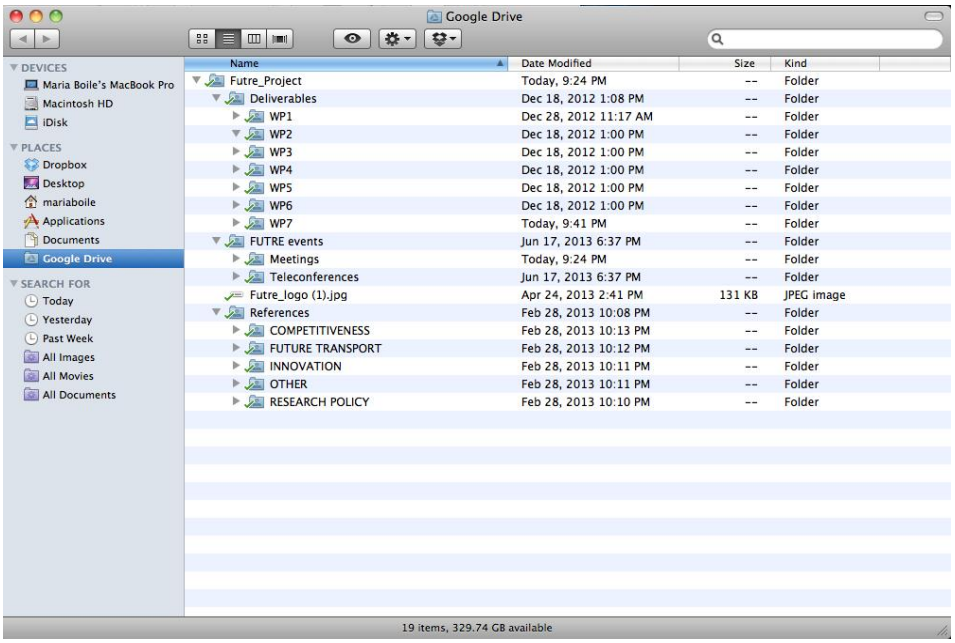

Figure 16-Workspace structure

1.6 List of Beneficiaries and Contact Details

The following table presents the list of partners involved in the FUTRE Project along with their details and main responsible person.

Table 11: List of beneficiaries

No	Partner	Country	Responsible person	Address	Email
1	Centre for Research and Technology Hellas – Hellenic Institute of Transport, ***(Coordinator)***	Greece	Dr Maria Boile	52 Egialias str., 15125, Marousi, Athens	boile@certh.gr
2	TIS PT, Consultores Em Transportes, Inovacao E Sistemas, SA	Portugal	João Vieira	Av. Marquês de Tomar 35, 6º DRT. 1050-153, Lisbon	joao.vieira@tis.pt
3	Fraunhofer-Gesellschaft Zur Foerderung Der Angewandten Forschung E.V	Germany	Dr. Michael Krail	Breslauer Strasse 48, 76139 Karlsruhe, Germany	michael.krail@isi.fraunhofer.de
4	Karlsruhe Institute of Technology- Institute for Technology Assessment and Systems Analysis (ITAS)	Germany	Mr. Jens Schippl	Karlstraße 11 76133 Karlsruhe GERMANY	jens.schippl@kit.edu
5	JRC -JOINT Research Centre-European Commission-Institute For Prospective Technological Studies, Transport Sector Economic Analysis	Belgium	Dr. Panayotis Christidis	Inca Garcilaso 12, 41092 Seville, Spain	Panayotis.Christidis@ec.europa.eu

2. Use and dissemination of foreground

2.1. Section A

Template A1: List of all scientific (peer reviewed) publications relating to the foreground of the project.

TEMPLATE A1: LIST OF SCIENTIFIC (PEER REVIEWED) PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES										
NO.	Title	Main author	Title of the periodical or the series	Number, date or frequency	Publisher	Place of publication	Year of publication	Relevant pages	Permanent identifiers[3] (if available)	Is/Will open access[4] provided to this publication ?
1.	FUture prospects on TRansport evolution and innovation challenges for the competitiveness of Europe	J. Schippl (KIT-ITAS)	Presentation at First I-C-EU Workshop	21/01/2013		Leuven, Belgium	2013		http://www.i-c-eu.eu/workshopsmeetings/20130121_workshop_Leuven/I-C-EU_worksh	yes

[3] A permanent identifier should be a persistent link to the published version full text if open access or abstract if article is pay per view) or to the final manuscript accepted for publication (link to article in repository).
[4] Open Access is defined as free of charge access for anyone via Internet. Please answer "yes" if the open access to the publication is already established and also if the embargo period for open access is not yet over but you intend to establish open access afterwards.

TEMPLATE A1: LIST OF SCIENTIFIC (PEER REVIEWED) PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES

									op_20130121_10_FUTRE_KIT.pdf	
2.	Assessing the future competitiveness of the European transport sector	M. Reichenbach/ J. Schippl (KIT-ITAS)	Poster presentation at PACITA conference	13-15/03/2013		Prague, Czech Republic	2013	pp. 269-270	http://www.pacitaproject.eu/wp-content/uploads/2013/03/Book-of-abstracts-Prague.pdf	yes
3.	Future Mobilities in freight transport	M.Reichenbach/ M.Boile/ A.Papanikolaou (KIT-ITAS/HIT)	Presentation at Global Conference On Mobility Futures	4-6/09/2013		Lancaster, United Kingdom	2013	pp. 62	http://www.lancaster.ac.uk/fass/events/mobility-futures/docs/Mobility%20Futures%20Programme%20Abstracts.pdf	yes
4.	Future transport scenario building and development for long-term sustainable	M.Boile/A.Papanikolaou/A. Aggelakakis (HIT)	Presentation at 2nd Conference on	5-6/05/2014		Volos, Greece	2014		http://www.este.civ.uth.gr/2ndCSUM_2014.ht	no

TEMPLATE A1: LIST OF SCIENTIFIC (PEER REVIEWED) PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES

	decision making		Sustainable Urban Mobility						ml#	
5.	Integrating Urban Vehicle Characteristics into Sustainable Transportation Planning	L. Mitropoulos (HIT)	Presentation at 2nd Conference on Sustainable Urban Mobility	5-6/05/2014		Volos, Greece	2014		http://www.este.civ.uth.gr/2ndCSUM_2014.html#	no
6.	Four future pathways on mobility needs. Think about implications for mobility management.	J. Bernardino (TIS)	Presentation at European Conference on Mobility Management	7 – 9/05/2014		Florence, Italy	2014		http://epomm.eu/ecomm2014/#A1	yes

Template A2 lists all dissemination activities of the project, including publications, conferences, workshops, web sites/applications.

TEMPLATE A2: LIST OF DISSEMINATION ACTIVITIES								
NO.	Type of activities[5]	Main leader	Title	Date/Period	Place	Type of audience[6]	Size of audience	Countries addressed
	Publication	*CERTH-HIT*	*FUTRE Newsletter 1-4*	30/05/2013 (Newsletter 1) 31/12/2013 (Newsletter 2) 19/08/2014 (Newsletter 3) 11/11/2014 (Newsletter 4)	*E-Mail, Web*	*scientific community, industry, policy makers, media*	*A few hundred*	*All European Countries*
	Publication	*CERTH-HIT*	*Future Prospects On Transport Evolution And Innovation Challenges For*	*November 2014*	*Online*	*scientific community, industry, policy makers, media, other*	*A few hundred*	*EU- all interested parties*

[5] A drop down list allows choosing the dissemination activity: publications, conferences, workshops, web, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters, Other.

[6] A drop down list allows choosing the type of public: Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias, Other ('multiple choices' is possible).

TEMPLATE A2: LIST OF DISSEMINATION ACTIVITIES								
			The Competitiveness Of Europe- Final electronic publication					
	Workshop	*KIT-ITAS*	*I-C Project workshop: 'Assessing Impacts of Competitiveness and Regional Growth from Transport Infrastructure Investment – How far Can We Go?*	*21 January 2013*	*Leuven, Belgium*	*Scientific Community*	*15*	*EU*
	Workshop	*TIS PT*	*Workshop on "Transport Needs 2050"*	*7- 8 March 2013*	*Convento da Arrábida, Portugal*	*Transport experts, Industry, Futurologists*	*19*	*EU*
	Workshop	*JRC*	*Workshop on 'Emerging Transport Innovations & Technologies'*	*28-29 November 2013*	*Brussels, Belgium*	*Industry experts*	*19*	*EU*
	Workshop	*CERTH-HIT*	*Workshop on "the competitiveness and innovation policy of the transport sector"*	*2 – 3 July 2014*	*Thessaloniki, Greece*	*Transport experts, Industry*	*17*	*EU*
	Conference	*KIT-ITAS, Max Reichenbach*	*PACITA*	*13-15 March 2013*	*Prague,*	*Scientific*	*150*	*EU*

TEMPLATE A2: LIST OF DISSEMINATION ACTIVITIES								
			conference "Technology Assessment and Policy Areas of Great Transitions" (poster presentation)		*Czech Republic*	*Community, Policy makers*		
	Conference	*KIT-ITAS, Max Reichenbach*	*Global Conference On Mobility Futures (presentation)*	*4-6 September 2013*	*Lancaster, United Kingdom*	*Scientific Community*	*250*	*EU*
	Conference	*HIT, Maria Boile Anestis Papanikolaou Aggelos Aggelakakis*	*2nd Conference on Sustainable Urban Mobility: "Future transport scenario building and development for long-term sustainable decision making" (presentation)*	*5-6 May 2014*	*Volos, Greece*	*Scientific community*	*150*	*GR*
	Conference	*HIT, Lambros Mitropoulos*	*2nd Conference on Sustainable Urban Mobility: "Integrating Urban Vehicle Characteristics into Sustainable Transportation*	*5-6 May 2014*	*Volos, Greece*	*Scientific community*	*150*	*GR*

TEMPLATE A2: LIST OF DISSEMINATION ACTIVITIES								
			Planning" (presentation)					
	Conference	*TIS* *João Bernardino*	*European Conference on Mobility Management: "Four future pathways on mobility needs: Think about implications for mobility management" (presentation)*	*7 – 9 May 2014*	*Florence*	*Policy makers, scientific community*	*150*	*EU*
	Conference	*FhG-ISI*	*Annual Conference of the German System Dynamics Society*	*22 May 2014*	*Karlsruhe, Germany*	*Scientific Community, Policy Makers*	*80*	*DE*
	Web	*CERTH-HIT*	*Project Website*	*Continuous*	*Online*	Scientific Community, Industry, Civil Society, Policy makers, Media, Other	*n.a.*	*All European Countries*

2.2. Section B

(Confidential[7] or public: confidential information to be marked clearly)

Part B1

Not applicable

Part B2

Not applicable

[7] Note to be confused with the "EU CONFIDENTIAL" classification for some security research projects.

3. Report on societal implications

A General Information *(completed automatically when **Grant Agreement number** is entered.*

Grant Agreement Number:	314181
Title of Project:	FUTRE— FUture prospects on TRansport evolution and innovation challenges for the competitiveness of Europe
Name and Title of Coordinator:	Dr Maria Boile

B Ethics

1. Did your project undergo an Ethics Review (and/or Screening)? • If Yes: have you described the progress of compliance with the relevant Ethics Review/Screening Requirements in the frame of the periodic/final project reports? Special Reminder: the progress of compliance with the Ethics Review/Screening Requirements should be described in the Period/Final Project Reports under the Section 3.2.2 *'Work Progress and Achievements'*	***No***
2. Please indicate whether your project involved any of the following issues (tick box) :	
RESEARCH ON HUMANS	
• Did the project involve children?	*No*
• Did the project involve patients?	*No*
• Did the project involve persons not able to give consent?	*No*
• Did the project involve adult healthy volunteers?	*No*
• Did the project involve Human genetic material?	*No*
• Did the project involve Human biological samples?	*No*
• Did the project involve Human data collection?	*No*
RESEARCH ON HUMAN EMBRYO/FOETUS	*No*
• Did the project involve Human Embryos?	*No*
• Did the project involve Human Foetal Tissue / Cells?	*No*
• Did the project involve Human Embryonic Stem Cells (hESCs)?	*No*
• Did the project on human Embryonic Stem Cells involve cells in culture?	*No*

• Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos?	*No*
PRIVACY	
• Did the project involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?	*No*
• Did the project involve tracking the location or observation of people?	*No*
RESEARCH ON ANIMALS	
• Did the project involve research on animals?	*No*
• Were those animals transgenic small laboratory animals?	*No*
• Were those animals transgenic farm animals?	*No*
• Were those animals cloned farm animals?	*No*
• Were those animals non-human primates?	*No*
RESEARCH INVOLVING DEVELOPING COUNTRIES	
• Did the project involve the use of local resources (genetic, animal, plant etc)?	*No*
• Was the project of benefit to local community (capacity building, access to healthcare, education etc)?	*No*
DUAL USE	
• Research having direct military use	No
• Research having the potential for terrorist abuse	*No*

C Workforce Statistics

3. Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).

Type of Position	Number of Women	Number of Men
Scientific Coordinator	1	0
Work package leaders	0	3
Experienced researchers (i.e. PhD holders)	3	8
PhD Students	1	4
Other	3	7

4. How many additional researchers (in companies and universities) were recruited specifically for this project?	**1**
Of which, indicate the number of men:	1

D Gender Aspects

5. Did you carry out specific Gender Equality Actions under the project?

○ Yes
✓ No

6. Which of the following actions did you carry out and how effective were they?

	Not at all effective				Very effective
❑ Design and implement an equal opportunity policy	○	○	○	○	○
❑ Set targets to achieve a gender balance in the workforce	○	○	○	○	○
❑ Organise conferences and workshops on gender	○	○	○	○	○
❑ Actions to improve work-life balance	○	○	○	○	○

○ Other:

7. Was there a gender dimension associated with the research content – i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in trials, was the issue of gender considered and addressed?

○ Yes- please specify

✓ No

E Synergies with Science Education

8. Did your project involve working with students and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)?

✓ Yes- please specify: Two system dynamics master students of the New University of Lisbon accompanied the related work in WP3 as part of a course assignment

○ No

9. Did the project generate any science education material (e.g. kits, websites, explanatory booklets, DVDs)?

○ Yes- please specify

✓ No

F Interdisciplinarity

10. Which disciplines (see list below) are involved in your project?

✓ Main discipline[8]:: 2.1 Civil engineering (architecture engineering, building science and engineering, construction engineering, municipal and structural engineering and other allied subjects)

○ Associated discipline[5]:

○ Associated discipline[5]:

G Engaging with Civil society and policy makers

11a Did your project engage with societal actors beyond the research community? *(if 'No', go to Question 14)*

○ Yes
✓ No

11b If yes, did you engage with citizens (citizens' panels / juries) or organised civil society (NGOs, patients' groups etc.)?

✓ No

○ Yes- in determining what research should be performed

[8] Insert number from list below (Frascati Manual).

○ Yes - in implementing the research ○ Yes, in communicating /disseminating / using the results of the project	

11c In doing so, did your project involve actors whose role is mainly to organise the dialogue with citizens and organised civil society (e.g. professional mediator; communication company, science museums)?	○ ✓	Yes No

12. Did you engage with government / public bodies or policy makers (including international organisations)

○	No
○	Yes- in framing the research agenda
✓	Yes - in implementing the research agenda
✓	Yes, in communicating /disseminating / using the results of the project

13a Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?

✓	Yes – as a **primary** objective (please indicate areas below- multiple answers possible)
○	Yes – as a **secondary** objective (please indicate areas below - multiple answer possible)
○	No

13b If Yes, in which fields?

Agriculture		Energy		Human rights	
Audiovisual and Media		Enlargement		Information Society	
Budget		Enterprise		Institutional affairs	
Competition		Environment		Internal Market	
Consumers		External Relations		Justice, freedom and security	
Culture		External Trade		Public Health	
Customs		Fisheries and Maritime Affairs		Regional Policy	
Development Economic and Monetary Affairs		Food Safety		✓ Research and Innovation	
Education, Training, Youth		Foreign and Security Policy		Space	
Employment and Social Affairs		Fraud		Taxation	
		Humanitarian aid		✓ Transport	

13c If Yes, at which level?

- ○ Local / regional levels
- ○ National level
- ✓ European level
- ○ International level

H Use and dissemination

14. How many Articles were published/accepted for publication in peer-reviewed journals?		**0**
To how many of these is open access[9] provided?		
How many of these are published in open access journals?		
How many of these are published in open repositories?		
To how many of these is open access not provided?		
Please check all applicable reasons for not providing open access:		
❑ publisher's licensing agreement would not permit publishing in a repository ❑ no suitable repository available ❑ no suitable open access journal available ❑ no funds available to publish in an open access journal ❑ lack of time and resources ❑ lack of information on open access ❑ other[10]: ……		
15. How many new patent applications ('priority filings') have been made? *("Technologically unique": multiple applications for the same invention in different jurisdictions should be counted as just one application of grant).*		**0**
16. Indicate how many of the following Intellectual Property Rights were applied for (give number in each box).	Trademark	**0**
	Registered design	**0**
	Other	**0**
17. How many spin-off companies were created / are planned as a direct result of the project?		**0**
Indicate the approximate number of additional jobs in these companies:		

18. Please indicate whether your project has a potential impact on employment, in comparison with the situation before your project:

❑	Increase in employment, or	❑	In small & medium-sized enterprises
❑	Safeguard employment, or	❑	In large companies
❑	Decrease in employment,	❑	None of the above / not relevant to the project
✓	Difficult to estimate / not possible to quantify		

[9] Open Access is defined as free of charge access for anyone via Internet.
[10] For instance: classification for security project.

19. For your project partnership please estimate the employment effect resulting directly from your participation in Full Time Equivalent (*FTE = one person working fulltime for a year*) jobs:	*Indicate figure:*
Difficult to estimate / not possible to quantify	✓

I Media and Communication to the general public

20. As part of the project, were any of the beneficiaries professionals in communication or media relations?

○ Yes ✓ No

21. As part of the project, have any beneficiaries received professional media / communication training / advice to improve communication with the general public?

○ Yes ✓ No

22 Which of the following have been used to communicate information about your project to the general public, or have resulted from your project?

❑	Press Release	❑	Coverage in specialist press
❑	Media briefing	❑	Coverage in general (non-specialist) press
❑	TV coverage / report	❑	Coverage in national press
❑	Radio coverage / report	❑	Coverage in international press
✓	Brochures /posters / flyers	✓	Website for the general public / internet
❑	DVD /Film /Multimedia	❑	Event targeting general public (festival, conference, exhibition, science café)

23 In which languages are the information products for the general public produced?

❑	Language of the coordinator	✓	English
❑	Other language(s)		

4. FINAL REPORT ON THE DISTRIBUTION OF THE European Union FINANCIAL CONTRIBUTION

This report shall be submitted to the Commission within 30 days after receipt of the final payment of the European Union financial contribution.