SEVENTH FRAMEWORK PROGRAMME

THEME [7]

Theme Title: Transport (including Aeronautics)

SuperGreen

SUPPORTING EU'S FREIGHT TRANSPORT LOGISTICS ACTION PLAN ON GREEN CORRIDORS ISSUES

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Deliverable D5.2

Define and submit R&D Recommendations,

Final version

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0 Executive Summary

SuperGreen is a project that aims to promote the development of European freight transport logistics in an environmentally friendly manner. Among other tasks, SuperGreen evaluates a series of corridors covering some representative regions and main transport routes throughout Europe. The project's web site is www.supergreenproject.eu.

The White Paper on Transport (2011) elaborates on a number of challenges faced by the European community, while also laying out corresponding strategies and remedial goals. Known and interrelated challenges such as increasing congestion, growth in trade volumes, energy consumption, and emissions are to be met by improved traffic management systems, infrastructure development, and developments within ICT and technology. These are key areas of focus if the target of reducing emissions from transport by 60% within 2050[1], and shifting 30% of cargo transports beyond 300 km from road to rail and waterborne by 2030 (and more than 50% by the year 2050), are to be achieved.

The main receiver of this document is the European Commission, more specifically DG-MOVE and DG-RTD, and the new Framework Programme for Research and Innovation - the Horizon 2020. As such, this final version of D5.2 aims to give recommendations for future R&D efforts which particularly support co-modal transport operations and the development of green corridors.

A number of sources have been reviewed, including Strategic Research Agendas from relevant Technology Platforms, initiatives for R&D result dissemination, and selected funding mechanisms. The results are further based on input from D5.1 and structured according to transport mode and the below SuperGreen common development needs developed in Work package 2:

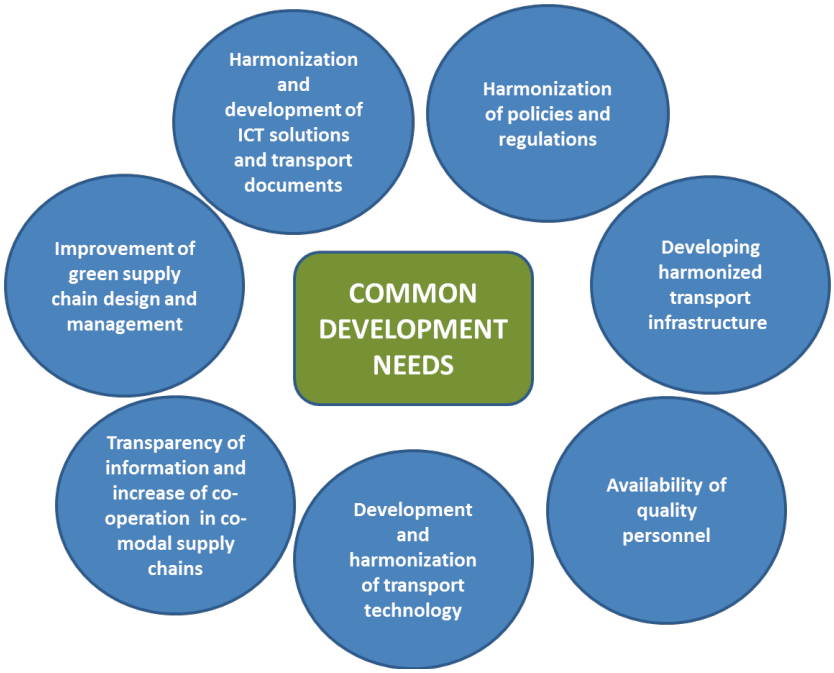

Figure 1: The SuperGreen Common Development Needs (Source: SuperGreen Project, 2011)

[1] With 1990 emission levels as the baseline

Lately much effort have been laid down in parallel with the work in the SuperGreen project, as all SRAs of relevant technology platforms have been through recent revisions giving valuable input to the project work. This final version of D5.2 presents some concluding recommendations based on the work performed throughout the project. The SuperGreen common development needs are as such an effort to advance and initiate intermodal R&D activities supporting the improvement of more sustainable intermodal operations on a corridor and Pan-European basis. When summarising the results from the analysis, the following generic points can be noted:

- There must be an increased focus on rectifying the evident lack of data and reliable tools enabling proper benchmarking exercises within the transport domain.
- A further strengthening of efforts securing integration and implementation of harmonised ICT solutions, also developing new ones (e.g. Single Window concepts).
- Increased focus on corridor and case-by-case specific analysis, both in terms of requirements and tailored solutions.
- Performance of impact studies for assessing potential environmental and cost savings when introducing new ICT and technology solutions
- Further development of freight flow optimisation and traffic management tools
- Efforts to enhance cargo interchange between transport modes, including expansion of the technology uptake by industry.
- Actions to improve the energy efficiency among transport operations and reducing dependency on fossil fuels.
- Development of harmonised transport documents

Moreover, considering this is the final version of D5.2 (M36), a set of concrete call texts have also been developed by the project. Also based on the Common Development Needs, these represent main effort towards providing more detailed and targeted recommendations for future green corridor R&D activities.

1 Introduction - Purpose of this document

The overall purpose of this document is to describe the work done in SuperGreen Work package 5 (WP5), under Task 5.2 "Define and submit R&D call recommendations". Being a two-stage process this is the updated and final version of deliverable D5.2. Based on input from Task 5.1 "Identify unsolved bottlenecks", task 5.2 defines and suggests recommendations for future R&D activities to the European Commission, hereunder DG-MOVE and DG-RTD, and especially the Horizon 2020.

An important part of the work is therefore to coordinate with other Strategic Research Agendas (SRAs) of relevant technology platforms such as Waterborne, European Intermodal Research Advisory Council (EIRAC), European Rail Research Advisory Council (ERRAC), and the European Road Transport Research Advisory Council (ERTRAC). The recent launch of the SRA for Inland Waterway Transport has also been revisited. In addition, several other relevant sources have been investigated in order to secure coordination of the recommended R&D priorities:

- Transport Research & Innovation Portal[2]
- The EC Research and Innovation website/platform[3]
- The Strategic Transport Technology Plan[4]
- The Joint Research Centre
- The ERA-WATCH platform[5]
- The European Green Car Initiative[6]
- Horizon 2020[7]

Since the work of Task5.1 serves as key input it should be mentioned that the gap analysis performed therein, contributing to bottlenecks mitigation and removal, will determine what is available and what is needed to make the corridors greener according to the defined benchmarks. This potential gap makes the basis for potential R&D recommendations to be described in Task 5.2.

[2] http://www.transport-research.info/web/

[3] http://ec.europa.eu/research/index.cfm?lg=en

[4] http://ec.europa.eu/transport/research/sttp/sttp_en.htm

[5] http://erawatch.jrc.ec.europa.eu/erawatch/opencms/about/

[6] http://www.ertrac.org/en/content/european-green-cars-initiative_52/

[7] http://ec.europa.eu/research/horizon2020/index_en.cfm

2 Objectives

2.1 Objectives of the SuperGreen project

The EU Commission's Freight Transport Logistics Action Plan (2007), introduces a series of policy initiatives and a number of short to medium-term actions to improve efficiency and sustainability of freight transport in Europe. One of these actions is to define "Green transport corridors for freight". In this framework, the SuperGreen project, an acronym for the "Supporting EU's Freight Transport Logistics Action Plan in Green Corridors Issues" project, was launched.

The general objective of the SuperGreen project is to support the development of sustainable transport networks by fulfilling requirements covering environmental, technical, economical, social and spatial planning aspects.

The SuperGreen project is a coordination action. It has sufficient "reach" in the wide area of freight logistics, and it will actively contribute by giving input to on-going and new projects so that resources are used most beneficially. The SuperGreen project will:

- Give overall support and recommendations on Green Corridors to EU's Freight Transport Logistics Action Plan.
- Conduct a programme of networking activities between stakeholders (public and private) and on-going EU and other research and development projects to facilitate information exchange, research results dissemination, communication of best practices and technologies at a European, national, and regional scale, thus *adding value to on-going programmes*.
- Provide a schematic for overall benchmarking of Green Corridors based on selected KPIs, also including social and spatial planning aspects.
- Deliver a series of short and medium-term studies addressing topics that are of importance to the further development of Green Corridors.
- Deliver policy recommendations at a European level for the further development of Green Corridors.
- Provide the Commission with recommendations concerning new calls for R&D proposals to support development of Green Corridors.

2.2 Objectives of Work Package 5 and Task 5.2

The main objective of WP 5 is to identify and define recommendations for calls for R&D proposals to the Commission. Building on input from other related work packages (WP 2- Benchmarking Green Corridors, WP 3- Sustainable Green Technologies, WP 4- Smart exploitation of ICT-flows, and WP6- Policy Recommendations), Task 5.2 consist of important sub-tasks such as:

- Based on the identified ICT and technology gaps for mitigating bottlenecks in European supply chains from Task 5.1 (Identify unsolved bottlenecks), study and evaluate research agendas (SRAs) in relevant Technology Platforms, and to the extent possible also in national R&D activities in terms of on-going activities for closing the gaps.

- Synthesize R&D efforts being carried out at a pan-European basis to conclude on recommendations for future R&D to the Commission.
- Coordinate with results from WP6 and include relevant aspects in the final recommendations

The conceptual approach to the work is as visualized in the figure below.

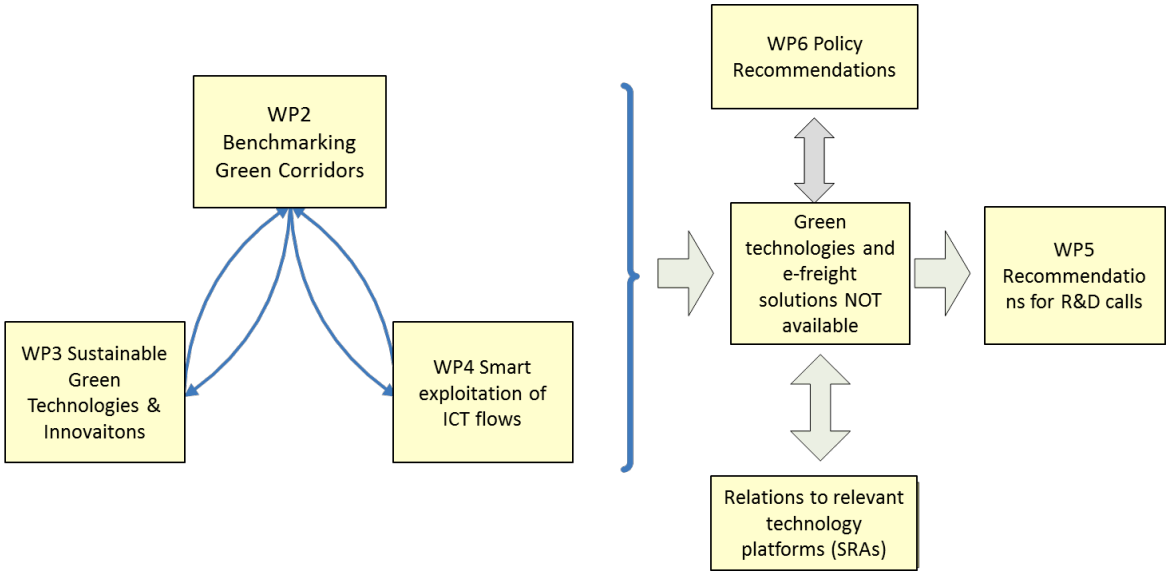

Figure 2: The conceptual approach in WP 5 (Source: SuperGreen Project, 2010).

3 Methodology

Based on the reported corridor specific bottlenecks, and the related ICT and technology gaps identified, Task 5.1 produced a number of points as input to the development of the final R&D recommendations. These were included in the Task 5.2 analysis and further elaborated on.

Further, all Strategic Research Agendas from relevant Technology Platforms were revisited and the main objective was to document the following elements:

- SRA work & related challenges
- SRA specific R&D recommendations
- Identify R&D GAPS and recommendations – hereunder providing an overview of the following.
    - identify on-going R&D activities that are specifically targeted for solving the identified bottlenecks, and
    - equally important if there is a lack of activities for solving the identified bottlenecks (i.e. disclosure of R&D gap).
- Compare and contrast the contents of the White Paper on Transport (2011) with the different SRAs of relevance, and identify possible gaps within R&D focus.

Also, for this final version of D5.2 there has been a revision of the relevant provided input from WP6, and a further specification of the final recommendations has been completed by the development of specific call texts. These are presented in chapter 10.

It should be noted that the identified R&D recommendations are limited to the results from the SuperGreen corridor analyses, and from the analysis of other relevant sources as given in this report (e.g. Transport Research & Innovation Portal, EC – Research and Innovation-Transport, The Green Car Initiative, etc.).

Moreover, by reviewing SuperGreen work and other relevant sources, the main objective of Task 5.2 is to develop R&D recommendations that intensify and go beyond what is already defined by different EC transport Research Advisory Councils and other research initiatives.

4 Background

Although the significance of previous and on-going R&D efforts has resulted in considerable advances towards increased efficiency and reduced environmental footprint within the European transport industry, there is still a need for further efforts to support the development of efficient transports and the free movement of goods within the EU.

A closer look at European trade and the region's modal split reveals that road transport in 2008 accounts for as much as 1.878 Billion tonne-km (Btkm) of all goods transported within the EU. This is 46 % of the total Btkm, with rail, inland waterways and short sea shipping accounting for 11 %, 3,5 % and 36 % respectively (European Road Statistics, 2010). This understates clearly that road is by far the preferred mode of transport within Europe today. Although the growth in trade has resulted in the development of a more cost effective SSS network, linking Europe's major hub ports to smaller European ports, particularly in the Baltic Sea but also to UK, the Iberian Peninsula, and the Mediterranean Sea and the Black Sea (ref. feedering), the current situation in ports and on the European road network gives rise to serious concerns. Due to a lack of transport capacity from infrastructure struggling to cope with the increase in traffic volume, the European road network is suffering from congestion. The European freight volume is predicted to increase with as much as 50% by the year 2020. In addition, the White Paper on Transport (2011), targets for achieving a 60% reduction in emission from transport operations by 2050, and a 50% shift of road transports to rail, sea and inland waterways by 2050, clearly signalize that considerable actions are necessary (The EU White Paper on Transport, 2006; Baltic Maritime Outlook, 2006).

For EU as a region it is vital to continue the long-term efforts towards securing economic growth and minimizing the impact on the environment and the society at large. Important elements for reaching these targets are a prolonged effort towards establishing innovative infrastructures (e.g. Forever Open Road, energy neutral or energy generating motorways), on new organisational concepts (e.g. payload sharing, advanced logistics, supply chain management and e-freight), and methods of working related to their introduction and on innovative vehicle technologies (e.g. modular vans and lorries, electric and diesel-electric vehicles, etc.), (EU White Paper, 2011, Green Cars Initiative, 2010).

This work includes important aspects such as developing measurements of transport impact on society, establishing a consensus on the measurement framework for transport and logistics environmental footprint, and on the measurements of transport and logistics performance.

Another aspect is to secure technology uptake by the industry. An example of the importance of technology uptake by the industry is provided by the Second IMO Green House Gas (GHG) study (2009), identifying that 1,046 million tonnes (3.3 %) of global CO_2 emission in 2007 came from shipping. A significant potential for a reduction of GHG through technical and operational measures were acknowledged, and if implemented, these measures could in total increase efficiency and reduce the emissions rate by 25% to 75% below the 2007 level.

5 Relevant Strategic Research Agendas (SRAs)

This chapter provides an overview of focal European instruments promoting R&D recommendations and development strategies for all surface transport modes, all targeted to answer future cargo transport demands and challenges. Produced by various transport Research Advisory Councils, all represented by a wide range of European transport stakeholders[8], the relatively recent updated versions of different SRAs relevant for the SuperGreen project are briefly elaborated on, namely the Road SRA (2010), the Waterborne SRA (2011), the Rail SRA (2011), and the Intermodal SRA (2011). In addition, the recent launch of the Inland Waterway transport SRA (2012) has been included in the overview. The mode-specific focus is given by the nature of the different SRAs, although all documents contain elements for improving transport interfaces and co-modality. Since SuperGreen aims to promote R&D recommendations advancing and reinforcing the ones already identified, such an overview is necessary as well as useful. Further, in order to advance sustainable mobility across modes it is necessary to address both mode-specific and intermodal challenges.

Moreover, as part of identifying possible gaps in research focus areas and nonconformities between the White Paper on Transport (2011) and the respective SRA's, a gap analysis has been carried out. Although acknowledging that documents present R&D recommendations at different levels of detail, the White Paper being on a more generic level, the exercise serves its purpose by signalling elements that might benefit from to a closer coordination between the two documents.

5.1 The European Road Transport Research Advisory Council (ERTRAC)

ERTRAC[9], the European Road Transport Research Advisory Council, represents the diverse range of road transport stakeholders and brings them together with representatives from public authorities at the European, national, regional and urban levels. The main objective is to develop a shared vision and to ensure a timely, coordinated and efficient implementation of road transport research in Europe, with the objective to tackle the societal challenges of road transport and to enhance the European competitiveness.

[8] consumers, manufacturers, suppliers, infrastructure operators and developers, service providers, energy suppliers, research organisations, cities and regions as well as public authorities at both European Union and national level.

[9] http://www.ertrac.org/en/content/mission_2/

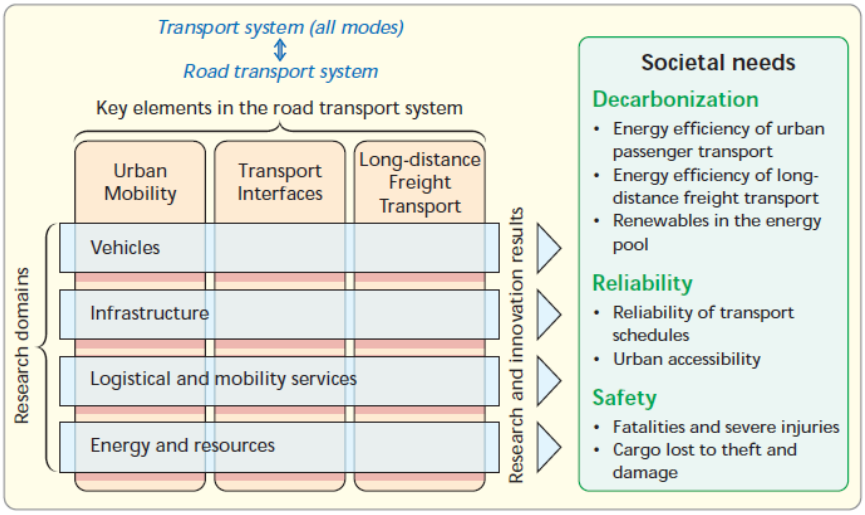

Figure 3: A systems approach to achieving a 50 % more efficient road transport systems (Source; ERTRAC SRA, 2010)

As illustrated by both the above figure and the next figure, the innovation in European road transport is focused on urban mobility, transport interfaces and long distance freight transport. The research domains are vehicles, infrastructure, logistical and mobility services and energy and resources. The main objective is to improve and fulfil societal needs (such as e.g. interconnection between urban and rural areas by providing reliable transport systems) and to reduce negative societal impacts by e.g. minimizing environmental impacts and preventing and minimizing the number of incidents.

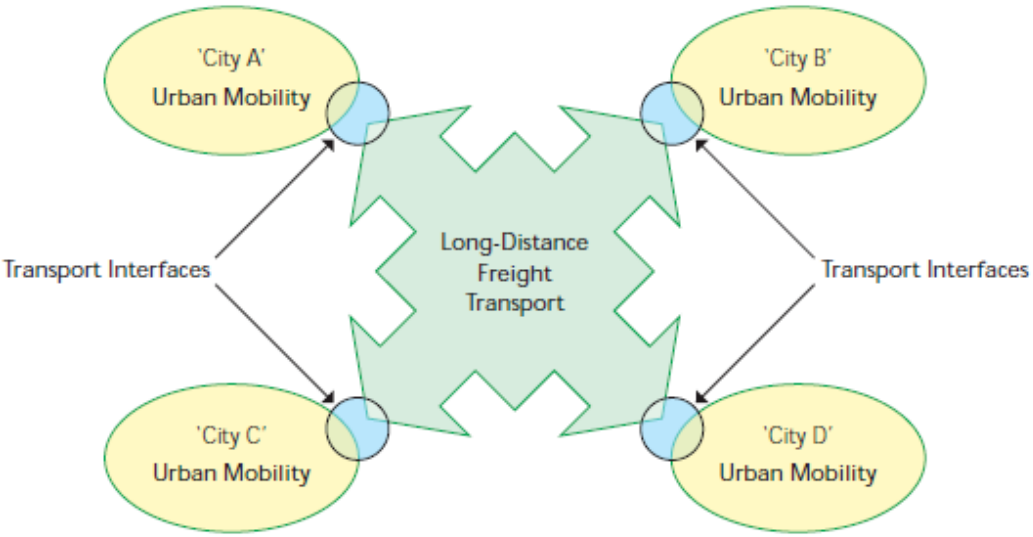

Figure 4: The focus areas and main elements of road transport research (Source; ERTRAC SRA, 2010).

For more details regarding specific research priorities for de-carbonizing road transport please view the ERTRAC Strategic Research Agenda[10] (2010).

5.1.1 R&D gaps between ERTRAC and The White Paper on Transport

Both documents contain a lot of similar issues to be addressed within future R&D for road transport. In general the ERTRAC SRA gives more precise R&D recommendations than presented in the White Paper. As the ERTRAC SRA is for road transport only it is natural that the White Paper is a bit more general. Safety matters, infrastructure, vehicles and elements related to logistics services and have a major significance in both documents. The specific recommendations noted are related to these four groups and presented in the following four figures.

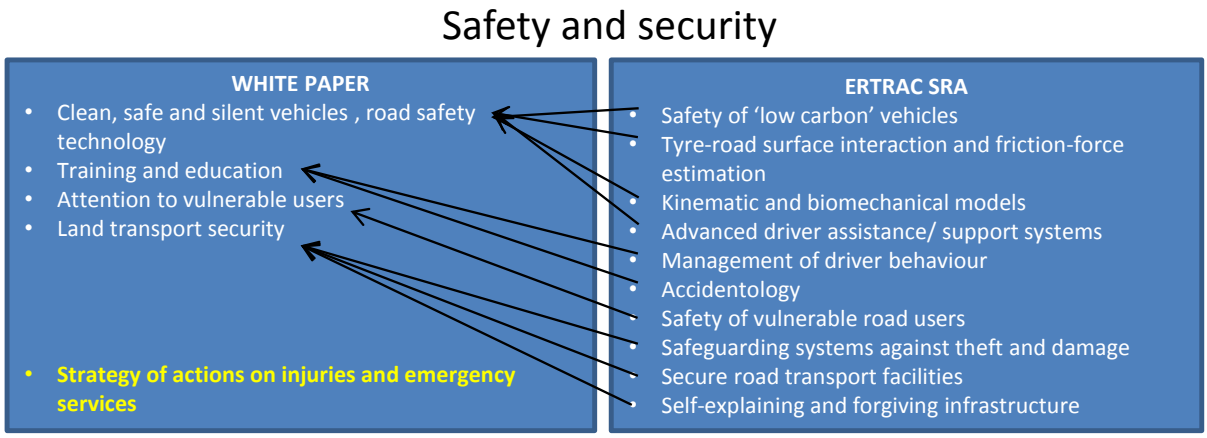

Figure 5 Recommendations on safety matters in the White Paper and ERTRAC SRA

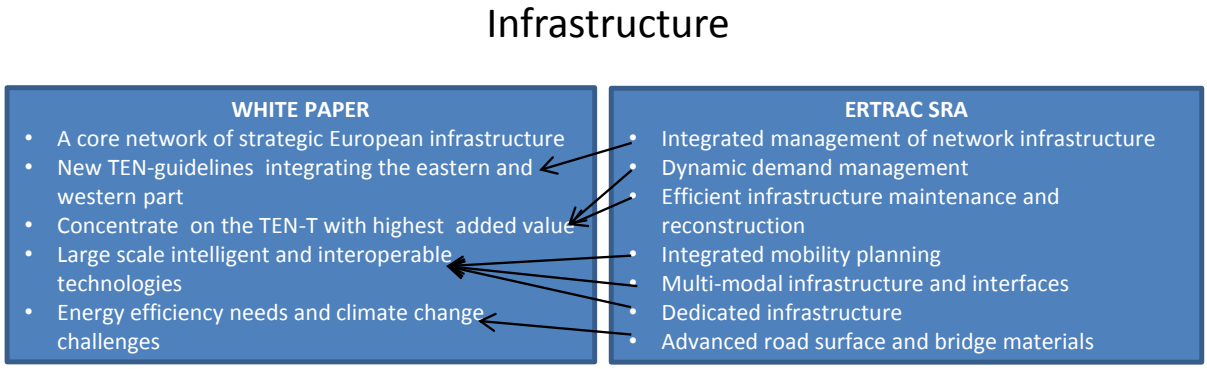

Figure 6 Recommendations for infrastructure in the White Paper and ERTRAC SRA

Concerning infrastructure related issues the White Paper concentrates more on the TEN-T concept, whereas TEN-T is actually not mentioned in ERTRAC at all. The ERTRAC recommendations are more detailed and concrete.

[10] http://www.ertrac.org/en/content/ertrac-publications_10/

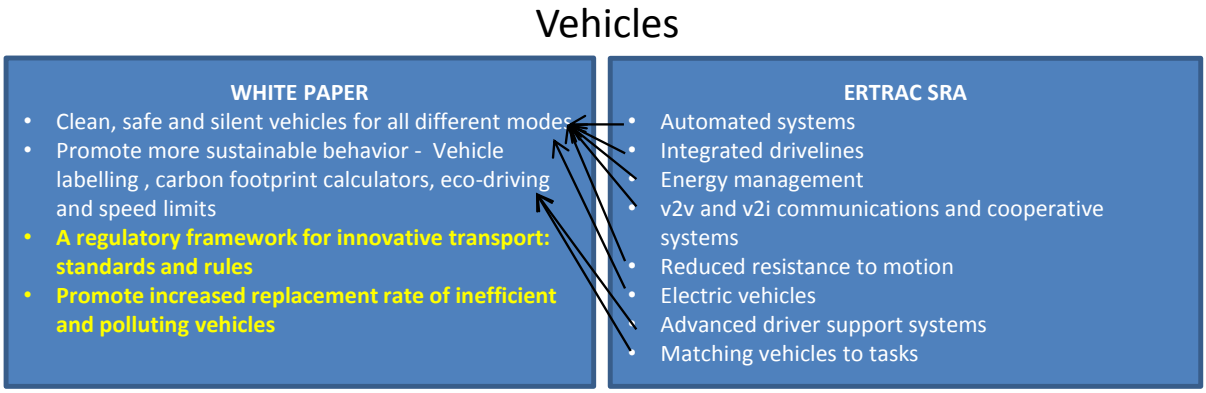

Figure 7 Recommendations for vehicles in the White Paper and ERTRAC SRA

The White Paper concentrates more on the regulatory aspects of vehicle development, while ERTRAC describes specific vehicles and systems to meet future requirements.

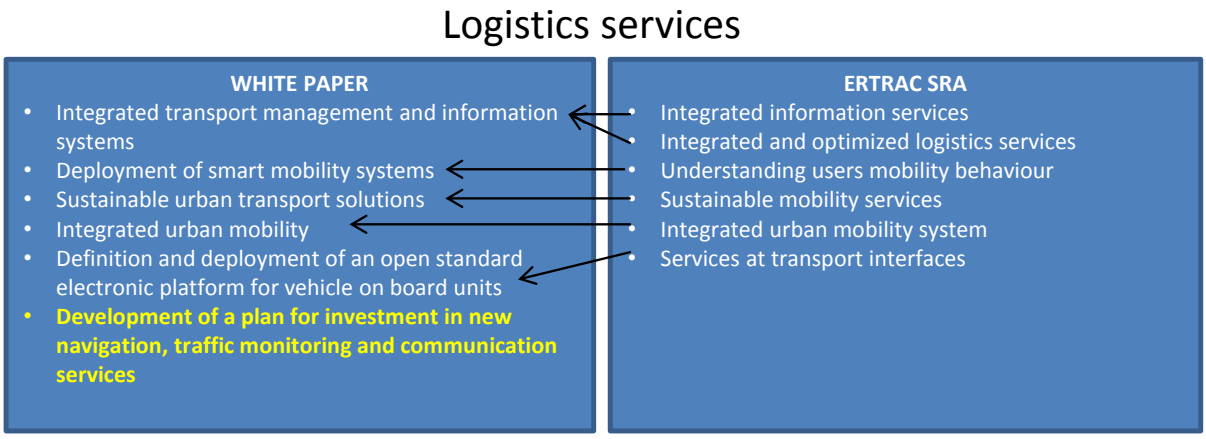

Figure 8 Recommendations for logistics service in the White Paper and ERTRAC SRA

Integration, mobility systems and interfaces related recommendations can be found from both documents. The White Paper also gives recommendations related to investments. This issue is not considered in the ERTRAC paper.

In the figures above there are a lot of similarities. The comparison of the two documents is quite difficult as there are different terms used to describe the same issues. There are also several overlapping issues. Based on the above analysis, the main gaps in the two papers may be indicated by:

- Strategy of actions on injuries and emergency services
- A regulatory framework for innovative transport: standards and rules
- Promotion of increased replacement rate of inefficient and polluting vehicles
- Development of a plan for investments in new navigation, traffic monitoring and communication services

Naturally, there are issues raised in the White Paper which are not mentioned in the ERTRAC SRA. However, the main difference between the two papers seems to be that the White Paper has a lot of recommendations related to regulations and funding. These issues are not included in the ERTRAC SRA. Harmonisation, reviewing, adaption of different rules, regulations and legislation are mentioned in several sections of the White Paper.

Further, there are some additional differences not mentioned in the figures. In ERTRAC recommendations related to energy and resources are considered as one major group, while in the White Paper these issues have been considered as part of vehicle improvements.

Global competiveness of automotive industry is one of the major issues in the ERTRAC SRA. This issue is not considered in the White Paper. Global competitiveness in ERTRAC deals with road transport related productions systems. In the White Paper opening up third country markets in transport services, products and investments is considered important. The White Paper also deals with the consequences of further liberalisation of the road transport markets for the road freight transport industry.

5.2 The Waterborne Technology Platform (WATERBORNE)

WATERBORNE[11] is an initiative that came forth from the Maritime Industries Forum (MIF) and its R&D committee in 2005 and is making considerable efforts to regularly update R&D requirements in the maritime sector for European competitiveness, innovation and the meeting of regulations like safety and environment. The stakeholders include EU associations covering deep and short sea shipping, inland waterways, yards, equipment manufacturers, marine leisure industry, research and university institutions, classification societies etc.

A vision of the year 2020 (Vision 2020) was developed and was followed by the first WATERBORNE Strategic Research Agenda (WSRA) in 2007. The WSRA has now been reviewed and updated to reflect developments in the waterborne transport sector. New environmental and economic challenges experienced since the publication of the first issue are also considered. The changes include an increased priority on CO_2 reduction, the growing offshore renewable energy market and refitting existing ships to accelerate the introduction of the environmental and economic benefits of new technology.

The WSRA addresses the innovation challenges in the next 15 years, summarised under the 3 pillars of the Waterborne Vision 2020:

- Safe, Sustainable and Efficient Waterborne Operations
- A Competitive European Maritime Industry
- Manage and Facilitate Growth and Changing Trade Patterns

[11] http://www.waterborne-tp.org/

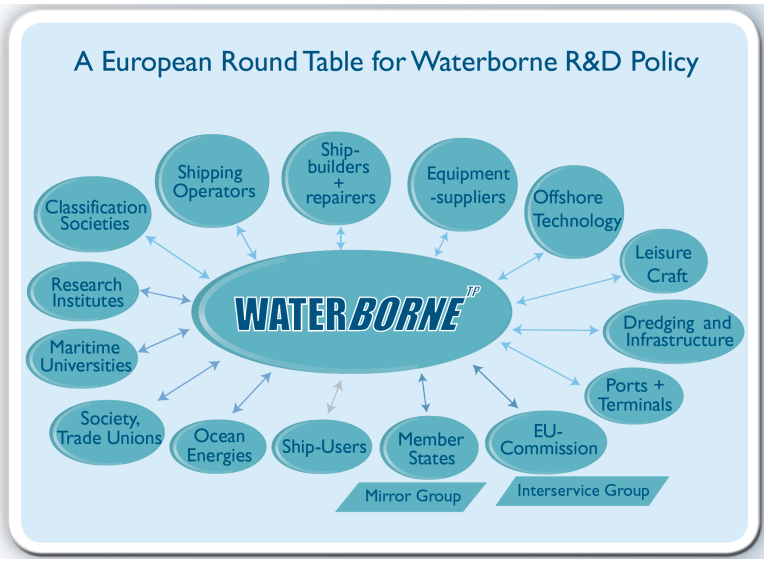

Figure 9: WATERBORNE stakeholders (Source; Waterborne SRA, 2011)

For more details regarding specific research priorities for waterborne transport please view the Waterborne Strategic Research Agenda[12] (2011).

5.2.1 R&D gaps between Waterborne and The White Paper on Transport

The main objective of the Waterborne Strategic Research Agenda (WRSA) is to identify the main R&D challenges for Europe necessary to support the achievement of the aforementioned three main pillars of the waterborne vision.

In the WSRA each pillar is supported with elaborations and specifications of different R&D initiatives in need of further work and development. Developed by the industry stakeholders it also provides the platform for a detailed implementation plan.

Three main pillars of the White Paper 2011 necessary for establishing competitive and resource efficient European transport system are mentioned:

1. De-carbonisation: Developing and deploying new and sustainable fuels and propulsion systems (i.e. energy efficiency, less energy consumed per ton-km, reduction of noise)
2. Enabling modal shift: Optimising the performance of co-modal logistics, including utilisation of more energy-efficient modes (i.e. enabling a required shift in freight transport from road-only to rail, sea and inland waterways)
3. Infrastructure: Increasing the efficiency of transports and utilisation of infrastructure by means of information systems and market-based incentives (i.e. develop an efficient TEN-T core network capable of handling transport volumes of the future)

[12] http://www.waterborne-tp.org/index.php/documents

To meet these challenges it becomes necessary to focus on the "full development cycle"; research, innovation, and deployment. In terms of R&D gaps there are no particular and fundamental aspects identified, however the following elements should be noted.

Main gaps identified are as follows:

- Only to a limited extent the White paper consider issues related to intellectual property rights (IPR)
- The WSRA has limited focus on key performance indicators (KPIs) and ex-ante project evaluation procedures
- Further, the White paper has limited focus on supporting extended operations as those related to the production of wind, tidal and wave energy, while also technologies related to offshore operations moving into increasingly deeper waters. Although not directly being relevant for transport these are matters having an impact on the design of vessels and cargo handling technologies.
- The White Paper handles impact of climate change on infrastructure, but not its impact on transport modes.
- The WSRA has limited focus on the development of a co-modal carbon footprint calculator to take care of the maritime needs.

5.3 Inland waterway Transport (PLATINA IWT SRA)

PLATINA[13] is a coordination action funded within the Seventh Framework Programme. It is aimed at the promotion of inland waterway transport (IWT). The main objective of PLATINA is to support the Commission, Member States and third countries in the implementation of the NAIADES action programme. PLATINA provides technical and organisational assistance while at the same time ensuring active participation of key stakeholders.

As one important element to facilitate innovation, PLATINA experts have prepared a first release of the Strategic Research Agenda (SRA) for Inland Waterway Transport. The intention was, to indicate major research areas and priorities, thereby supporting innovation policy, e.g. in terms of possible input for future research programmes at national or European level. The current version is focussed on ship technology. Issues related to infrastructure are not considered, yet. These will be dealt with in the second version of the SRA, which is expected to be published in 2012.

The SRA is based on anticipated developments and scenarios, on a sound analysis of system characteristics, strengths and weaknesses of inland waterway transport as well as on the analysis of global and sector-specific challenges. It determines strategic goals and provides a comprehensive overview on required research demand and activities, clustered within 3 pillars

- enhancing competitiveness,
- improving environmental sustainability and

[13] http://www.naiades.info/downloads

- managing growth and changing trade patterns.

Challenges	Strategic Goals	Strengthening competitiveness						Environmental sustainability						Managing growth and changing trade patterns					
Research Pillars	Research Topics	Refitting vessels	Fleet adaption to climate change	Innovative vessel design	Shipbuilding technology	Structural strength of the hull	Handling, maintenance, repair	Means to reduce emissions of existing technologies	New technologies for power supply on board	Energy efficient navigation	Hydrodynamics	Equipment on board	Advanced safety standards	Intermodal solutions	New logistic approaches	Advanced RIS services	Advanced security standards	Support of education and training	New markets
Infrastructure conditions and limits	Better exploitation of available infrastructure		x	x		x				x	x				x	x		x	
Over-aging of large parts of the fleet	Modernisation of the fleet	x		x	x		x	x	x		x	x	x						
Lack of nautic. person. and increasing requirements to nautical personnel	Coping with increaing requirements on professionals			x			x						x				x	x	
Predicted increases in transport demand	Releasing other modes of transport	x		x								x		x	x				x
	Intelligent IWT-approaches for general cargo	x		x	x	x						x	x	x	x	x			x
	Improvement of data management and information systems												x		x	x	x		
Climate change impacts	Reduction of greenhouse gas emissions							x	x	x	x			x					x
	Coping with expected infrastructure conditions		x	x			x			x	x		x		x	x			
	Maintain manoeuvrability and safety standards		x	x									x			x		x	
Finiteness of the resource "fossil fuel"	Transition to the "after-fossil-fuel-era"			x				x	x	x	x							x	
Limitation of hazardous emissions	Further reduction of fuel consumption and emission	x		x				x	x	x	x	x				x		x	
	More pronounced role of IWT within intermodal transport chains			x										x	x	x		x	

Figure 10: Overview of challenges and strategic goals and corresponding research pillars and topics of the Strategic Research Agenda for Inland Waterway Transport (Source: The PLATINA Project, 2011)

The second release of the Strategic Research and Innovation Agenda for Inland Waterway Transport will be called «Navigator 2020» and is planned to be released by the end of November 2012. The Navigator 2020 will take up two key EU objectives for the role of IWT in the European Economy: to serve the EU market and citizens' needs for uncongested and efficient transport mobility and to create a resource-efficient, climate change resilient and low-emission transport system.

The vision identifies goals and actions for inland waterway transport within the fields of

- logistics efficiency,
- infrastructure,
- vessels,
- education & qualification.

In order to address the identified challenges these are all areas that need considerable attention. Furthermore, subsequent to a broad consultation with key experts in the sector,

also specific research topics and measures to deploy the results of the related projects will also be prepared.

5.3.1 R&D gaps between IWT SRA and The White Paper on Transport

The main R&D pillars of the IWT SRA is somewhat aligned with those of the Waterborne SRA, namely (1) strengthening competitiveness, (2) ensuring environmental sustainability, and (3) aiming to match growth and changing trade patterns. Also, since the newly released SRA has been developed by the EU funded PLATINA project, with a main objective of assisting The Commission in realising its R&D objectives, there appears to be no significant R&D gaps between the IWT SRA and the White Paper. As with the other SRAs from relevant technology Platforms, it identifies some specific recommendations being directly related to each main R&D pillar. Some of these recommendations include:

- Innovative vessel design
- Shipbuilding technology
- Engine improvement for emission reduction
- Improvement of hydrodynamics
- Innovative intermodal transport solutions
- Advanced River Information Services

In addition to the above mentioned bullets, focus is also directed towards the development and improved utilisation of infrastructure (i.e. ports, terminals, river-locks, etc.).

Moreover, some of the gaps as identified in the analysis of Waterborne and the White Paper also applies here:

- The White Paper has little focus on development of new transport concepts
- The WSRA and IWT have limited focus on key performance indicators (KPIs) and ex-ante project evaluation procedures
- The WSRA and IWT have limited focus on the development of a co-modal carbon footprint calculator to take care of the waterborne needs.

5.4 European Rail Research Advisory Council (ERRAC)

The European Rail Research Advisory Council (ERRAC) was established in 2001 with the main objective to create a single European body with both the competence and capability to help revitalize the European rail sector and make it more competitive, by fostering increased innovation and guiding research efforts at a European level. ERRAC comprises 45 representatives from each of the major European rail research stakeholders: manufacturers, operators, infrastructure managers, the European Commission, EU Member States, academics and users' groups. ERRAC covers all forms of rail transport: from conventional, high speed and freight applications to urban and regional services.

ERRAC (2010) has defined a strategic roadmap for R&D for rail freight until 2015 to address the following issues: interoperability, new maintenance work management and information on the shipment position. The more recent documentation of the ERRAC

roadmap (2011[14]) has formulated three research agendas for promoting a rail freight modal shift. First is technical improvement through better wagon design for all types of services and reduced maintenance cost, enhanced train interfaces with other modes, track maintenance and traffic management to boost punctuality and reliability. Second is to address the rail system in view of creating a network through development of flexible local distribution with specialized operators, improving interoperability, cross border information system and harmonising safety rules towards seamless network goal. Third is the commercial and marketing issue to address new markets or reopen lost markets to road, organizing co-modality efficiently, real time information service to customers, interconnecting clients for easy tendering, integrated supply chain logistics and efficient spatial planning to support more productive rail transportation. The following figure show the seven ERRAC priority areas supporting rail as the sustainable backbone of single European transport area.

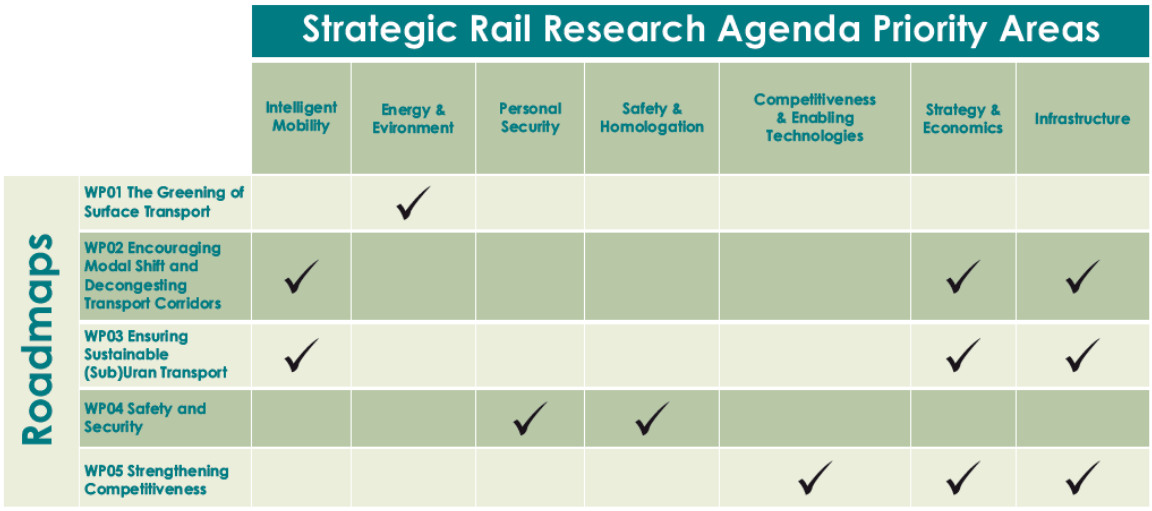

Figure 11: ERRAC strategic research priorities (ERRAC SRA, 2011)

For more details regarding specific research priorities for rail transport please view the Railway Strategic Research Agenda[15] (2011).

5.4.1 R&D gaps between ERRAC and The White Paper on Transport

As with the other SRAs, both the White Paper on Transport and the ERRAC SRA are sourced from industry and academic experts, meaning that the ability for SuperGreen as a project to make significant contributions to the discussion on new R&D topics is somewhat limited. This ability is further limited as both documents have been subject to recent revisions (i.e. in 2011).

Although no specific gaps were identified between the two documents, the following aspects are to be noted in terms of important focus areas towards securing sustained growth within the rail industry:

[14] http://www.errac.org/spip.php?article4

[15] http://www.errac.org/IMG/pdf/railroute2050_errac_final_v2.pdf

- The rail industry has little knowledge as to what extent the different aspect of the agenda have been accepted or rejected by the public or industry. As such it is necessary to investigate level of technology uptake, in addition to disclosing to what extent the different R&D topics within the industry have been covered.
- Despite the interest from potential customers to increase utilisation of rail transport, more efforts must be targeted for improving service levels and added value provided by rail. This also includes a better understanding in change of logistics cost by adding rail transport into the supply chain operations.
- From the industry point of view, several voice for an open rail freight market, and that any improvement to rail services including technology and services are indeed added value to customers. The main challenge is therefore to establish a solid basis for enabling rail to compete head-on with road. Much of the technology supporting the latter is already available, but what is more lacking is the cost related to implementing new technologies and ICT solutions for increasing operational efficiency.

5.5 European Intermodal Research Advisory Council (EIRAC)

Launched in 2005, the European Intermodal Research Advisory Council (EIRAC)[16] is a peer group of more than 50 high level industrial players, and focuses on achieving interoperability between modes with a view to the creation of a single European logistic system in line with the objectives set out in the White Paper on Common Transport Policy.

EIRAC's mission is to determine the vision, scope and content of the Strategic Research Agenda for intermodality as an important step towards the creation of a co-ordinated intermodal research strategy for Europe. The intermodal industry faces specific challenges of interoperability, logistics, security, socio-economics and education, and the SRA addresses all these challenges. The goal is to develop intermodal transport as an important part of the sustainable transport system. Intermodal transport then becomes a high quality service, which is seamless, reliable, available, accessible, secure, sustainable, accountable, and affordable.

In the SRA EIRAC a set of certain research priorities are identified, and the selection of priorities has been based on objective criteria that EIRAC has established, taking into account relevant policies related to the fields considered most important. These are:

- Energy efficiency
- CO_2 reduction and sustainability
- Efficient use of infrastructure
- Horizontal collaboration
- Supply chain policy
- Education and training
- Supply chain security

[16] http://www.eirac.eu/

Table 1: EIRAC Strategic research priorities (EIRAC SRA, 2005)

	Interoperability Between Modes	Logistics	Security	Socio-Economics	Education and Training
Seamless	X	X			X
Accessible		X			
Reliable	X	X	X	X	X
Available		X		X	X
Sustainable	X			X	
Accountable		X			X
Transparent		X		X	X
Secure			X	X	
Affordable			X	X	

Regarding intermodal specific R&D priorities proposed by EIRAC, please see the SRA Rail Route 2050 – the sustainable backbone of the single European transport area[17].

5.5.1 R&D gaps between EIRAC and The White Paper on Transport

Both the White Paper on Transport and the EIRAC SRA cover some very similar aspects, and although not representing clear R&D gaps, there are some important issues that should receive increased R&D efforts:

- More efforts are needed towards "de-stressing" of the supply chain, i.e. relaxing the "constraints" on the supply chain to achieve a natural efficiency. This also means that the alleviation of typical transport bottlenecks should be pursued.
- Ports and inland terminals represent important transhipment points, attracting and generating much transport activity. Thus, further efforts towards reducing energy consumption form such operations, along with other negative externalities (i.e. noise, emissions to air), needs to be pursued.
- In relation to intermodal operations, both efficient cargo handling technology and development of smart solutions for secure shipments need to be developed.
- Also, too little effort is invested in sharing sustainable collaborative logistics knowledge between manufacturing industries and the transport & distribution sector.

5.6 Conclusions of the gap analysis

The investigation carried out above does show that the gaps in terms of R&D and development needs between the White Paper and the SRAs of relevance are seemingly few and far between. Most likely this is the result of all documents being based on input from industry experts, being subject to recent revisions, but also due to their incorporated support for having a strategic approach to long-term development within each transport sector. Another main reason is that the different SRAs are mainly mode-specific, and with

[17] http://www.eirac.eu/documents/The%20next%20EIRAC%20Strategic%20agenda%202010-2030+.pdf

the provision of more concrete recommendations along with expected research outcome, the recommendations are presented on a more detailed level as compared to the White Paper.

However, there are some issues of generic nature that have been integrated into the SuperGreen recommendations, and thus being a representation of some important development needs within the Green Corridor context:

- Efforts towards reducing energy consumption from port and terminal operations should receive continued focus. This also due to the need for reducing negative externalities from such operations (i.e. noise, emissions to air). Supporting the development of technology and solutions for efficient cargo handling technology therefore becomes of key importance.
- In order to support secure transport solutions, development of such technology need to be further developed (also supporting co-modal operations). Among other things this relates to technology fitted for cargo surveillance.
- Key performance indicators (KPIs) and ex-ante project evaluation procedures must receive more focus. The main objective of such work must be to enable proper benchmarking of transport mode performance, but also to better understand the impact of targeted infrastructure projects (e.g. TEN-T, Inter-Reg, etc.) .
- More efforts should be put into the development of a co-modal carbon footprint calculator supporting optimal utilisation of available transport resources. The calculator must avoid polarization of modes, meaning that favouring of modes must be avoided. Further, the tool must be supported by a standardised measurement methodology.
- Investigations on technology uptake within the different transport modes should be carried out in order to achieve a better overview of current status. Such an overview will also uncover to what extent the different R&D topics have been covered.

The abovementioned bullets are by no means meant to be exhaustive.

6 European R&D activities – efforts, status and results

Supplementing the previous chapter, an overview of current efforts and status within transport industry research results is also needed for SuperGreen to provide a set of useful R&D recommendations. This chapter provides information on a selection of relevant initiatives particularly targeted for promoting and disseminating information about R&D results. However, as European transport research covers a wide range of topics and themes, all promoting different sub-themes and tasks (often accompanied by detailed description of R&D recommendations), this analysis will be on a high-level. Initiatives identified are the Transport Research Knowledge Centre, EC- Research and Innovation – Transport, the Strategic Transport Technology Plan, and the ERA-WATCH platform. In addition, the rather newly established funding mechanism "the Green Car Initiative" is visited. Further, the main pillars and focal areas for the new R&D program "Horizon 2020" is presented (European Commission, 2011).

As such, the order and selection of the different initiatives may seem arbitrary. However the main focus has been on identifying key initiatives with the objective of transferring R&D results to the transport stakeholders, in addition to pure R&D supportive mechanisms. Note that the listed initiatives by no means are meant to be exhaustive.

6.1 Transport Research & Innovation Portal

Previously known as the Transport Research Knowledge Centre (TRKC; an initiative funded by FP6), the main objective of the Transport Research & Innovation Portal (TRIP) is to connect transport research with EU policy, and to provide an overview of research activities both on an EU and a national level. In order to meet those objectives, the Centre has developed two key services, namely the Compendium and the different Thematic Research summaries.

6.1.1 Transport Research in the European Research Area – a compendium

In June 2010 the document "Transport Research in the European Research Area- a guide to European, international and national programmes and projects[18]", was published. This is a compendium mainly targeted for the European Commission's Directorate-General for Energy and Transport (DG-TREN) with two main objectives:

- To establish a comprehensive overview of the extent of research and project results across the European research area.
- To make results available in a handy format to practitioners and policy makers.

Moreover, the compendium provides a summary of the outputs from TRIP, a free-of-charge web portal that makes transport research results and best practices from the European Research Area easily accessible. As such it serves the role as a primary source of information for policy makers and research managers at European, national and local levels. In particular, it provides an overview of transport research funding mechanisms and sources at European, international and national level including a directory of programmes,

[18] http://www.transport-research.info/download/TRKC_Compendium.pdf

a summary of thematic definitions and information on the Thematic Research Summaries and Policy Brochures available on TRIP.

The compendium is structured in four chapters:

- Chapter 1 explains the rationale behind the project and the methodology used to collect, monitor and analyse transport research programmes and projects across Europe. It also describes the other key publications such as the Thematic Research Summaries and Policy Brochures.
- Chapter 2 provides short definitions for each of the 30 themes chosen for categorising transport research projects. The relevant research results are summarised in the Thematic Research Summaries (please see section below).
- Chapter 3 describes the approaches to research management in 30 European countries, all members of the European Research Area. It also includes a list of government departments, ministries and the main actors involved in transport research as well as a list of identified programmes sponsored by these bodies.
- Chapter 4 covers the Thematic Research Summaries and Policy Brochures and gives an overview and brief description of all publications, which can be downloaded from the web.

The nations covered in the compendium are Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, and United Kingdom (TRKC, 2009).

The compendium is an important source of information for establishing an overview of relevant research initiatives that are not covered by the Framework programmes or the transport related Strategic Research Agendas (SRAs).

6.1.2 Transport Thematic Summaries of R&D efforts

Through the Transport Research & Innovation Portal[19], 30 thematic summaries are available for the public, each providing summaries of project research results from across Europe. Although not an exhaustive compilation, the content of each Thematic Summary is structured according to:

- Associated policy issues
- Synthesis of findings from completed projects
- References to policy documents
- Projects contributing to each theme
- Implications for further research.

The latter is of particular interest for the SuperGreen project, and a compiled overview of the R&D recommendations from a selection of Thematic Summaries of particular relevance for SuperGreen is given in Annex 1. However, based upon the Thematic Summaries identified, being: Transport Management (2010), Safety and Security in Mobility (2010), Integration and Policy Development (2011), Environmental

[19] http://www.transport-research.info/web/publications/thematic.cfm

Aspects(2010), Freight Transport (2010), Infrastructure and Trans-European Networks (2010), Waterborne Transport (2010), Road transport (2010), and Rail Transport (2010), Decision Support Tools (2010), a synopsis of the R&D recommendations provided is given below. Please note that the following elements apply to all of the mentioned Thematic Summaries:

- Decongestion of transport
- Engine and propulsion technology for increased energy efficiency
- Institutional cooperation (e.g. competitiveness, environment, energy, safety and security)
- Securing integration of supply chain and transport systems (pan-European interoperability).
- Strategies for awareness raising and training key stakeholders
- Infrastructure safety (data for reliable design and safety recommendations)
- Production processes and vehicle innovation
- Promotion of best practices and industry up-take of technology

6.2 EC – Research and Innovation – Transport

The website "EC- Research and Innovation - Transport[20]" serves as a main hub for dissemination of activities within European research, presenting the latest advances within a variety of topics, and as such being an important source of information for a range of different stakeholders. In regards to transport, the website communicates a set of research priorities and results for all transport modes however those relevant for SuperGreen are related to rail, road, water, and multimodal. For a detailed overview of the different issues and challenges identified for the different modes, along with corresponding research priorities, the website serves as an excellent reference point.

Although too detailed to be covered here in full, the issues, challenges and related R&D priorities for the different transport modes are connected to:

- Greening of transport operations and the environment (incl. de-congestion)
- Interoperability between modes
- Competitiveness
- Safety and security
- Innovative materials and production methods

As part of this web portal, the Commission plan to establish a Transport Research and Innovation Monitoring and Information System[21] (TRIMIS). By the use of funds from the new Research and Innovation Program - Horizon 2020, this system is aimed to become the Commission's instrument for mapping technology trends and innovation capacities. As

[20] http://ec.europa.eu/research/transport/index_en.htm

[21] http://wbc-inco.net/attach/Transport_Communication_EN12.pdf

such it is meant to serve the purpose for monitoring and steering the development and deployment of innovative solutions.

6.3 Strategic Transport Technology Plan (STTP)

As outlined in the White Paper on Transport (2011), the European Commission has launched an initiative to develop a strategic framework for future transport research, innovation and deployment. Based on the shared goal of establishing an integrated, efficient and environmentally friendly European transport system, the STTP[22] is meant to introduce shared areas of technology that are particularly beneficial for transport stakeholders to co-ordinate their efforts. I.e. it serves as the main strategy on how the European community should achieve the goals as defined by the White Paper. As an important step in realising this goal, transport stakeholders have been invited to take part in conferences and answering questionnaires, and the below is a selection of input received:

- Focus should be directed towards identifying the links and commonalities between Research & Innovation within infrastructure, vehicles and the users.
- Increased attention should be directed towards the changes experienced by the maritime industry as a consequence of environmental demands and rising fuel costs.
- Investigations should focus on whether a framework for fuel efficiency will contribute to increase the innovation speed and technology take-up.
- The STTP should clearly distinguish between the needs between inland waterway transport and seagoing transport.
- Safety and security are key issues that must receive more attention

In addition, a Communication entitled "Research and innovation for Europe's future mobility[23]" was adopted in September 2012. This document presents the main achievements within R&D and remaining challenges. It also proposes some ideas for how to better meet the needs of the European transport community. In addition to identifying important areas for further efforts within the transport R&D community, much focus is put on the ability to innovate and capitalize on the investments made. An important element identified is therefore the ability to overcome 'silo-thinking' in the different disciplines and research communities by promoting cross-industry efforts and more wide-spread dissemination of best practices throughout modes.

[22] http://ec.europa.eu/transport/research/sttp/doc/report_sttp_public_consultation.pdf

[23] http://wbc-inco.net/attach/Transport_Communication_EN12.pdf

6.4 Joint Research Centre

Being the European Commission's own internal science service, the main objective of the Joint Research Centre[24] (JRC), is to provide EU policy initiatives with independent and evidence-based research results through the entire development phase. The results created are disseminated to all EU member states, meaning that this centre acts as a source of inspiration and knowledge. In 2012, the JRC concluded on a scientific assessment as part of the STTP preparation, covering all transport sectors and issues. The report "Scientific Assessment of Transport Technologies[25]" investigates all aspects per transport mode, including co-modal, playing the role as key input to the selection of priority areas within research and innovation as defined by the STTP. As such, it evaluates the potential inherent in a series of technologies and their respective possibility to contribute to the realisation of EU policy objectives.

6.5 The ERA-WATCH platform

The ERA-WATCH[26] platform is the European Commission's information source on European, national and regional research systems and policies, with a main objective of supporting policy-making in the research field in Europe and to contribute to the realisation of the European Research Area (ERA). The long-term initiative is a joint effort by European Commission's Joint Research Centre - Institute for Prospective Technological Studies (JRC-IPTS), Directorate-General for Research and Innovation (DG-RTD), in close collaboration with the Directorate-General for Enterprise and Industry (DG-ENTR).

Covering a total of 61 countries; the 27 Member States of the European Union, 13 countries associated with the European Community's Research Framework Programme and 21 third countries, the platform holds relevance for WP 5 due to the extensive overview of up-to-date information and analysis of national funding mechanisms and regional and EU level R&D programs[27].

Moreover, the website contains tremendous amounts of information available for each country, covering several aspects of R&D and policy related issues such as overview of funding flows and structure of the research system, regional research policies, policy mix, governance structures, research funders, research performers, national policy and European research area.

[24] http://ec.europa.eu/dgs/jrc/index.cfm?id=10

[25] http://publications.jrc.ec.europa.eu/repository/handle/111111111/26330

[26] http://erawatch.jrc.ec.europa.eu/erawatch/opencms/about/

[27] http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/country_pages/

6.6 The Green Car Initiative

From the outset of increasing global and local pollution arising from transport of passengers and cargo, along with the necessity to further develop production processes for securing competiveness of European car manufacturers, the Commission has established a program to support research within the area of greening transport modes. By focusing both on passenger and cargo transport, the "Green Car Initiative[28]" provides funding for research within a variety of areas, and the most essential ones are listed below:

- Electric and hybrid vehicles
- Logistics (de-congestion and interoperability across modes)
- Internal combustion engine (increased energy efficiency and decreased emission)
- Biofuels
- Hydrogen fuel cells

The initiative also aims to provide the European industry with a financial boost for increasing the development and implementation of green transport technologies through the establishment of Public Private Partnerships. In June 2012, the second edition of the "European Roadmap – Electrification of road transport[29]" was published. Building on the roadmap published in 2009 its main focus is in de-carbonisation of passenger transport and cars. In addition, a draft version of the Multiannual Roadmap for the Contractual PPP "European Green Vehicles Initiative" was made publicly available for comments and input in July 2012.

6.7 Horizon 2020

Horizon 2020[30] is the new EU research framework programme planned for the period 2014 to 2020, replacing the 7th framework program. Three main research areas are described: Social challenges, industrial development and strengthened R&D:

- Societal challenges include research on health, demographic changes and wellness, food security and bio-based economy, safe, clean and effective energy, smart, green and integrated transport, access to raw materials, resource efficiency and climate handling, including, innovative and safe society.
- Industrial development includes leadership in generic and industrial technologies, access to risk capital and innovation in small enterprises.
- Strengthened R&D includes strengthened basic research, future and emerging technologies, qualification and carrier development and research infrastructure.

Particularly relevant for the SuperGreen project is how the new research program aims to secure development of smart, green and integrated transport solutions for contributing towards the development of a resource-efficient, environmentally-friendly, safe and

[28] http://ec.europa.eu/research/transport/road/green_cars/index_en.htm

[29] http://www.green-cars-initiative.eu/public/documents/Electrification_Roadmap_Web.pdf

[30] Horizon 2020 – The Framework Programme for Research and Innovation, COM(2011) 808 final, November 2011

seamless transport operations. Highlighting the need for breakthroughs in research, innovation and pan-European implementation of green technologies a number of activities are described. These are given below:

- Resource efficient transport that respects the environment
    - Securing greener transport mode design (energy and noise efficient)
    - Developing smart equipment and infrastructures
    - Improving transport and mobility in urban areas
- Better mobility, less congestion, more safety and security
    - A substantial reduction of traffic congestion
    - A substantial improvements in the mobility of people and freight
    - Developing and applying new concepts of freight transport and logistics
    - Reducing accidents rates and fatal casualties and improving security
- Global leadership for the European transport industry
    - Developing the next generation of transport means as the way to secure market share in the future.
    - On-board, smart control systems
    - Advanced production processes
    - Exploring entirely new transport concepts
- Evidence-based transport policy for the long term

6.8 Technology uptake in the transport industry

The level of technology uptake in the transport industry is vital for deployment and implementation of R&D results in the market, as well as for securing critical feedback concerning further development needs. The European Intermodal Association (EIA), being a membership organisation with the mission of promoting sustainable intermodal mobility in Europe, published in 2010 a document containing 49 different fact sheets describing different cases of best practices, particularly related to intermodal transport[31]. The document "Innovative Intermodal Transport" present adoption of innovative technology in intermodal chains, new types of services or business models, and successful entry into new markets, the fact sheets show how the intermodal transport industry has been progressing by successfully adapting to changing requirements and circumstances (i.e. representing technology uptake within the European transport industry). As such, the document can be viewed as an extension of the PROMIT[32] project, providing a comprehensive overview of transport related advances in terms of energy and operational efficiency (EIA, 2010).

[31] http://www.eia-ngo.com/other-intermodaldocuments.html

[32] http://www.promit-project.net/; with a main objective of contributing to a faster improvement and implementation of intermodal transport technologies and procedures, and for helping the promotion of intermodal logistics, best practices and intermodal transport opportunities for potential users as well as for politicians and for the research community.

6.9 Status of EU R&D efforts for Green Corridors

The overview of R&D priorities and recommendations as described by the Technology Platforms in the previous chapter (i.e. the SRAs), in addition to Horizon 2020 and the Green Car Initiative, clearly show an increased focus towards developing intermodal, energy efficient, and more competitive solutions for the transport industry. The latter encompassing a variety of topics, spanning from business models to pure operational measures.

At the same time, the significant source of information represented by The Transport Research & Innovation Portal, The EC – Research and Innovation web site, clearly show that the scope of R&D topics covered by various stakeholders are extensive and wide-ranging. In addition, these are very positive on-going efforts and processes for dissemination of transport and intermodal best practices throughout Europe.

However, the scope and the variety of R&D recommendations identified is no guarantee for successful implementation and industry adoption of project results. As identified in other SuperGreen deliverables (D2.5, D3.1v3, D3.3 and D4.1v2), there are still a number of transport related ICT solutions, greening technologies and bottlenecks that need attention and alleviating measures. Being summarized and accumulated in D5.1 they collectively form part of the basis for the R&D recommendations. Hence, before the attention is given to the final set of R&D recommendations from the SuperGreen project, the concluding remarks from D5.1 are revisited.

7 Findings and recommendations from D5.1

One important starting point for the SuperGreen R&D recommendations is naturally importing the findings and main conclusions from D5.1. The results from D5.1 indicates that the majority of bottlenecks identified can be improved by facilitating implementation and harmonisation of existing ICT-related measures, rather than of "hard" technologies. In many cases it also seems to be a matter of policies and harmonisation of regulations, than a question of need for new developments.

The identification of unsolved bottlenecks was categorised according to some overall needs for mitigating measures (i.e. operational, ICT and transportation technology, Infrastructure, Policies, Legislation and regulations, and other). Gaps as basis for R&D recommendations were identified according to these needs based on what is available of technologies and ICT. In case gaps are considered as policy issues, these will be taken care of in WP 6.

As of the above, the final input from D5.1 supporting the development of the SuperGreen R&D recommendations is summarized in the table below.

Table 2: Task 5.1 input to R&D recommendations

Task 5.1 input to R&D recommendations
1. Within the ICT domain, a portfolio of systems and solutions already exists. However, there is still a need to further streamline and harmonise solutions to fulfil the overall requirements of co-modality and secure interoperability. Also in securing industry wide implementations, efforts should be devoted towards further investigating the usage of "cloud computing" as low cost and low threshold alternative for integration e-Transport systems (for both large and small actors).
2. There is a need for increased emphasis on implementation of available supply chain management systems and solutions throughout the chain. Further elaboration on actions and measures that could reduce obstacles and improve stakeholders' ability to adopt them should be strengthened.
3. In some areas assignment of icebreakers to vessels is key issue for improved safety and efficiency of operations. There is still a gap in the implementation of available systems, and as part of this need for implementation of new functionality to meet user needs.
4. Major bottlenecks still exist due to lack of harmonisation at a Pan-European level. Existing policies and regulations on a Pan-European level should be further analysed with the aim of improved harmonisation throughout Europe. Examination of all measures and actions that could solve incompatibility issues, enhancement of ICT integration and ensure interoperability.
5. Further efforts should be made for piloting of available technologies and solutions in regions to improve efficiency of border crossings.

6. There is a continuous need for further development of key technologies that improve green corridor benchmarks. Technology, necessary to pursue R&D efforts within energy and propulsion systems, cargo handling and transfer, fuels and sources of energy, vehicles, navigation technologies for energy efficiency, fleet optimisation, etc., should be further developed and implemented. Actions and measures that may reduce obstacles and improve stakeholders' ability to adopt them should be emphasised.

7. Although previously debated, investigations on whether smaller ports are to be developed into preferred ports for European Short Sea Shipping by means of tailored functionality and equipment ought to be re-opened. Often specialised ports have proven to be more efficient in comparison to bigger and multi-commodity ports.

8. Rail freight operation is much about optimising the use of journey time. However, in order to facilitate this, more efforts should be targeted towards gaining access to the data, including structuring it for optimal use, allowing for measurement of potential time saving and thus less emission.

9. In support of energy efficient co-modal operations there is a need to develop a harmonised and commonly accepted carbon footprint calculator applicable for all transport modes. This also implies development of a standardised methodology for avoiding polarized results (i.e. favouring of modes). Also includes how emissions should be assessed: e.g. well-to-wheel or tank-to-wheel.

10. In support of safer, cleaner, and more reliable waterborne operations (including sea going and inland waterways), also, there is a need for developing financing and business models in support of fleet modernisation in support of strengthening the role of waterborne transport within co-modal transport solutions

11. Development of risk management and accidents averting practices, supporting the use of co-modal transport operations.

8 Transport mode specific R&D recommendations

Considering the main receiver of this document, being the European Commission, DG-MOVE and DG-RTD, and more specifically the new Framework Programme for Research and Innovation - the Horizon 2020, the main objective is to present the final set of R&D recommendations as identified by the SuperGreen project. As a reflection of the relevant SRAs, the focus of this chapter is directed towards identifying and elaborating on mode-specific recommendations (i.e. waterborne, intermodal, road and rail). The following joint discussion of waterborne transport and intermodality rests upon the nature of the industry (i.e. being fully dependent on operations in port of loading and port of discharge). Moreover, it also rests upon the value inherent in viewing waterborne transport in a wider perspective (i.e. becoming an integrated part of the transport chain), and the number of previous EU projects carried out with a similar focus.

8.1 Waterborne and intermodal specific R&D recommendations

8.1.1 Operational recommendations

Regarding pure operational bottlenecks related to waterborne operations (i.e. seagoing and inland waterways), and intermodality there are a number of on-going alleviating activities, which also are addressed in the recent updates of the SRAs. In addition to a number of projects that have been launched for improving intermodality operations, research has also focused on developing new vessel concepts that enable a better integration of waterborne transport modes into intermodal operations. As of this, R&D recommendations include:

- Investigation and impact studies of conditions under which slow steaming in EU's short sea routes seems favourable should be accomplished. This will inevitably necessitate the creation of a ship speed surveillance system which will make sure the rules will be obeyed even in times of high demand for shipping services. Caution should be exercised to avoid reverse modal shifts.
- Related to the above, efforts should be directed towards increasing the understanding of what impact "slow steaming" has on the environment, and on the transport industry at large.
- Continued focus on further development of cargo handling systems, integrated transport systems, promotion of best practices, efficient terminal lay-out, and port hinterland connections.
- Development of technology minimizing emission to air and water (i.e. propulsion technologies, exhaust cleaning systems, and grey/black water treatment technology). This also includes investigation of alternative solutions for prolusion technology (i.e. non-fossil)
- Development of vessel concepts creating a stronger link between shortsea and inland waterways
- Increase the attractiveness of waterborne professions through developing new training programmes, career opportunities, and technology for improving life at sea and on inland waterways.

8.1.2 ICT and transportation technology recommendations

There is a growing concern for developing actions to get better and transparent information of freight flows among the different transport stakeholders. Hence, policy decisions at European level should reflect the needs of the co-modal transport industry to contribute to promote sustainable and effective logistics throughout Europe. Recommendations for R&D are therefore covering the following:

- Continue work for the development of harmonised ICT and decision support systems.
- Development of ICT systems that promote and support development of improved business models (e.g. new intermodal transport solutions based on logistics and co-modality require the deployment of a new range of suitable ICT systems and technologies to become a real option for shippers).
- Efforts for gaining a deeper understanding of future demands within the ICT domain and transport technology, in addition to definition of ICT system requirements.
- For maritime transport, an adequate ICT system could not be identified for reduction of vessel waiting times outside ports (i.e. waiting for available quay space), creating an unnecessary increase in local emissions to air. It is therefore a need to develop a new system or to upgrade an existing system.
- For ice-infested waters there is also a requirement for implementing available decisions support tools for how to assign icebreakers to other vessels, with the use of already existing (communication)-technologies.
- For inland navigation, further actions are needed to close the gaps in national River Information Services (RIS) infrastructure and in the provision of services to logistical RIS users across Europe. The European and national legal framework on RIS needs updating and the implementation of the "European RIS Services" (e.g. European Vessel Certification Database, RIS Data Management System) is recommended.

8.1.3 Infrastructural recommendations

An efficient and seamless European transport system depends on efficient hubs or nodes that enable multimodal interconnections. Recommendations for R&D cover:

- Further development of a network of intermodal terminals across Europe, being part of multimodal supply chains.
- Development of transport technology and operational solutions targeting alleviation of the growing congestion on European roads and port access.
- Development of approaches and technical solutions for removal of bottlenecks and better utilisation of the existing infrastructure.
- Development of new financing and business models for increasing the fleet renewal rate.

8.1.4 Recommendations related to policies, legislation and regulations

There are some interesting measures related to solving the problems concerned with legislation, regulations and procedures in order to make maritime transport safer, more secure, greener and more competitive. Although this is the main focus of WP6, the following recommendations are identified by WP5:

- The lack of harmonisation of national regulations within various fields between nations.
- The barrier for carriage of dangerous goods due to differing regulations between transport modes, and thus also being a barrier to free market competition. Currently, the rules and procedures are highly more complex for sea transport than for land transport.

8.2 Rail specific R&D recommendations

Many of the challenges faced by rail transport are identified and their anticipated solutions are well known by the industry. However, there is a glacial response from the European railway sector to the recognition and response to these and a reluctance to undertake the sort of macro and micro reforms needed to make rail a more attractive option to shippers.

8.2.1 Operational recommendations

At the operational level previous projects including NEWOPERA and RETRACK have provided a number of R&D recommendations also relevant for SuperGreen. These recommendations can be viewed in annex 2. In addition, the following R&D recommendation applies:

- For long distance operation, considerations should be made regarding what the ideal number of large rail freight operators for optimised operation of a rail corridor would be. The rationale is that the appearance of a few more large players in the rail freight market would be helpful to bring the long distance cross border rail freight to be more competitive against road freight. In turn this will invite alliance of smaller players to form as bigger players that consequently creates a competitive market.

8.2.2 ICT and transportation technology recommendations

The rail industry needs to focus on developing solutions that produce quick but also sustainable results in terms of additional traffic and revenue, and there needs to be a much more profound adoption of commercially based initiatives. This needs to be matched with measures to constrain and drive down costs commensurate with a drive to raise asset and resource productivity by factor amounts. Moreover, R&D recommendations also include the following:

- In terms of "green technologies" identified by the project (e.g. braking energy recovery for rail), efforts should be targeted towards identifying application areas. This includes carrying out cost/benefit analysis.
- Efforts for shifting focus from over-reliance on technical measures towards more commercially based initiatives should be investigated.

- Identifying where and on which corridors such "green technology" should be promoted and implemented.

Also, the benefit of European Rail Traffic Management System (ERTMS) for advancing interoperability has been around for sometime (e.g. Vinck, 2006). Within the rail industry there is evidence that countries like UK, Sweden and Germany are setting targets to implement the technology extensively within the next few years. Some rail actors/operators are still in doubt of the benefits of the high investments needed. This is particularly true as high investments will create more expensive services and in turn reduce the competitiveness of the rail services compared to other modes. Further research and development may contribute to make the ERTMS technology and implementation more cost effective and thus reduce the investments needed. However, it has been highlighted that ERTMS would only make economic sense if all the corridors (long distance ones), are equipped with such technology (Schabert, 2006), which then reinforces questions about its deployment and the benefits that flow from its application.

8.2.3 Infrastructural recommendations

The rail sector is too much focused on prioritizing its own supply side measures as a priority. Instead attention should be directed towards meeting customer requirements and expectations making it competitive with road transport. At the same time there are challenges related to utilisation of wagon assets, but also for developing new economic concepts adapted to more sustainable operations. As such, recommendations for R&D activities encompass:

- R&D on developing strategic supports and promotional campaigns specifically targeted for the rail industry.
- Development of economic concepts to be applied on different corridors in order to determine necessary investments in infrastructure, bottlenecks, bypasses, technology, rolling stock, longer heavier trains, etc. in order to increase productivity, and generate additional capacity dedicated to freight transport.
- R&D on how asset management can lead to reduced dwell times and improved commercial activity (i.e. clarification of responsibility for individual assets).

8.2.4 Recommendations related to policies, legislation and regulations

Although being the main focus of WP6, the full use of rail's green endowment should be made ensuring this is contributing to sustainability, both in economical and environmental terms. Further, SuperGreen also supports the recommendations already identified by NEWOPERA and RETRACK, namely:

- Future project supported by EU to sponsor new rail freight services on other corridor to start up in the form of repayable working capital through new mechanisms or via existing instruments such as Marco Polo;
- At the national level, the Member States need to ensure that incumbents do not retaliate on pricing to drive away the new entrants;

- Need for a complete through transit ability to track the movement of the train, wagon and cargo module independently of the railway administration to confirm ETA or any revisions.

8.3 Road specific R&D recommendations

8.3.1 Operational recommendations

One of ICTs main scopes is to overcome complexity of modern transport systems and procedural obstacles. Research should be at a high level aiming to increase visibility in the supply chain management, effortless information transferring, friendlier Graphical User Interfaces (GUIs), simplify operations, unify various stakeholders and different countries technologies. More specifically these include:

- R&D for dynamic vehicle routing using real-time traffic information.
- R&D for dynamic congestion charging to control traffic.
- R&D focusing on single window apps along the EU road network.
- Combined legislation and operational R&D efforts to decrease non useful level of complexity
- R&D with extra focus on operations, (toll charging, crossing borders, customs duties, dangerous goods,)

In addition, more technology driven recommendations include decarbonisation through:

- Improving the air drag on lorries
- Improvement of combustion technology and exhaust gas cleaning technology
- Development of hybrid engine solutions

8.3.2 ICT and transportation technology recommendations

As stated before, ICT's implementation, adaptation and development are very crucial to the overall efficiency of the road transport. The R&D recommendations are focused in development, integration and implementation of road ICT technologies:

- R&D focusing in development of new, easily adopted and efficient ICTs to meet the future trends of road transport.
- R&D focusing in the integration of the existing road ICT technologies in order to increase performance and visibility.
- R&D focusing in information flow along the transport chain.

8.3.3 Infrastructural recommendations

Infrastructural bottlenecks in road transport are present and often magnified due to lack of stakeholders willingness for adaptation. To be more precise, the infrastructure sufficiency is dependent on the level of transport load and characteristics. The increase of transport load is developing bottlenecks on road transport and these bottlenecks can be overcome by

enhancing road and related infrastructures, by increasing the efficiency and the capacity of existing infrastructure or by encouraging shifts of road cargo to other modes of transport. Therefore the R&D recommendations for road transport include:

- R&D for developing forecasting and simulation techniques for future road cargo flows.
- R&D for increasing infrastructure efficiency and performance
- R&D for increasing road modes efficiency, performance and payload
- R&D for enhancing modal shift from road transport to rail, sea and inland waterways.
- R&D on specific areas of road transport such as expert pollution charging systems in trans European road networks or congestion avoidance systems

8.3.4 Recommendations related to policies, legislation and regulations

Recommendations related to policies, legislation and regulations will be addressed in deliverable D6.2. In addition to this, it is a commonly accepted fact that ICTs in general are value added investments in the transport industry. Additionally those systems exhibit an eco friendly impact on the environment either by directly decreasing emissions and other polluters or by increasing levels of safety and minimising accidental pollution. To that extent, proposed R&D recommendations include:

- R&D efforts seeking for and designing appropriate funding methods to develop, install and operate ICTs especially for road.
- R&D efforts aiming to enhance homogenizing standards and procedures for road transportation among EU countries.
- R&D recommendations to adopt a single window intra-European application dedicated to road transport.
- R&D on the regulatory framework of selection of critical ICTs and transforming them voluntary to mandatory use.
- R&D on efforts to enhance the use of common EU policies and regulations over the nationals so as if to avoid multi-legislation issues.

9 R&D recommendations for SuperGreen Common Development needs

As one of the main objectives of SuperGreen is to support the development of sustainable transport networks, there are obviously several intermodal development needs. These are important to address for securing efficient and effective co-modal operations within the pre-defined green corridors. But also if the transport sector is to reach the objectives set by the White Paper (2011), targeting a 60% reduction of transport emission by 2050, and a shift in cargo transport from road to rail, sea and inland waterway transport sea by 50% within 2050. The common development needs are given in the figure below:

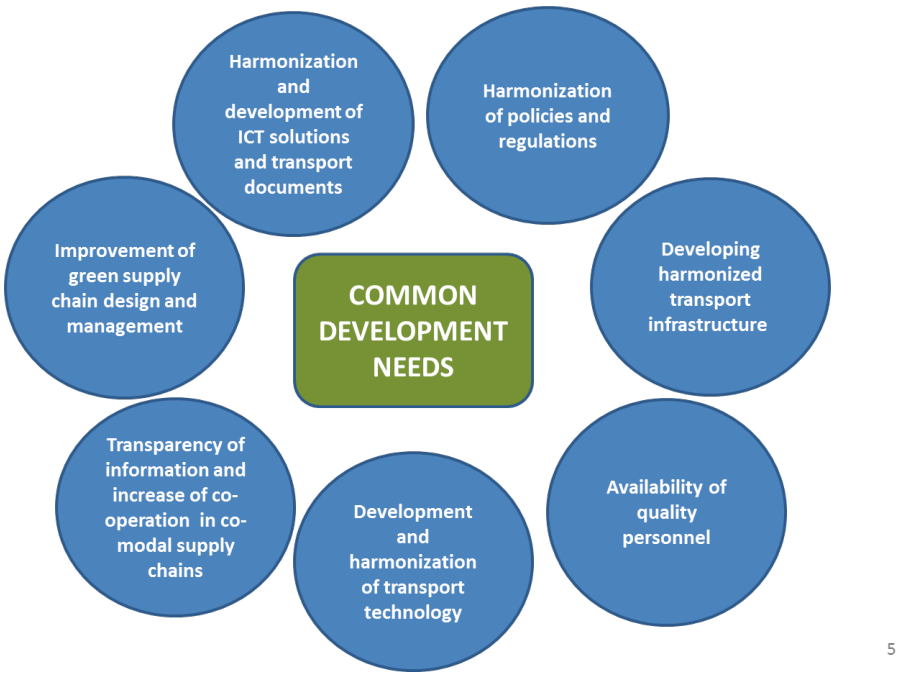

Figure 12: SuperGreen common development needs

The following tables elaborate on these common development needs by presenting relevant and general findings from the SuperGreen project and some final recommendations for R&D. In addition to accounting for the elements identified in D5.1 (as given in chapter 7), relevant conclusions of D6.2 – Policy Recommendations, Final version are also included.

9.1 Improvement of green supply chain design and management

Area of development	*Improvement of green supply chain design and management*
General findings	SuperGreen analysis indicates that there is a lack of detail analysis of case-by-case specific needs and requirements. Although ICT solutions such as VTS, ERTMS, VMS are currently being applied in selected road and rail networks and in transport nodes (i.e. ports, terminals and freight villages), it is necessary to apply technologies in more segments or critical nodes in order to better distribute the traffic flow and reduce congestion (especially due to

	capacity limitation of rail and road networks). In addition there is a clear lack of data and statistics on transport performance, but also for identifying directions and intensity of cargo flows within the European region.
Recommendations	• Development of co-modal transport optimisation models, development of transport simulators to better understand the impact of expected transport growth towards 2030, and development of co-modal emission calculators (CO_2, SOx, NOx, PM, etc.) • There is a need for increased emphasis on implementation of available supply chain management systems and solutions throughout the chain. • Development of business models supporting more integrated transport solutions and transparency of supply chain operations • As identified in D2.4 there is an evident lack of data and reliable tools enabling proper benchmarking exercises. This is critical for enabling measurement of transport performance. In addition, D6.2 – Policy Recommendations, Final version concluded on a few issues also relevant for this development area: • The concept of cluster governance, applicable in cases where a closer integration of the involved actors could lead to overall performance improvements, needs to be further researched as it seems quite promising for supply chain applications. • The work performed on standardised estimation of transport-related external costs, with emphasis on measuring and allocating CO_2 and other emissions, needs to be continued until a universally acceptable methodology is reached. The work of CEN and ISO in this direction needs to be supported and accelerated. • The Life Cycle Cost methodology needs to be introduced in decision making and environmental assessment. • At least one certified multimodal carbon and environmental footprint calculator needs to be developed supporting the relevant actions of the 2011 White Paper.

9.2 Harmonisation and development of ICT solutions and transport documents

Area of development	*Harmonisation and development of ICT solutions and transport documents*
General findings	SuperGreen results indicate that the problem is not as much the development of the systems themselves, but more a lack of appropriate implementation and harmonisation in order to secure information transparency and efficient information exchange. Thus, R&D should focus on how this should be facilitated on a Pan-European basis (e.g. case by case specific definition of needs), while also on developing regulatory issues to enhance the

	use of dedicated ICTs. Moreover, there is a need to further streamline and harmonise solutions to fulfil the overall requirements of co-modality and secure interoperability
Recommendations	• In order to advance technology up-take of existing solutions, and the development of new ones, a study of all main ports and transportation systems are necessary in order to harmonise the implementation of dedicated ICT systems and solutions (i.e. targeted impact studies). • Closely related to the above, more focus should be directed towards performing implementation analysis in order to secure that the benefits outweigh the costs in the most effective manner. • Further elaboration on actions and measures that could reduce obstacles and improve stakeholders' ability to adopt new ICT solutions should be strengthened. Development paths to follow are low threshold concepts such as cloud computing for information accessibility and data sharing. • Another crucial conclusion in terms of ICT is the limitation due to lack of harmonisation and integration ability of systems rather than in the development of the technology itself. There are many incompatibility issues among the candidate list of ICT systems making integration a difficult issue, representing a main obstacle and challenge. Identified in D6.2 – Policy Recommendations, Final version, the following is worth mentioning: • Information sharing is considered as the basic pillar of supply chain integration. The merits of taking initiatives for developing interoperable and interconnected solutions at a global scale can be assessed. While respecting the different information needs at each level, such initiatives should standardise information and communication protocols in order to avoid data duplication.

9.3 Harmonisation of policies and regulations

Area of development	*Harmonisation of policies and regulations*
General findings	Mainly, this is an issue for policy implications (i.e. WP6), rather than for research and development within ICT and technology. However, for the harmonisation and development of policies and regulations, a crucial conclusion is that the limit is not in the ICT technologies portfolio but in the willingness to adopt them. This is a main obstacle and challenge.
Recommendations	• Specifically related to transport documents, uniform European procedures and permits will definitely simplify transports, e.g. uniform European certificates and training CVs and documents. This is an important gap to close towards the realisation of more seamless boarder crossing procedures. • One recommendation for this development area is that an

	examination of all actions and measures that could limit obstacles and enhance transportation shareholders to adopt them should be carried out. E.g. present and market the benefits, penalize inefficiency, analyse industry reluctance and user-friendliness of developed systems, etc. • Further, all policies and regulations already existing should be analysed and harmonised (European regulation is needed to favour the transport and reduce the obstacles).

9.4 Developing harmonised transport infrastructure

Area of development	*Developing harmonised transport infrastructure*
General findings	Harmonised transport infrastructure, including terminals and transport nodes, are vital for achieving overall efficiency of logistics networks, so as for the environmental profile of the co-modal supply chains. Fast hinterland connections for import and export traffic are therefore necessary, including remote gateways and their transport connections. Thus, these recommendations are of particular relevant for the development of the TEN-T network
Recommendations	• Specifically related to SSS, investigations should focus on whether smaller ports are to be developed into preferred ports for European Short Sea Shipping by means of tailored functionality and equipment. Often specialised ports have proven more efficient in comparison to bigger and multi-commodity ports. • Although application and verification of interoperable technologies in railways is on-going, harmonisation and renovation of infrastructure across modes in the transport chain is needed. • Findings from SuperGreen which are aligned with the TEN-T requirements include: o Ensuring accessibility of modes to freight terminals and villages o Development of cargo handling technology supporting co-modality and energy efficiency (also reduced emission to air) o Seamless infrastructure connectivity (TEN-T network with local network) o Development of telematics and smart ICT solutions supporting co-modality, seamless information handling, and safety and security. From D6.2 – Policy Recommendations, Final version the following should also be observed • A comprehensive and more advanced European transport network model should be developed for supporting all cost-

	benefit analyses of transport infrastructure projects enhancing comparability and compatibility of results (e.g. an advancement of the existing TRANS-TOOLS).

9.5 Availability of quality personnel

Area of development	*Availability of quality personnel*
General findings	Despite being an important topic, the issue has not been particularly investigated by the project and possible alleviating measures in terms of ICT and technology will therefore not be elaborated on. However, according to what has been identified as relevant measures in an intermodal context a few aspects are noted.
Recommendations	• Uniform European procedures and permitting to simplify the transport are Uniform European CV to obtain the identification of the training and skills of personnel at an European level, and educational and training passport is needed to have specialized personnel • In order to successfully handle the shortage of waterborne professionals there is a need to develop actions for increasing the attractiveness of transport occupations, promote investments in new training programmes for the professionals and create new career opportunities. This applies for sea going trade as well as for inland waterways. In relation to manning requirements for inland navigation vessels, D6.2 notes that these are only partially harmonised across Europe and in some countries are considered unnecessarily high. A revision of the current legislation is therefore needed.

9.6 Development and harmonisation of transport technology

Area of development	*Development and harmonisation of transport technology*
General findings	In addition to developing key technologies supporting achievement of corridor benchmarks, on-going and future R&D activities within the area should continue its efforts within energy management and efficiency, emission reduction technology, operation decision support systems, cargo handling, etc., should be further developed and implemented.
Recommendations	• Actions and measures that may reduce obstacles and improve stakeholders' ability to adopt greening technologies should be emphasised. One key activity could be to apply pilots for developing and implementing decision support systems for benchmarking energy use and emissions on a uniform level for all transport modes, also in co-modal solutions. • De-carbonising technology development such as exhaust-treatment systems, alternative propulsions technologies and

	concepts (e.g. LNG, Hybrid solutions, Dual fuel, etc.). • Development of cargo handling solutions (standardised) enabling efficient and effective (un)loading operations. Related to this particular development need, D6.2 identified the following corresponding issues: • Introduction of a load efficiency labelling system that provides incentives to transport operators for improving the load factors of their vehicles should be studied and reviewed.

9.7 Transparency of information and increase of co-operation in co-modal supply chains

Area of development	*Transparency of information and increase of co-operation in co-modal supply chains*
General findings	Within the area there is a need to solve the mentioned incompatibility issues among transport modes and examine regulatory measures to implement dedicated ICT systems. Further, this work must be supported by detail analysis of corridor specific needs.
Recommendations	• R&D should focus on appropriate measures to solve obstacles and enhance willingness to adopt and further improve the proposed ICT technologies. There is a portfolio of available technologies but users are seldom aware of its benefits and improvement potential. • The development of a standardised methodology for avoiding polarized results (i.e. favouring of modes). Also includes how emissions should be assessed: i.e. well-to-wheel or tank-to-wheel. • Support the development of risk management and accidents averting practices, supporting the use of co-modal transport operations. In addition, D6.2 identifies the development of fuel consumption standards for trucks as a viable approach for improving transparency of supply chain and transport system performance.

10 The SuperGreen call texts in support of green corridors

Based on its findings, the SuperGreen project has developed a set of call-texts supporting future development of Green Corridors. Reflecting the already discussed SuperGreen Common Development Needs (Chapter 9), the call texts represent specific examples and suggestions on how the more generic recommendations can be transformed into more specific ones. As such it may be relevant as recommendations for future calls under the multimodal topics of the new EU Framework Programme for Research and Innovation – The Horizon 2020.

10.1 GC.SST[33].2014.1.1. Improvement of green supply chain design and management

Content and Scope

Congestions along main transport routes on the European continent is a well known and outspoken problem, causing undesirable and negative externalities on local communities as well as on a more global scale. Taking into account the expected growth in transport volume and cost towards 2050, there is a definite need to establish more sustainable transport solutions, and hence improve the utilisation of modes individually and in combination.

The R&D objectives supporting the specific Green Corridor development needs and management are closely related to the following activities:

- As a mean to mitigate congestions and emissions to air, more detailed analyses regarding corridor-by-corridor specific needs and requirements are necessary. As part of mapping infrastructure and ICT needs, a study of main transport systems and nodes within the respective corridors is needed.
- Identify tools and mechanisms for accelerating the industry up-take of greening technologies, including identification and dissemination of best practices within the transport sector.
- Development and implementation of available supply chain management systems and solutions throughout the chain needs to be emphasised. This includes development of business models and/or methodologies supporting a holistic and optimal utilisation of transport assets in co-modal solutions. A prototype of a certified environmental footprint calculator is considered an important deliverable.
- The concept of cluster governance applicable for supply chains needs to be further elaborated, and in particular its value adding potential where a closer integration of the involved actors could lead to improvements in overall supply chain performance.
- Development of reliable tools enabling both data accumulation and proper benchmarking exercises, for use in development of supply chains and for comparative purposes.

[33] Green Corridor. Sustainable Surface Transport

- Particularly related to the above, development of systems and solutions for solving the current lack of transportation information on EU-level is expected to be investigated (e.g. volumes, types of goods, flow directions, etc.).

Expected impact
The project is supposed to give important contributions to meet the challenges related to congestions and emissions as defined by the White Paper on Transport - Roadmap to a single European transport area (COM, 2011). In particular, new insight to make advances in the development and industry up-take of greening technologies, along with innovative models, methods, and tools for the development of resource efficient transport operations from a holistic point of view, including co-modality and utilisation of hubs, are considered important outcomes of the work.

Identification of development needs to make different corridors more sustainable is also supposed to be among the important deliverables from this project. Thus, identifying solutions for solving current lack of transport related data is important.

10.2 GC.SST.2014.1.2. ICT for Green Transport Logistics

Content and Scope
Typical problems in the transport logistics area include one or a combination of problems from the following non-exhaustive generic list of issues: Optimal vehicle speed, optimal vehicle size, routing and scheduling, fleet deployment, intermodal network design, modal split, facility location, warehousing, transhipment, queuing at terminals, terminal management, global supply chain management, and others. The traditional analysis of these problems has been in terms of cost-benefit and other optimization criteria from the point of view of the logistics provider, carrier, shipper, or other end-users. Such traditional analysis by and large either ignores environmental issues, or considers them of secondary importance. Green transport logistics tries to bring the environmental dimension into the problem, and specifically the dimension of emissions reduction, by trying to analyse the trade-offs that are at stake and exploring ‘win-win’ solutions.

Since ICT provides critical information to transport stakeholders affecting the ability to make decisions, it is clear that the role of ICT in green transport logistics is paramount. This role has been identified in the new White Paper on Transport; however R&D should be conducted to identify the best ways to reach the stated policy goals. Related activities include:

- Formulation of a representative spectrum of transport logistics problems as optimization problems with the environmental dimension on board. These problems should be at the strategic, tactical and operational levels and should encompass both static and dynamic elements. A taxonomy of relevant KPIs should be identified.
- Identification of role of ICT in terms of data collection, transmission, processing (pre and post), storage, hardware and software, to better handle the problems identified earlier. Public data versus private data. Identification of which data should be collected and best methods of doing so.
- Development of operations research and other methods for the solution of problems identified earlier. Methods include exact approaches and heuristics. Quantification of benefits. Optimization of computational performance.

- Development of ICT tools, both centralised and de-centralised, to help operators and other transport stakeholders, improve upon solutions and achieve better system performance in terms of the selected KPIs.
- Development of ICT tools for emissions data collection, measurement and reporting, e.g. a certified co-modal carbon footprint calculator.
- Simulation of system performance and real-world demonstration of ICT systems and tools that can achieve documented improvements. Analysis of policy options and policy recommendations.

Expected impact
This work will extend and integrate on-going EU and national research efforts in several disciplines, including ICT technologies, systems and tools, operations research methods for improved transport logistics, and emissions modelling, inter alia. It will provide important support to reach the sustainability objectives of the 2011 White Paper on Transport. It will help identifying the most cost-effective ways of deploying ICT systems across Europe, as well as guidance for related strategic decisions. The impact will span all hierarchical levels, including strategic long-run considerations, tactical level planning and operational 'dynamic' environments.

10.3 GC.SST.2014.1.3. Harmonisation and development of policies and regulations

Content and Scope
Green Corridors will not only be affected by transport policy, but also by other related policies such as environmental, maritime, energy, sustainability, innovation, security and cohesion policies. In the recent years, transport services have been constrained by two or more contradictory policies (e.g. MSP of 2007 and ICZM of 2000)[34], which imposes conditions unable to fulfil both or all of them at the same time.

Policies are usually implemented through different regulatory initiatives and frameworks, some of them are voluntary: Recommendations and Positions, while others are mandatory: Decisions and Directives. The overlap of international, EU, national and sometime regional regulations, creates additional constraints and bottlenecks in the development of the several and different regulatory frameworks. The policy and regulation implementation supporting this specific Green Corridor development need are closely related to the following activities:

- Identify technical regulations from ISO, EU and Member States standardization bodies affecting different aspects of Green Corridors, especially in the technology side, for example, CO_2 calculators.
- Identify legal regulations from UN conventions, EU and Member States legislation bodies, affecting different aspects of Green Corridors, especially in the implementation side (e.g. Eco-bonus tax schema[35]).

[34] The implementation of ICZM - Integrated Coastal Zone Management, a 'land focused' policy Recommendation of 2000 from DG-Environment, and the implementation of the 'sea focused' MSP - Maritime Spatial Planning of 2007 from DG-MARE, can be contradictory as of their difference in perspective (land vs. sea), and number of years in difference.

[35] http://www.crpm.org/pub/agenda/1998_2012-05-22_ecobonus.pdf

- Cluster governance is another related concept, especially for supply chains belonging to cross border co-modal corridors, connecting markets intra-EU and extra-EU from Africa, Asia or non-EU European countries.
- A special focus should be put on passenger transport services within co-modal Green corridors, which are designed for both cargo and passengers. In the recent years, significant changes in Member States concerning legal and organisational frameworks of public transport have been observed. These changes aim at improving transparency, economic efficiency and the quality of the service. The European Commission promotes this development through the provision of an appropriate legal framework at European level, as originally suggested in the Citizens' Network Green Paper and later reinforced and clearly indicated in the Communication "Developing the Citizens Network".

Expected Impact
Impacts on EU Policies should be expected in the following areas:

- Improved coordination between EU and International regulatory initiatives from organisations like UNCTAD, OECD, ISO, ILO and IMO.
- Improved coordination between EU and Member States regulatory initiatives to avoid contradictory actions to the end-users and customers.
- Simplification of regulatory instruments to avoid negative perception from end-users and customers side.

10.4 GC.SST.2014.1.4. Development and harmonisation of transport infrastructure

Content and Scope

Infrastructure and terminals are vital for the overall efficiency of logistics networks, so as for the environmental profile of the co-modal supply chains. Terminals and infrastructure need to be developed in an integrated manner to secure interoperability between modes, and to streamline and harmonize the overall efficiency. This also includes development of technologies and concepts for seamless cargo handling. The harmonised development of the infrastructure should be based on on-going processes defining the best standards to achieve an integrated and streamlined European transport infrastructure that fulfils environmental and sustainable requirements.

The R&D objectives supporting this specific Green Corridor development need are closely related to the following activities:

- Improvement of intermodal hub equipment and easy cross docking technology to increase productivity and standardised modal shift capability.
- Innovative solutions for more efficient boarder crossings. Efficient and economically attractive solutions for the upgrading of existing infrastructure as multimodal terminals, sea and river ports, and city logistic centres to make operations more sustainable.
- Innovative solutions to combine freight and passenger transport infrastructures with green technologies in a realistic and efficient way.

- Advances in the implementation of standard interoperable technologies in railway infrastructure: Signalling system, catenary, axle load, maximum length of passenger and freight trains, gauge, etc.

Expected impact

The work is expected to give important contributions for reaching the objectives related to more harmonized, efficient and sustainable co-modal transports and is supposed to give guidance for the implementation of novel green technologies in transport infrastructure (i.e. clean & low-emission energies).

The work will significantly contribute to the deployment of TEN-T infrastructure by gradually integrating modal systems, also considering the new Member States and their specific identified infrastructure gaps, as stated in the White Paper on Transport (2011).

10.5 GC.SST.2014.1.5. Availability of quality personnel

Content and Scope

Shortage and over ageing of mariners, especially boat masters, are experienced in various parts of the European maritime industry, in inland waterway transport as well as in short sea shipping. The professional requirements to be met by the staff in both sectors are increasing and changing due to changing regulations, increasing traffic volumes, increasing vessel sizes, utilisation of new technical and electronic equipment, and increasing needs for emission reduction and energy-efficient navigation.

Besides navigational and technical aspects, issues related to logistics and integrated transport chains become increasingly more important in waterborne transport (i.e. including both sea going and inland waterways transport). To keep pace with this development, logistics competence becomes an important and required skill for vessel operators. In this context also the qualification of road- and rail operators & forwarders with respect to the potential of inland waterway transport becomes of importance.

This development calls for harmonization between modes as well as excellent, highly efficient and attractive education and training. R&D activities for ensuring the availability of quality personnel will be focussed on:

- Development of common e-learning tools. The independence of actual place of training is among the advantages of e-learning systems. Also valid for inland waterways, this is especially relevant for maritime transport, with long time periods on board at sea and very limited possibilities for attending land based training courses Some European countries have already gained experiences with different e-learning tools in nautical education.
- Logistics education for mariners: creation of a Network of Logistics Education and Training institutes, supporting the harmonisation of education standards at a European level. Development of European training modules for logistics education focussed on waterborne transport. Similarly, road- and rail operators & forwarders need knowledge and competence in the potentials of waterborne transport.
- Development of dedicated waterborne transport training simulators. Simulators are considered as innovative tools which can support and accelerate education of mariners, as various tasks and extreme situations can be simulated free of risk. Due to the limited market, there is a lack of simulators adapted to the special needs of

inland navigation. Moreover, development of on-board tools and simulators for training of energy-efficient navigation on rivers and at sea are needed.

Expected impact

Up-to-date knowledge for maritime and inland waterways will be available and easily accessible in the form of e-learning for harmonised nautical education and training. This will allow for efficient use of the time spent on board a vessel, acquisition of new knowledge in relation to changing framework conditions and technical developments as well as exchange of nautical staff.

Inclusion of specific issues related to maritime and inland waterway transport in logistics education will increase the knowledge and awareness of the potential of waterborne transport, contributing thereby to co-modality and modal integration, as well as reduction of environmental, climate change and safety impacts.

Use of simulators and decision support tools for sustainable and energy-efficient waterborne operations will lead to more efficient education, improved qualification of mariners and increased efficiency and safety in the operations.

10.6 GC.SST.2014.1.6. Development and harmonisation of transport technology

Content and Scope

Green technology is at the heart of future sustainable logistics and the development moves towards *'energy'* based measures as much as *'activity'* based measures. For this reason a corridor based approach such as *'Green Freight Corridor'* would be suitable for this call; looking to address long distance green alternative technology whilst also looking at marketing existing technologies to improve the corridor performance across different transport modes.

Moreover, development and harmonisation of infrastructure, terminals and transport technology is vital for the overall efficiency of logistics networks and co-modal supply chains. Transport vehicle technology should be developed alongside the development of terminal and infrastructure so they can easily be integrated ensuring interoperability between modes, and streamlining the overall efficiency. The harmonised development of the transport technologies for vehicles and infrastructures should refer to the process of defining the best standards and interconnectivity of the European transport system in the most environmental and sustainable way.

The R&D objectives supporting the development of Green Freight Corridors are closely related to the following activities:

- Gain a better understanding of fuel efficient technology across different modes within a designated corridor.
- Identify an alternative technology within a specific corridor supported by a cost benefit analysis and a number of key stakeholders inputs.
- Enlarge, maintain, and improve a technology knowledge based platform, meeting the demands of long distance freight stakeholder's quality partnership. Transferring

the success of City Logistics freight quality partnership ventures into longer distance freight operation.

- Improve intermodal hub equipment and cross-docking technology towards increasing productivity and modal shift capability (i.e. supporting seamless co-modal operations).
- Identify innovative solutions for cross-border sections and bottleneck gaps. Providing an efficient and economically attractive solution for the upgrading/up-taking of existing green infrastructure; such as multimodal terminals, maritime and river ports, and city logistic centres.

Expected impact

Through providing a better understanding of each technology's greening potential and impact on fuel efficiency, it is expected that such technologies will be adopted to meet the requirements of the sustainable green economy, thereby contributing to the 2011 White Paper low carbon future goals. Whilst currently country based evidences exist, the corridor level evidence is relatively limited and has potential for further investigation.

Provide opportunities for new insight into how to accelerate development and industry up-take of greening technologies by means of among others innovative models, methods, and tools for the development of resource efficient transport operations. The efforts should be carried out from a holistic point of view, including co-modality and utilisation of hubs. To the extent possible considerations should also try to take into account scenarios beyond the direct outcomes of the work.

10.7 GC.SST.2014.1.7. Transparency of information and increased cooperation in co-modal supply chains

Content and Scope

There is a considerable cost saving potential inherent in more open information sharing and in the integration of systems along the entire supply chain. This will push the development of co-modal supply chains and further the development of new and integrated ICT systems, along with new methods and tools for information handling.

In the supply chains there are numerous spots where exchange of information takes place, and mutual trust is a prerequisite as well as a facilitator. However, lack of trust causes deviations in transport chains, unclear responsibilities between different stakeholders, the use of so called 'random subcontractors', and problems related to co-operation and data interchange between transport clients and operators.

Transparency in information to all stakeholders involved from consignor to consignee is therefore a prerequisite for successful development and implementation of ICT systems. Current systems support and promote co-modal and sustainable logistics, however there is still a need to further develop and implement ICT applications that meet the current demands and those of the future.

Concerning availability and implementation of ICT systems, the main challenge is caused by insufficient harmonisation of national and EU policies to implement suitable ICT systems rather than lack of technological solutions and systems. Regulatory measures to

implement dedicated ICT systems should be examined and appropriate measures to solve obstacles and enhance willingness to adopt proposed ICT technologies should be implemented.

The R&D objectives supporting these specific Green Corridor development needs are:

- In order to obtain a comprehensive overview of the current status, representative supply chains and their stakeholders should be examined. Transparency in the information sharing throughout the entire supply chains should be aimed at as basis for cross fertilizing between actors and modes. Networking among the relevant parties is essential.
- Closely related to the above, main emphasis should be put on the co-operation and information exchange between different stakeholders within the supply chains to identify problems and challenges as basis for gap analyses. The analytical work should also indicate how networks supporting sustainable transport operations ought to be structured.
- Standardized activities should be generated based on the data gathered from the case studies. The activities should aim to overcome the issues related to lack of transparency and to improve co-operation within the supply chains. Business models to improve co-operation and plans for data platforms supporting these models should be generated. The models should cover overall supply chains serving different lines, businesses and industries.
- The standardized activities should be evaluated in order to determine the best solutions with regards to functionality and greening potential. The evaluations should include KPIs related to efficiency, reliability, service quality, environmental sustainability, infrastructural sufficiency, safety, and social issues (e.g. employment, working conditions, traffic safety etc.). Based on the evaluations, the selection of the best business models and data management models as well as standardized activities should be defined.

Expected impact

In particular, the project should contribute to improve the greening of supply chains and hence the greening of the transport corridors. Parts of the results should be based on access to more open logistics information, thus making it possible to develop and obtain more efficient logistics chains. Business models to improve co-operation and data platforms for different branches of industries as well as more open virtual logistics centres serving several supply chains and industries should be utilized to improve the activities.

The work should also provide new knowledge on how to eliminate overlaps in transport and logistics operations. Optimal supply chain management systems and platforms should contribute to a reduction in unnecessary transport operations, increasing capacity utilisation of all transport modes and thus reducing transport costs. The platforms and business models for operation may contribute to increase business volume for service providers, and promotion of value added services to end customers.

11 Conclusion

In order to develop recommendations for future R&D calls within the transport domain, a number of relevant sources have been investigated. In addition to incorporating input from Task 5.1, focus has also been directed towards WP2, WP3, WP4, and WP6.

The recent updates of the different SRAs from the relevant Technology Platforms, along with their respective roadmaps for implementation, present clear and profound long-term development strategies. Representing a more specified and detailed description of R&D development needs, each Research Advisory Council also aims to support the achievement of the following European transport objectives as stated by the White paper on Transport - 2011:

- Improved sustainability of operations
- De-carbonization of modes
- Improved competitiveness

In support of the above, the final SuperGreen R&D recommendations presented do show that there are still room for broadening existing and defining new areas for R&D activities. This is particular relevant for the further development of the green corridors. The SuperGreen common development needs are as such an effort to advance and initiate intermodal activities supporting the improvement of more sustainable intermodal operations on a corridor and Pan-European basis. When summarising the results from the analysis, the following generic measures are noted:

- There must be an increased focus on rectifying the evident lack of data and reliable tools enabling proper benchmarking exercises within the transport domain.
- A further strengthening of efforts securing integration and implementation of harmonised ICT solutions, also developing new ones (e.g. Single Window concepts).
- Increased focus on corridor and case-by-case specific analysis, both in terms of requirements and tailored solutions.
- Performance of impact studies for assessing potential environmental and cost savings when introducing new ICT and technology solutions
- Further development of freight flow optimisation and traffic management tools
- Efforts to enhance cargo interchange between transport modes, including expansion of the technology uptake by industry.
- Actions to improve the energy efficiency among transport operations and reducing dependency on fossil fuels.

Moreover, the defined SuperGreen call texts represent a possible approach on how future R&D efforts within this subject can be targeted.

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13 Annexes

13.1 Annex 1 TRKC – Thematic R&D implications and recommendations

Transport management – Thematic Research Summary

The transport management theme is very wide ranging, covering all transport modes and overlapping with numerous other themes. However, by referring to 35 projects (25 being EU funded), it includes traffic management for all modes as well as mobility management aspects for passengers and logistics for freight. When summarizing implications and recommendations for further R&D, the document highlights the following:

- Congestion, conventional pollution, health damage and accidents are largely concentrated in urban areas and need to be addressed in an integrated way.
- EU-sponsored research is continuing into the formulation and exchange of best practice in areas such as transport infrastructure, norm-setting, congestion and traffic management, public transport services, infrastructure charging, urban planning and safety issues.
- Although much technical research work has taken place, delivering transport and traffic management tools, processes and best practice, further research into costs and benefits of various aspects, services and tools related to transport management is needed, due to continuing lack of exploitable data in most modes and sectors.
- Similarly, in some cases research is needed on the integration of tools and processes into existing business models.
- Business model research needs are rather specific to individual organisations and local circumstances, hence research at EU level may not necessarily be appropriate in all cases, but further dissemination and exchange of good practice solutions to such issues and examples of successful implementations would be beneficial.
- Furthermore, several of the systems and concepts developed require more robust testing in a real environment (with real users) over longer periods – i.e. Field Operational Tests (FOTs). This is now a major area within FP7 related to Information and Communications Technology (ICT) for transport.
- There is a continuing requirement for support from the EU for some key pan-European industrial projects, in particular SESAR (for air traffic management) and ERTMS (for rail).

Safety and Security in Mobility – Thematic Research Summary

The document deals with Safety and Security in transport, although the emphasis of the current issue is on safety, mostly due to the fact that security is quite a new theme which in turn limits the availability of research results. When summarizing implications and recommendations for further R&D, the document highlights the following:

- Road infrastructure safety is an R&D topic that is perceived to be an area that only to a limited extent is investigated. Lack of availability of comprehensive data as input to reliable design and safety recommendations prevails. Hence it has been suggested in the course of recent research to collect more data on the performance of the same (design and safety) in different accident situations. Information on infrastructure and maintenance costs of various design and safety measures need to become more easily available.
- Finally, the roles of the various European Technology Platforms should be mentioned in the context of future research plans and strategies such as the Strategic Research Agendas from the European advisory councils for road, rail, waterborne, air and intermodal transport (ERTRAC, ERRAC, WATERBORNETP, ACARE and EIRAC respectively).

Integration and Policy Development –Thematic Research Summary

This document includes an upstream analysis of policy options, long-term visions and scenario-building, as well as transport planning aspects on a transversal level, e.g. taking into account economic, environmental, societal, land use or other factors. When summarizing implications and recommendations for further R&D activities, the document highlights the following:

- The interdependence between freight and passenger transport should be explicitly modelled and there should be an improvement in the relationship between the policy levels and the functioning of the transport system.
- The definition of a series of population thresholds for urban areas, for which national transport data should be disaggregated and reported to Eurostat, measuring performance in a consistent manner when assessing it against common overarching national and European objectives, and the definition by the EC/Eurostat of a small number of 'quick win' indicators for which the Member States should provide data at urban level, measured in a consistent way. These should concentrate on outcome indicators for which there are common objectives at the European level and for which national data is already collected for all countries.
- A standard definition for transport fatalities and serious injuries, continued research aimed at defining means to characterise and benchmark transport outcomes, and the launch of a periodic (e.g. every 3 to 4 years) Eurobarometer survey on urban transport issues for the EU-27.

Environmental Aspects- 2010 - Thematic research summary

The document covers 3 sub-themes by elaborating on background, research objectives, research results, and policy implications. When summarizing implications and recommendations for further R&D activities, the document highlights the following:

- With regards to sub-theme one, Global warming is now acknowledged to be an urgent issue, but this is not yet feeding through into research findings and there is a more urgent need for research into carbon creation in transport and its impacts on global warming. In similar vein, the need to act swiftly on the findings from the

large and growing amount of research into the rapid expansion of air transport, its environmental impacts and how they might be mitigated is becoming more pressing. More research on how to cost carbon emitted from transport most meaningfully is also required.

- Although much of the requirements for the fundamental research appears to be met, sub-theme two highlights that mitigation requires not only significant research and development of new transport technologies, but also considerable changes in operating practices in the transport industry as well as changes in transport behaviour, both in the shorter term through mode shifting and in the longer term, such as through changes in land-use planning.

Freight Transport – 2010 - Thematic research summary

The first part of the document includes a brief overview of the scope of the theme and summarises the main policy developments at EU level relevant to the theme. The second part contains a synthesis of the main findings and policy implications from research projects and identifies the implications for further research. When summarizing implications and recommendations for further R&D activities, the document emphasises need for further research in developing tools for increasing the competitiveness of waterborne transports. In particular, actions should be taken to on (SPIN-TN, 2005):

- Expand services such as PortNet to cover European Ports at a regional level, and through interregional exchange to achieve pan-European interoperability.
- Carry out surveys to identify all information requirements that can impact directly or indirectly on inland and short sea shipping. Then survey all currently available information tools to check whether the above identified requirements are included, and create a list of missing information. Finally, identify way for obtaining the missing information.
- Design a strategy for awareness raising and training key stakeholders of short-sea shipping, river-sea shipping, and inland navigation to encourage the exchange of commercial information, and how to best use such information for maximizing the efficiency of their processes and operations.

Infrastructure and Trans-European Networks – Thematic research summary

The theme of Infrastructure Provision is concerned with the design, construction and maintenance of transport infrastructures for all modes. Both physical networks and information and communication networks are considered as infrastructure. Further, the theme deals with aspects related to the development of the TEN-T including planning, financing and implementation. The following R&D activities are concluded for further actions:

- a number of proposals for research projects aimed at developing road infrastructure according to identified future needs (“Reliable infrastructure”, “Green Infrastructure”, “Safe & smart infrastructure”, “Human infrastructure”);
- recommendations for improving the toolbox and the methodology developed to apply Reliability Centred Maintenance (RCM), analysis to railway infrastructure;

- further research to prove the advantages of GNSS (Global Navigation Satellite Systems) safety applications in the railway environment and validate Galileo;
- issues for improving the proposed methodology for evaluating infrastructure projects;
- further research topics for the development of a common approach for transport infrastructure development in the Mediterranean area

Waterborne Transport – 2010 Thematic Research Summary

The theme comprises five main topics; short sea shipping, inland waterways, ship design, operation and maintenance, maritime safety, and ports and port operations. Following areas for further R&D are concluded:

- Pollution prevention / response, and ship dismantling (focus areas are propulsion, coatings, dismantling, and mitigation of accident-related pollutant spills);
- Vessel technology: propulsion, hull, on-board materials (designing propulsion systems featuring low emission targets, while at the same time defining low-pollutant standards for hull coatings, which also have consequences for the rate, effectiveness, and safety of future vessel);
- Safety of crew, passengers, and port personnel (improve procedures for accident-response, notably the efficient evacuation of passengers and crew. Further, safety of port personnel, particularly in the freight handling departments, is a necessary field of research, until recently neglected);
- Integration in the inter-modal transport chain (more classical sense of "vehicle technology" enhancement, particularly in the areas where competition with other modes is strong (short-sea shipping, and inland waterway commodity transport). Indeed, engine design and innovative propulsion methods are promising fields);
- Economics and business studies (for advancing intermodal freight management, and the efficient intermodal relationships along the handling chain, in order to reduce the bottlenecks often incurred at ports, reduce costs, and improve cost-price principles);
- Institutional cooperation (in order to enhance coordination in scientific, industrial and regulatory issues. Framework research could therefore tackle aspects such as competitiveness, environment, energy, safety and security and human considerations).

Road transport – Thematic Research Summary

The focus of research covered in this summary relevant to SuperGreen is on road infrastructure planning and operation, road vehicles and road use (including driving). Further, the recommendations for R&D given in this report are largely covered by ERTRAC's Research Framework[36] (ERTRAC, 2008), covering the following main aspects (and as such also to some extent being included in FP7):

[36] http://www.ertrac.org/pictures/downloadmanager/1/9/ertrac_research_framework_2008_13.pdf

- Urban Mobility: achieve sustainable mobility for passengers and freight in the urban environment
- Energy, Resources, and Climate Change: provide environmentally friendly road transport systems and a secure, renewable energy supply
- Long distance freight transport
- Road Transport Safety: reduce road transport injuries, fatalities, and accidents

According to the Road SRA, these main aspects will be met by the following elements:

- the world's most advanced electric and ICE propelled vehicles;
- the world's most advanced vehicle concepts, best adapted to their application;
- a road infrastructure network and associated management structure that is able to support the world's highest traffic intensities, as well as providing the highest levels of accessibility and reliability;
- logistical services that hold the highest operational levels of integration and collaboration throughout the entire chain;
- the world's most energy-efficient urban mobility solutions, which will simultaneously guarantee the highest degree of accessibility;
- the highest levels of decarbonisation for road transport fuels, and the most efficient use of fossil and renewable resources;
- the world's lowest level of fatalities and severe injuries per distance travelled, and the highest level of security in freight transport; and
- the world's most flexible and effective production and supply network, which is able to cope with the concurrent challenges of generating ample vehicle concepts, adapting to changing volumes and competing effectively in the global markets

Rail Transport – Thematic Research Summary

In relation to recommendations for further R&D efforts the report points to the seven research priority areas as identified in the ERRAC SRA, covering the following themes:

- Intelligent mobility, essentially to work towards a European-wide intelligent infrastructure with compatible technology between member states and across transport modes, to support improved customer information systems,
- Energy and environment, to work towards new standards and regulations which improve environmental performance and reduce dependence on fossil fuels without detriment to the commercial competitiveness of the rail mode,
- Combatting terrorism and vandalism in order to achieve improved personal security for rail customers and staff,
- Faster implementation of new technologies, to improve the spread of European homologation, calling for streamlined testing and acceptance procedures without compromising safety regimes,

- Enabling technologies for increased rail competitiveness, through the creation of more attractive products for customers and the reduction of life cycle costs through modern technology in all aspects of railway operation,
- New accounting and planning models are required to provide a better understanding of the costs of operating and maintaining rail infrastructure and how these costs vary with changes in types of train used and in service frequency, in order to improve rail economics and strategy.
- Infrastructure developments: there is a need to develop infrastructure systems that can deliver interoperability, increased capacity, increased axle weights and track stability whilst at the same time having low maintenance costs or even be maintenance-free.

13.2 Annex 2 R&D recommendations from NEWOPERA and RETRACK

- Apply economic concept to address specific corridors by making the necessary investments in infrastructure, bottlenecks, bypasses, technology, rolling stock, longer heavier trains, etc. in order to increase productivity, generate additional capacity to be dedicated to freight;
- Upgrading of old or unused rail lines as available resources to be exploited to make the best use of the available infrastructures;
- Make use of the opportunity to maximize capacity use of freight on the progressive introduction of the new High Speed Line in several European member States;
- Future project supported by EU to sponsor new rail freight services on other corridor to start up in the form of repayable working capital through new mechanisms or via existing instruments such as Marco Polo;
- At the national level, the Member States need to ensure that incumbents do not retaliate on pricing to drive away the new entrants;
- EU rail freight sector cannot retain a supply side model of operations in the vague hope that traffic will elect to use rail services under economic or environmental duress but to demonstrate that it can deliver supply side model of operation that is routinely consistent, reliable, customized, secure and cost effective services.
- Need for ease of access by potential users/shippers/cargo interests of the available train services, routes and schedules operated together with input on available space (wagons or container slots), prices, links to any pre or end haulage (road sectors for inter-modal and local trip workings for rail), terminal positions in terms of transit time and storage.

- Need for a complete through transit ability to track the movement of the train, wagon and cargo module independently of the railway administration to confirm ETA or any revisions.
- Disruption management and recovery systems to be in place with information passed to shippers/terminals/hauliers to facilitate re-planning and use of resources
- 24/7 railway
- Greater reliability and information exchange between the infrastructure mangers, train operators, 3PL and shippers.