SEVENTH FRAMEWORK PROGRAMME

THEME [7]

Theme Title: Transport (including Aeronautics)

SuperGreen

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

Grant agreement for: <Coordination and Support Actions (coordination)>

Grant agreement no.: TREN/FP7TR/233573/"SUPERGREEN"

Deliverable D5.1

Identify unsolved bottlenecks, 1st version

Due date of deliverable: 15th of January 2012

Actual submission date: 15th of January 2012 (revised: 29.03.2012)

Organisation name of lead partner for this deliverable: MARINTEK

Document ID number: 05-51-RD-2012-02-01-0

REVISIONS/DOCUMENT HISTORY:

Index	Date	Authors	Reviewers	Subject
1.0	09.12.11	Holte E.A., Minsaas A., Kvamstad B.	Task 5.1 partners	Task internal review
2.0	22.12.11		NewRail, PAG	Distributed for internal review
3.0	13.01.12		MTK	Final version
4.0	29.03.12		MTK	Revised final version

CLASSIFICATION AND APPROVAL

Classification: **R** **Public** (PU)

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Document summary information

Authors and contributors

Initials	Author	Organisation	Role
EAH	Even Ambros Holte	MARINTEK	Author
BK	Beate Kvamstad	MARINTEK	Author
AM	Atle Minsaas	MARINTEK	Author
HP	Harilaos Psaraftis	NTUA	Contributor
IS	Ilkka Salanne	SITO	Contributor
SF	Sara Fozza	DAPP	Contributor

Revision history

Rev.	Who	Date	Comment
1.0	MTK	09.12.2011	Draft version distributed to Task participants for comments
2.0	MTK	22.12.2011	Distributed for internal review
3.0	MTK	13.01.2012	Delivery of final version
4.0	MTK	29.03.2012	Delivery of revised final version

Quality Control

	Name	Date
Checked by WP leader	Even Ambros Holte, MARINTEK	13 Jan 2012
Checked by internal reviewer	Paulus Aditjandra, NewRail	04 Jan 2012
Checked by internal reviewer	Humberto Moyano, Gijón Port Authority	12 Jan 2012

APPROVAL:

The Coordinator of the project consortium via a return email has approved the final version of this SuperGreen Deliverable.

ACKNOWLEDGMENT

Funding for the SuperGreen project has been provided by the European Commission (DG-MOVE) and by partners' own funds, in the context of Grant Agreement No. TREN/FP7TR/233573/"SUPERGREEN".

DISCLAIMER

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List of Abbreviations

ERTMS – European Railway Management System

JUP – Janela Unica Portuaria (Port of Sines Single Window Solution)

Fretis – Freight Transport Information Technology Solutions

ETA – Estimated Time of Arrival

ICT – Information and Communication Technology

KPI – Key Performance Indicator

VMS - Variable Message Signs

RTG – Rubber Tired Gantry Crane

VCO - Virtual Customs Office

ENSI - Enhanced Navigation Support Information

VTS – Vessel Traffic Service

AIS – Automatic Information System

VTMIS - Vessel Traffic Management Information System

ITS – Information Transport Systems

FIS - Fairway Information Service

RIS – River Information Service

TM – Traffic Management

LNG – Liquefied Natural Gas

INECs – Inland Electronic Navigational Charts

GNSS – Global Navigation Satellite System

dGNSS- Differential Global Navigation Satellite System

GOFREP – Gulf of Finland, Mandatory Ship Reporting System

IWT – Inland Waterway Transport

CHD – Charges and Harbour Dues

GMP – Good Manufacturing Practice

EBIS - European Barge Inspection Scheme

ISO – International Organization for Standardization

EIA – European Intermodal Association

0 Executive Summary

This document is Deliverable D5.1 of the Task 5.1 “Identify unsolved bottlenecks” of Work Package 5 "Recommendation for R&D Calls". It presents the results during the first working session (M13 – M24) of the task. The main objective of Task 5.1 is to identify unsolved bottlenecks with regards to availability of technologies and ICT solutions that may make green corridors even greener based some benchmarking key performance indicators. Gaps in available technologies and ICT solutions are basis for recommendations for calls for R&D proposals to the Commission.

- KPIs for benchmarking green corridors defined in WP2 are related to emissions, transport cost and time, frequency and reliability of service.
- Available technologies, their application and greening potential, have been identified in WP3.
- Complementary to the technology focus in WP3, ICT solutions and the exploitation of ICT flows towards the goal of greener transports have been evaluated in WP4.

Mitigating measures to the identified bottlenecks have been categorised along the following lines:

- Improvement of green supply chain design and management
- Harmonisation and development of ICT solutions and transport documents
- Harmonisation and development of policies and regulations
- Development and harmonisation of transport infrastructure
- Development and harmonisation of transport technology
- Availability of qualified personnel
- Improvement of transparency of information and increase of co-operation in supply chains and transport systems

The work with Task 5.1 indicates that more of the identified bottlenecks can be improved by facilitating implementation and harmonisation of existing ICT-related measures, rather than of "hard" technologies. However, in many cases it's rather a matter of policies and harmonisation of regulations, and political reluctance to implement what is already available in terms of ICT systems and technologies, than a question of need for new developments.

The work with this task has revealed a huge activity is taking place throughout Europe and outside the EU Framework programmes with a common goal to make freight transports even greener given the defined set of KPIs.

As can be seen from this first version of D5.1, most findings and recommendations are given on an aggregated level, being based on the conclusions from WP2 and on preliminary results both from WP3 and WP4The work in Task 5.1 will therefore be further detailed and elaborated on in the final version of this deliverable, scheduled for delivery in M36.

1 Introduction - Purpose of this document

This deliverable describes the work done in SuperGreen WP5 under task 5.1 "Identify unsolved bottlenecks". The work was based on the results from previous work packages in SuperGreen with the overall goal to identify gaps in available technologies and ICT solutions to make transport corridors even greener based on a given set of Key Performance Indicators. The following bullets introduce the different work packages and their focus of work.

- Key Performance Indicators (KPIs) and areas for improvements of transport corridors have been identified in WP 2 "Benchmarking Green Corridors".
- Green technologies and innovations for improving the benchmarks of transport corridors have been identified in WP 3 "Sustainable Green Technologies and Innovations".
- The role of ICT solutions and flows ("e-freight solutions") towards further greening of transport corridors has been defined and exploited in WP 4 "Smart Exploitation of ICT-flows"

The inputs provided from WP2, 3, and 4, respectively, have been applied in a gap analysis for determining whether solutions exist for solving the identified bottlenecks or not. In case there are no identified green technologies (WP 3) or e-freight solutions (WP 4) available, there is a technology gap between what is available and what is needed to make the corridors greener according to the defined benchmarks. This gap makes the basis for potential R&D recommendations to be implemented in future calls of the FP7, and is the main issue of this deliverable for further elaboration in task 5.2.

The work is based on the experience of the SuperGreen partners, and on past and current research activities in EU research and in national research programmes.

Previous work within the SuperGreen project identified a number of transport related bottlenecks within some different transport corridors which was defined as basis for the activities. The work carried out in task 5.1 analyses these bottlenecks in terms of existing and available technologies and ICT solutions, and elaborates whether these could be implemented. In case the case of "no", gaps are consequently identified.

- The identified gaps are categorised and structured with respect to *possible measures for improvement*.
- Potential *impact on the greening of corridors of identified measures* is evaluated.

2 Objectives

2.1 Objectives of the SuperGreen project

The EU Commission's Freight Transport Logistics Action Plan[1] 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 actively contributes by giving input to on-going and new projects so that resources are used most beneficially. The SuperGreen project aims:

- 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 5.1

The main objective of WP 5 is to identify and define recommendations for calls for R&D proposals to the Commission. Basing its work on input from other related work packages (WP2 - Benchmarking Green Technologies, WP3 - Sustainable Green Technologies, and WP4 - Smart exploitation of ICT-flows), task 5.1 has an explicit focus on the following:

- Identify, cluster and explore transport related bottlenecks from the defined SuperGreen transport corridors (based on input from WP2).

[1] Communication from the Commission: COM (2007) 607 final – "Freight Transport Logistics Action Plan"

- Identify and document how available green technologies (WP 3) and e-freight solutions (WP 4) may contribute to make existing corridors green(er).
- Identify the potential technology and ICT gaps between existing solutions and what are required to improve the identified bottlenecks as basis for providing input to future R&D calls for the FP7 and beyond (in task 5.2).

The conceptual approach to the work is visualised in the figure below.

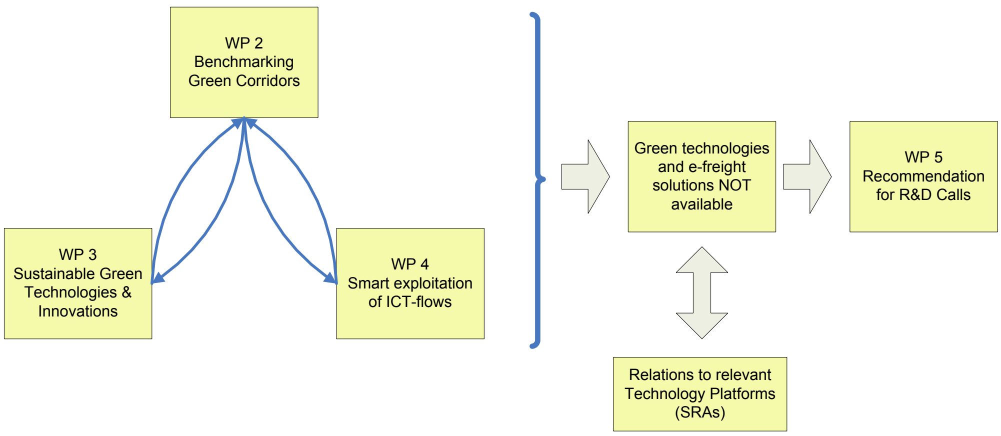

Figure 1: Conceptual approach to the work in WP 5

The work was based on the work carried out in WP2, 3, and 4, and the experience of the SuperGreen partners, in addition to past and current research activities in EU research and in national research programmes.

The identified technology gaps were categorised and structured, and the potential impact on the greening of corridors identified to the extent possible. This will make the results more applicable for further elaboration in task 5.2, where the main objective is to provide R&D recommendations to the Commission.

3 Methodology

Task 5.1 bases its work on the results from the previous WPs 2, 3, and 4, respectively:

- Key Performance Indicators for benchmarking green corridors, and SuperGreen transport corridor definitions, from WP 2;
- Green technologies, application areas and greening potential from WP 3;
- Smart ICT and information flows, application areas and corresponding greening potential from WP 4.

It should be noted that the identified bottlenecks are limited to the results from the SuperGreen corridor analyses and that other bottlenecks not explicitly mentioned in this report may exist. These will, however, not be considered as part of this work.

In case there are no identified green technologies (WP 3) or e-freight solutions (WP 4) available for improving the benchmarks, there is a technology gap between what is available and what is needed to make the corridors greener according to the defined benchmarks. This gap makes the basis for potential R&D recommendations to be described in task 5.2.

Measures taken to mitigate bottlenecks may affect the bottleneck itself as well as affecting border effects. As an example, port congestion has a direct impact on the efficiency of cargo throughput in a port, which in a larger scope also affects the efficiency of the supply chain. Port congestion will also result in an increase in local pollution due to an expected increase in energy consumption. However, the work in task 5.1 will only take into consideration consequences on the specific bottlenecks per se, and not consider possible border effects.

As the outputs from the previous work packages are so important for the work in task 5.1, a short recap of the main output from the respective work packages is given below.

3.1 WP2: Benchmarking Green Corridors

A fundamental part of the WP 2 work has been the definition of the SuperGreen transport corridors which have been used as cases for the work, the definition of the Key Performance Indicators (KPIs) for benchmarking green corridors, and the identification of corresponding bottlenecks based on the KPI definitions.

- The SuperGreen transport corridors are defined in Table 1
- The Key Performance Indicators (KPIs) as given by Table 2
- The bottlenecks are given by Table 3

Table 1: Final SuperGreen Corridors (SuperGreen, Deliverable D2.5)

CORRIDOR NICKNAME	CORRIDOR DESCRIPTION
Brenner	Berlin-Munich-Salzburg-Verona/Milan-Bologna-Naples-Messina-Palermo, Branch A: Salzburg-Villach-Trieste (Tauern axis) Branch B: Bologna-Ancona/Bari/Brindisi-Igoumenitsa/Patras-Athens
Finis Terrae	Madrid-Gijon-Saint Nazaire-Paris Branch A: Madrid-Lisboa
Cloverleaf	Cork-Dublin-Belfast-Stranraer Branch A: Munchen-Friedewald-Nuneaton Branch B: West Coast Main line
Edelweiss	Helsinki-Turku-Stockholm-Oslo-Göteborg-Malmö-Copenhagen (Nordic triangle including the Oresund fixed link)- Fehmarnbelt - Milan - Genoa
Nureyeev	Motorway of Baltic sea Branch: St. Petersburg-Moscow-Minsk-Klapeida
Strauss	Rhine/Meuse-Main-Danube inland waterway axis Branch A: Betuwe line Branch B: Frankfurt-Paris
Two Seas	Igoumenitsa/Patras-Athens-Sofia-Budapest-Vienna-Prague-Nurnberg/Dresden-Hamburg
Mare Nostrum	Odessa-Constanta-Bourgas-Istanbul-Piraeus-Gioia Tauro-Cagliari-La Spezia-Marseille-(Barcelona/Valencia)-Sines Branch A: Valencia-Marseille-Lyons Branch B: Piraeus-Trieste
Silk Way	Shanghai-Le Havre/Rotterdam-Hamburg/Gothenburg-Gdansk-Baltic ports-Russia Branch:Xiangtang-Beijing-Mongolia-Russia-Belarus-Poland-Hamburg

Table 2: SuperGreen corridors KPIs

KPI	Unit
CO_2 emissions	g/ton-km
SO_x emissions	g/1000 ton-km
Relative transport cost	€/ton-km
Transport time (or average speed)	Hours (or km/h)
Frequency, services per year	number
Reliability, on time deliveries	%

Table 3: Breakdown of bottlenecks reflecting type and area of relevance

number	Bottlenecks - main development areas (Identified by WP2 - SITO)
	Operational Bottlenecks
1	Congestion
2	Interoperability problems on railways (change of traction, different control, signaling and command systems)
3	Modal shift from SSS to rail
4	Border crossings
5	Increase of maritime transports, bigger risks of accidents
6	dues, opening times, infrastructure planning), lack of common IWT language
7	Complex administrative processes, shortage of maritime professionals
	Policies, legislation and regulations
8	Regulations and policies for polluting management (sulphur, etc.)
9	Lack of harmonization of national regulations (operational standards, certification of personnel)
10	Longer and heavier trucks (60tns, 25.25m) only allowed in FI and SE
11	Complex Customs procedures
12	Inland vessel certification, new quality systems
13	Inadequate capacity of facilities at the border crossing
14	Complex rules on carriage of dangerous goods by sea
15	Different bills of loading
	Infrastructure
16	Capacity limitations of rail and road networks
17	Slot restriction on the rail network and different gauges
18	Road congestion , insufficient road infrastructures capacity
19	Rail electrification of non-electrified rail stretches, monorail tracks
20	Ports and port capacity
21	Klaipeda-Minsk connection, inland waterways
22	Shallow- water sections
23	Increased traffic volume in Hamburg and Thessaloniki ports
24	Road and rail hinterland connections of ports
25	Railway terminals capability of handle long trains
	ICT and Transportation technology
26	Need to develop new ICT systems
27	Introduction of VMS (Variable Message Signs, beforehand information on traffic situation and bottlenecks)
28	HGV (heavy goods vehicle) design using low carbon technologies, traffic signaling/ control at urban
29	Implementation of ERTMS (European Railway Traffic Management System)
30	Customs surveillance
31	Affordable technologies for fleet modernization
32	maritime/e-freight/e-customs, distance learning)
33	Combining data reception and measures of intervention, need for platform for routing and T&T information
	Other
34	Alps and the Pyrenees (Brenner, Finis Terrae)
35	Winter weather/ ice conditions (Brenner, Edelweiss, Nureyev)
36	Island" countries, dependency of SSS (Cloverleaf, Nureyev)
37	Security issues (piracy) (Silk Way)

Measures to mitigate the identified bottlenecks were initially studied in WP2 and a set of common development needs were identified and categorised as depicted below (Figure 2).

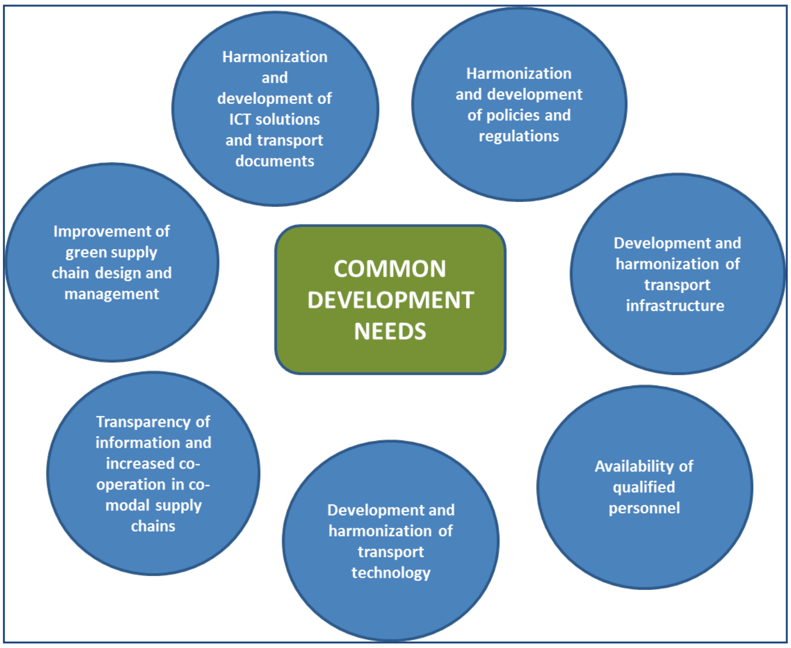

Figure 2: Common development needs to mitigate main bottlenecks from WP 2

3.2 WP3: Sustainable Green Technologies and Innovations

WP 3 deals with green technologies and innovations which can be applied in the transport corridors to improve the benchmarks. Focus is on the identification, selection and benchmarking of green technologies which may mitigate the bottlenecks, and to what extent the technologies contribute to improve the benchmarks.

The following categories of technologies have been considered in the study:

- Engines and Propulsion Systems;
- Fuels and Sources of Energy;
- Cargo Handling and Transfer;
- Cargo Preparation;
- Heating and Cooling;
- Innovative Loading Units and their Treatment;
- Vehicles;
- Navigation Technologies;
- Best Practices.

A series of technologies according to the above categorisation have been subject to comprehensive studies for the various transport modes as indicated by Table 4 below.

Table 4: Number of technologies studied for various transport modes and categories.

Transport mode	Engines and Propulsion Systems	Fuels and Souces of energy	Cargo handling and Transfer	Cargo Preparation	Heating and Cooling	Innovative units and Treatment	Vehicles	Navigation technologies	Best practices	TOTAL
Inland Waterways	11	10	3	0	0	0	4	2	0	**30**
Maritime	11	21	29	0	0	2	3	14	2	**82**
Railway	8	17	4	0	0	13	12	3	10	**67**
Road	7	18	0	0	1	1	16	3	1	**47**
Multimodal	0	3	16	0	2	3	0	0	0	**24**
TOTAL	**37**	**69**	**52**	**0**	**3**	**19**	**35**	**22**	**13**	**250**

3.3 WP4: Smart Exploitation of ICT-flows

The objective of WP 4 is to define and exploit the role of ICT flows towards the goal of greener transport, and is complementary to the technology focus in WP3. The mitigating effect of implementation of identified ICT measures to meet the needs of the identified bottlenecks in Figure 2 is considered.

A classification of information flows in road, rail, maritime and, inland waterway transport, rail and road transport applications, is developed. Their mode of usage, their integration among various systems and related problems are also analysed. Main results, tools and methods of EU projects such as FreightWise, E-freight, and other related projects are presented.

Based on the preliminary analysis carried out, it is fair to say that bottlenecks on supply chain ICT are mainly caused due to causes that include:

- Incompatibility of systems. Different transport nodes use different ICT standards and protocols and that causes incompatibility and lack of information succession. For example the ICTs for the link of Port and Vessels, are often either incompatible or unconnected with the ICTs operating at the link of Port and trucks. An unexpected deviation of Estimated Time of Arrival (ETA) of a vessel is very crucial information for truck operators. This will not be reported to the truck drivers, unless they decide to seek for that information, which may not be the case.
- Non integration of ICT systems. Transportation stakeholders often do not realise the benefits from the ability to access and exploit information flows. ICT systems integration would help ensure information succession and help towards optimum logistics operations.
- Limitation to basic – static functionality. ICTs utility is strongly dependent on the level of technology that they implement. The quality of information is increased when moving from static to dynamic systems. Moreover the incorporation of computational algorithms and optimisation routines provide top quality information and the potential utilisation is at maximum level.

Among the outputs from WP 4 is a clustering of ICT applications and measures into some main groups as given by Table 5.

Table 5: ICT clusters identified

ICT cluster number	examples of ICTs	ICT cluster
1	Unified Electronic toll system (CHD) Congestion Charging Toll amount depending on the pollutant category of the truck (German highway truck toll system)	**Expert charging systems**
2	ERTMS Traffic flow optimization, Caesar (or systems of individual operators like kombiverkehr, ökombi, etc) VTS/VTMIS, LRIT Electronic Traffic Management, River Information Service (RIS) Fairway Information Service (FIS) Information for Law- enforcement (ILE) Traffic control systems (TMC pro/TMC Plus, GPS/GSM) OPTIMAR International networking of national traffic control centres ICT: How to assign icebreakers to other vessels Traffic signaling optimization	**Centralised transportation management systems**
3	Platooning Intelligent Speed Adaption (ISA) Speed limits on the highway depending on CO2 emission values (VBA Umwelt Tirol)	**Decentralised transportation management systems**
4	Conducted communication systems Broadcasting systems (TMC, TMCpro, TPEG, DVB, DAB) Mobile radio systems (GSM,SMS,GPRS,UMTS) Car-to-X-Communication ENC/ECDIS Broadband communication (WiFi/WiMAX, digital VHF, etc), GNSS (GPS, Glonass, Galileo) Automatic Identification System (AIS) LRIT – Long Range Identification and Tracking, radar SafeSeaNet AGHEERA RFID SCHENKER SMARTBOX Route Guidance systems Personal navigation assistant (Navigationssysteme) Head-up display (HUD) Navigation system for trucks: Map & guide professional	**Broadcasting, monitoring & communication systems**
5	Road-weather-information systems (SWIS, AWEKAS, GFS Europa, Coupled general Circulation Models Eumesat Polar Systems (EPS)) Speed limiter Night Vision System Distance control systems Collision warning systems Braking assistant systems Lane Departure Warning (LDW) Lane keeping assistant	**Safety systems**
6	Single Window solutions JUP Fretis ShortSeaXML Port Community Systems	**E-Administrative Systems**
7	Anonymised sensor data gateway etc	**Emissions footprint calculator systems**

4 Exploring corridor related transport bottlenecks

WP 2 made a comprehensive effort into benchmarking the SuperGreen corridors. Based on this work a set of relevant bottlenecks for further studies was identified and categorised according to following main categories:

- Operational bottlenecks
- Bottlenecks related to ICT and transportation technology
- Infrastructural bottlenecks
- Bottlenecks related to policies, legislation and regulations
- Other bottlenecks

In the subsequent sections relevant bottlenecks identified within the SuperGreen corridors are further elaborated according to this categorisation. Suggestions for alleviating measures are proposed.

An overall picture of identified bottlenecks within the corridors is given in the table below.

Table 6: Identified bottlenecks within the corridors

SuperGreen Corridor Bottlenecks Matrix

Category	#	Bottleneck Description	Brenner	Finis Terrae	Cloverleaf	Edelweiss	Nureyev	Strauss	Two Seas	Mare Nostrum	Silk Way
Operational	1	Complexity related to ports (port dues, opening hours, etc.)						x		x	
	2	shortage of maritime professionals								x	
	3	Interoperability problems on railways (signals, commands, control systems)	x	x		x					x
	4	Safety and Security issues (incl. Accidents, cargo, crew safety)					x			x	x
	5	Congestion	x	x	x						
	6	Modal shift, SSS to rail/ road to rail/SSS			x						
	7	Border crossings					x	x	x		x
	8	Lack of common IWT language						x			
ICT and transportation technology	9	New standard ship designs for increased IWT						x			
	10	Under-developed River Information System (RIS)						x			
	11	Lack of IWT fleet modernisation						x			
	12	Lack harmonized ICT systems, e.g eFreight, eMaritime, eCustoms	x		x		x	x	x	x	x
	13	Lack of low carbon technologies in heavy road transport			x						
	14	Lack of ERTMS implementation	x	x		x					
	15	Customs surveilance					x				
	16	Lack of satelite based ICT applications (tracking & tracing)								x	x
Infrastructure	17	Capacity limitations on road and rail (congestion & slot restrictions)	x	x	x	x			x		
	18	Differing rail gauges (different national standards)	x	x		x					x
	19	Lack of electrified rail stretches			x	x					
	20	Lack of port capacity					x	x	x	x	x
	21	Insufficient port and hinterland capacity (road & rail)					x		x	x	x
	22	Insufficient lock capacities						x			
	23	Shallow water sections						x			
Policies, Legislation, and regulations	24	Lack of traffic regulations/policies for pollution management	x				x				
	25	Lack of harmonization of national regulations	x	x				x			x
	26	Ensuring and enabling modal shift			x						
	27	The lack of longer and heavier trucks				x					
	28	Complex customs procedures					x		x	x	x
	29	Inland vessel certification						x			
	30	Complex rules on maritime transport of dangerous goods								x	
Other	31	The Alps	x								
	32	Winter (ice conditions)	x			x	x				
	33	The Pyrenees		x							
	34	Island countries (dependent on SSS)			x		x				

If we look at the most frequent bottlenecks in terms of times noted in Table 6, the following picture appears:

Table 7: Observed frequency of identified bottlenecks in the corridors

Bottleneck #	# Identified	Corridor
(11) Lack harmonised ICT systems, e.g. e-Freight, e-Maritime, e-Customs	7	Brenner, Cloverleaf, Nureyev, Strauss, Two Seas, Mare Nostrum, Silk Way
(3) Interoperability problems on railways (signals, commands, control systems)	5	Brenner, Finis Terrae, Edelweiss, Silk Way
(17) Capacity limitations on road and rail (congestion & slot restrictions)	5	Brenner, Finis Terrae, Cloverleaf, Edelweiss, Two Seas
(20) Lack of port capacity	5	Nureyev, Strauss Two Seas, Mare Nostrum, Silk Way
(7) Border crossings	4	Nureyev, Strauss, Two Seas, Silk Way
(18) Differing rail gauges (differing national standards)	4	Brenner, Finis Terrae, Edelweiss, Silk Way
(21) Insufficient port and hinterland capacity (road & rail)	4	Nureyev, Two Seas, Mare Nostrum, Silk Way
(25) Lack of harmonization of national regulations	4	Brenner, Finis Terrae, Strauss, Silk Way
(28) Complex customs procedures	4	Nureyev, Two Seas, Mare Nostrum, Silk Way
(4) Safety and Security issues (incl. Accidents, cargo, crew safety)	3	Nureyev, Mare Nostrum, Silk Way
(1) Congestion	3	Brenner, Finis Terrae, Cloverleaf
(14) Lack of ERTMS implementation	3	Brenner, Finis Terrae, Edelweiss
(32) Winter (ice conditions)	3	Finis Terrae, Edelweiss, Nureyev

A preliminary conclusion of this picture is that a vast majority of the bottlenecks may be alleviated by means of ICT related measures.

In the subsequent sections, possible existing measures to meet and alleviate most of the identified bottlenecks in the various groups are further elaborated based on the findings in WP 3 and WP 4 concerning technologies and ICT, respectively.

An overall goal with this exercise has been to identify possible gaps in availability of technologies and ICTs, respectively, as basis for R&D recommendations to be identified in Task 5.2.

4.1 Operational bottlenecks

Operational:

- *Interoperability problems on railways (Brenner, Edelweiss, Finis Terrae, Silk Way)*
- *Border crossings (Nureyev, Strauss, Two Seas, Silk Way)*
- *Increase of maritime transports, bigger risks of accidents (Nureyev)*
- *Financing and insurance of vessels, problems with local and port authorities, lack of common IWT language (Strauss)*
- *Complex administrative processes, shortage of maritime professionals (Mare Nostrum)*
- *Safety & Security (Brenner, Silk Way)*

4.1.1 Interoperability problems on railways (Brenner, Edelweiss, Finis Terrae, Silk Way)

There are interoperability problems on railways in several of the SuperGreen transport corridors. The change of traction and signalling systems at the borders between European Railway networks still reduces efficiency; at these spots, traction locomotives and drivers need to be changed at the border, causing delays to the circulation. In addition there are also different train control and command systems in use.

In order to alleviate this bottleneck and improve the competitiveness of rail transport in general, the European Railway Management System (ERTMS[2]) is being deployed in new high speed rail connections under construction, e.g. in the Munich–Verona rail line which will open in 2015.

With regards future needs, it is necessary to follow the process for pan-European implementation of ERTMS, meaning it is more a matter of proper and wide-range ICT implementation than lack of ICT systems and technologies, albeit there is some need for fine-tuning. R&D should therefore put emphasis on regulatory issues enhancing the implementation of dedicated ICT systems. The potential of expanding the use of GNSS (GALILEO) and dGNSS (EGNOS) for rail positioning and energy optimisation of traffic should also be investigated.

Overall identification of mitigating measures in WP 3 and WP 4 to meet this bottleneck is given by the table below:

Bottleneck # 2: Interoperability problems on railways		
Short description of measure(s)	**GAP analysis**	**Potential greening impact**
- ICT technologies and systems (e.g. Centralised transportation management systems, Traffic flow optimization)	- Harmonization within the transport chain is needed. - Lack of centralised national/EU policy to implement suitable ICT systems. - Lack of in detail analysis of corridor specific needs.	- More efficient transports, less emissions

[2] An initiative backed by the European Union to enhance cross-border interoperability and signalling procurement by creating a single Europe-wide standard for train control and command systems (European Railway Agency, 2011, https://www.era.europa.eu/core-activities/ertms/pages/home.aspx)

The potential greening impact of implementing such ICT measures is difficult to quantify with any specific values that are applicable on a Pan-European basis. However, as the ERMTS will provide the locomotive drivers with more real-time information of traffic, this opens for the ability to adjust speed and engine thrust according to traffic, thereby avoiding unnecessary fuel consumption and thus reduce emissions. Further, increased operational efficiency and reduced travel time also provides the ability to increase the desired cargo shift from road to rail.

4.1.2 Border crossings (Nureyev, Strauss, Two Seas, Silk Way)

The border crossings between EU and non-EU countries are major bottlenecks which concern many transport corridors and countries in Europe. Many of the problems are related to the lack of harmonisation of procedures between countries. Border crossings, inspections and different formalities are time consuming with considerable waiting time. This causes delays and congestions.

Much work has been carried out in order to alleviate this bottleneck, particularly within developing different ICT based Single Window solutions such as: e-Administrative Systems, e-Custom Single window, eFreight Single Window, e-Maritime Single Window, and solutions like JUP, Fretis, the Swedish "The Virtual Customs Office" (VCO), the Finish ENSI system, and Port community systems.

Most ICT measures will more or less contribute positively to fuel economy and hence reduce emissions. In many cases ICT interoperability will be improved, thus most probably also the efficiency, which is very important from an EU policy perspective. Table 5 identified the following ICT clusters:

- Expert charging systems;
- Centralised transportation management systems;
- Decentralised transportation management systems;
- Safety systems;
- E-Administrative Systems;
- Emissions footprint calculator systems.

In principle, a spectre of ICT solutions will significantly contribute to mitigate this bottleneck, and many dedicated systems are already available as elaborated in WP 4. However, there is still a long way to go on harmonising the implementation of such systems so as to improve the interconnection and thus the border crossings.

Overall identification of mitigating measures in WP 3 and WP 4 to meet this bottleneck is given by the table below:

Bottleneck # 4: Border crossings		
Short description of measure(s)	**GAP analysis**	**Potential greening impact**
- E-Administrative Systems- Single Window solutions, JUP, Fretis, Port community systems, VCO, ENSI	- Lack of in detail analysis of case by case specific needs and requirements. - Lack of harmonisation	- Fewer emissions, less consumption,

As for the interoperability problems related to railways, it is difficult to specifically quantify the potential greening impact of implementing such ICT systems to make border crossings more effective. Generally spoken, if congestions and tedious border crossings can be reduced and made more efficient and effective, less energy will be consumed and the transport work will be improved contributing to less emission (e.g. less 'stop-and-go' operations and reduced waiting times at border crossings). This rests upon the fact that rail freight operations is about optimising the use of journey time. However, in order to do so a key issue is to gain access to the data that allows measurement of potential time saving and thus less emissions.

4.1.3 Increase of maritime transports, bigger risks of accidents (Nureyev)

In the Baltic Sea the traffic volumes are estimated to grow rapidly and especially the oil transports from Russia. This means more and/or larger vessels and a potential increased risk for accidents and pollutions.

The Baltic Sea is known as a highly sensible environment and is further exposed to ice during winter. This causes operational challenges.

The Aegean Sea is very sensitive with respect to environmental pollutions and oil spills from ship accidents.

A series of possible ICT measures have been introduced for control and guidance of the traffic in such areas, like:

- Mandatory Ship Reporting System (GOFREP),
- Vessel traffic service (VTS),
- Automatic Identification System (AIS),
- Vessel Traffic Management and Information Systems (VTMIS)

Despite the considerable effort in developing advanced control and guidance systems, the major problem to gain full effect still seems to be on the implementation side, as lack of harmonisation and integration of the various systems hampers the development.

Overall identification of mitigating measures in WP 3 and WP 4 to meet this bottleneck is given by the table below:

Bottleneck # 5: Increase of maritime transports, bigger risks of accidents		
Short description of measure(s)	**GAP analysis**	**Potential greening impact**
- Centralised transportation management systems , Traffic flow optimization	- Lack of centralised national/EU policy to implement suitable ICT systems. - Lack of in detail analysis of corridor's specific needs - Lack of harmonisation	- More efficient transports, safer transports, less emissions.

The implementation of such systems will most likely contribute to better and more secure transport of seaborne transports, thus also have a positive effect on the greening potential.

4.1.4 Financing and insurance of vessels, problems with local and port authorities, lack of common IWT language (Strauss)

In Inland Waterways Transport (IWT) there are barriers related to the financing of investments in vessels, but also with regards to insurance of vessels. Related problems mentioned with respect to financing are amongst others: lack of harmonisation of the conditions for financing and insurance between countries, poor profitability causes banks to waive from engagements, lack of support of authorities (e.g. with regard to taxes, subventions, state guarantees etc.). Further, the lack of a common IWT language has also been mentioned as a problem for operators in international transport.

In terms of R&D measures to alleviate this bottleneck very much is about harmonisation of procedures and ICT. As an example the Fairway Information Service (FIS) could be useful. FIS contains geographical, hydrological and administrative data. It provides dynamic as well as static information about the use and status of the inland waterway. FIS will provide standardised electronic charts and standardised notices to skippers in a machine readable format and in eleven languages. Another alternative in this context could be Statistics (ST). This is an electronic data collection system that contains relevant inland waterway freight statistics. It will facilitate the process for data providers and statistical offices.

The toll systems in general are also a major problem in inland navigation. Different toll systems in Europe and different languages complicate the communication and information flow. Waterway Charges and Harbour Dues (CHD) could be mentioned in this context. RIS can assist in levying charges for use of infrastructure tolls. The travel data of the ship can be used to automatically calculate the charges and initiate invoicing, thus facilitating the process for waterway users and authorities.

Harmonised ICT solutions will contribute to common procedures and reporting processes within the IWT transport sector, and will promote more effective transports, thus also containing a greening potential.

From a technology point of view, R&D on new technologies for e.g. propulsion systems, fuel and energy and cargo handling will contribute to increased efficiency in inland navigation. Increased efficiency often means better overall profitability, which may make it easier to finance new vessels.

Future efforts within R&D on new business and financing models in order to support fleet may also contribute to alleviate this bottleneck.

Overall identification of mitigating measures in WP 3 and WP 4 to meet this bottleneck is given by the table below:

Bottleneck # 6: Financing and insurance of vessels, problems with local and port authorities, lack of common IWT language		
Short description of measure(s)	**GAP analysis**	**Potential greening impact**
- Engine and propulsion systems; Fuels and sources of energy; cargo handling technologies. - E-Administrative Systems – single window solutions, JUP, Fretis, Port community systems, VCO, ENSI	- Old tonnage prevents increased efficiency in inland navigation. - Lack in harmonisation. - Improvements may give better overall economy, thus make financing easier.	- More efficient transports, safer transports, less emissions.

4.1.5 Complex administrative processes, shortage of maritime professionals (Mare Nostrum)

The administrative procedures for maritime transport are often unnecessarily complex, in duplex, and not harmonised between countries or ports.

- In certain ports customs documents have to be delivered in hard-copy to the customs office that is often located far away from the quay, even with reduced opening hours.
- In some ports, unloading can only start after all documentary formalities have been completed.
- There are language difficulties in many ports and ship manifests and certificates in languages other than their own may be refused.
- Pilotage services can be a serious problem. Short sea vessels call regularly at the same port, and their masters are familiar with the fairways and infrastructure. Although some countries do offer a Pilotage Exemption Certificate (PEC), there are often national requirements that make a PEC difficult to obtain.
- Electronic manifests are not universally accepted by all ports in the EU. Only 55% of ports use electronic systems for handling ship and cargo information. Use of fax and telephone is still common.
- Only a few Member States have a national single window approach. The linkage between the SafeSeaNet and the port networks is very limited.

As identified in WP 4, considerable research has been carried out on improving administrative procedures, e.g. on establishing a maritime single window (e.g. EU projects: FreightWise, MarNIS, Flagship, eFreight). Despite this a pan-European single window solution for the entire industry is still missing, particularly for ship-port interfaces and harmonised with customs procedures.

The growing shortage of maritime professionals is yet another operational problem. Thus, as it entails the risk of loosing the critical mass of human resources that sustains the competitiveness of the European maritime industries in general, it serves as important input to WP 6 (Policy recommendations) in SuperGreen.

Although the potential greening impact is difficult to quantify, it is no doubt that e-Maritime single windows will have a significant contribution towards increasing efficiency and reducing the overall energy consumption, thus also the pollution from vessels.

Overall identification of mitigating measures in WP 3 and WP 4 to meet this bottleneck is given by the table below:

Bottleneck # 7: Complex administrative processes, shortage of maritime professionals		
Short description of measure(s)	**GAP analysis**	**Potential greening impact**
- E-Administrative Systems – single window solutions, JUP, Fretis, Port community systems, VCO, ENSI - No specific technology identified	- Lack in harmonisation. Improvements may give better efficiency and thus overall economy.	- More efficient transports, safer transports, less emissions.

4.1.6 Safety & Security (Brenner, Silk Way)

There are also bottlenecks related to safety and security. The intrusion of illegal immigrants inside trucks is a problem along the Brenner Corridor. Security of cargo being transported over long distances is also a challenge, mostly due to considerable time spent in far regions with minor possibilities for follow up and control. In the Aden Bay there is a security problem due to the increasing number of piracy incidents on vessels. Restricted possibilities for follow up and control may be considered as a bottleneck.

Heavy traffic in narrow waters like parts of the Baltic Sea may cause a safety problem due to dense traffic. During winter parts of the Baltic Sea are covered with ice. Weather ice conditions may represent a serious danger to ships and therefore to the whole ecosystem. Operating in ice infested waters affects ship's speed, resulting in increased fuel consumption and GHG emissions.

Due to the dense traffic and challenging navigation in many of the Baltic Sea shipping routes, accidents occur more often in the Baltic Sea than in many other waters. The Baltic Sea is fully covered by an Automatic Identification System (AIS), which is a great advancement in maritime safety. Still this system needs improvements in order to resolve observed bottlenecks and to make maritime traffic even safer.

Overall identification of mitigating measures in WP 3 and WP 4 to meet this bottleneck is given by the table below:

Bottleneck # 35, 37: Safety & Security		
Short description of measure(s)	**GAP analysis**	**Potential greening impact**
- E-Administrative Systems – single window solutions, JUP, Fretis, Port community systems, VCO, ENSI - Centralised transportation management systems, ICT. - Assignment of icebreakers to vessels	- Lack in harmonisation. Improvements may give better efficiency and thus overall economy. - Insufficient implementation of available planning systems for assigning icebreakers to vessels. (IBNet[3] or similar)	- More efficient transports, safer transports, less emissions. - Reduced risk for collision and grounding, thus also for oil spill and pollution to sea.

[3] **IBNet** (IceBreakerNet) is a computerised information and management system used by the Swedish and Finnish icebreaking services.(http://www.sjofartsverket.se/en/About-us/Activities/Icebreaking/IBNet/)

4.2 Bottlenecks related to ICT and transportation technology

ICT and Transportation technology:
- *Need to develop new ICT systems (Brenner, Cloverleaf, Nureyev, Strauss, Two Seas)*
- *Lack* of harmonization of systems and data (Brenner, Silk Way)
- *Customs surveillance (Nureyev)*
- *Outdated waterway fleet (Strauss)*
- *Bottlenecks in RIS (River Information System) (Strauss)*

4.2.1 Need to develop new ICT systems (Brenner, Cloverleaf, Nureyev, Strauss, Two Seas)

Albeit considerable efforts are taking place in developing e-Freight systems to support and promote co-modal and sustainable logistics throughout Europe, there is still an enormous need for further developing and implementing new ICT applications to meet the market demands. In inland waterways transports information logistics services are still in their infancy. The fact that co-modality will grow is a major driver in the development of ICT systems. The functional requirements to ICT solutions are continuously increasing to meet the demands for online decision support. Interoperability throughout the logistics chain and deviation handling are key issues. Damage control of cargo and security issues needs to be handled in a proper way from consignor to consignee.

Important contributions to possible solutions of this bottleneck can be achieved by means of new ICT applications. Examples are traffic control to decrease congestion, and new systems to alleviate operational problems due to ice situation in the Baltic Sea.

Overall identification of mitigating measures in WP 3 and WP 4 to meet this bottleneck is given by the table below:

Bottleneck # 26: Need to develop new ICT systems		
Short description of measure(s)	**GAP analysis**	**Potential greening impact**
- E-Administrative Systems – single window solutions, JUP, Fretis, Port community systems, VCO, ENSI - Centralised transportation management system. - Assignment of icebreakers to vessels	- Lack in harmonisation. Improvements may give better efficiency and thus overall economy. - Insufficient implementation of available planning systems for assigning icebreakers to vessels. (IBNet or similar) - Standard protocoling and interfacing.	- More efficient transports, safer transports, less emissions.

4.2.2 Lack of harmonisation of systems and data (Brenner, Silk Way)

Access to a common data platform is a prerequisite and a must for seamless information exchange in logistics. All parties involved should have access to the same data needed for interoperability and required interchange between partners. E.g., in rail transports border authorities and customs should receive the required information in due time prior to train arrivals, so as to prepare and check the required documents before the train arrives. Common data protocols and platforms increase the visibility of transports, and is a prerequisite for effective transport planning as well as for real time tracking and tracing of transport means and cargo. Various ICT systems need to be integrated to give the sufficient capability and power for real time planning and follow up of effective and sustainable supply chains.

The use of satellite based applications for maritime surveillance was identified as a potential development area. Such systems will be part of the e-Maritime Initiative on developing an integrated EU system providing e-services at different levels of the transport chain. In this respect the e-Maritime system must be able to interface with the e-Freight and the e-Customs systems, as well as with all other relevant ICT systems for the various modes.

Overall identification of mitigating measures in WP 3 and WP 4 to meet this bottleneck is given by the table below:

Bottleneck #9, 26, 27, 32, 33: Lack of harmonisation of systems and data		
Short description of measure(s)	**GAP analysis**	**Potential greening impact**
- Common emission footprint calculator - E-Administrative Systems – single window solutions, JUP, Fretis, Port community systems, VCO, ENSI - Centralised transportation management system, ICT – VTMIS, VTS, AIS, ERTMS, Traffic flow optimisation, Optimar, Caesar - Broadcasting, monitoring and communication systems – AGHEERA, Smartbox, ITS - No technologies except ICT identified	- Lack of implementation of available and existing systems - Lack in harmonisation. - Lack of centralised/EU policy to implement suitable and dedicated systems	- More efficient transports, safer transports, less emissions.

4.2.3 Customs clearance (Nureyev)

The technical equipment in transit points at the borders of the Baltic countries is below standard. This delays and hampers border crossings dramatically. The efficiency of the customs clearance in these transit points is lagging behind what should be expected and delays transits.

There is a general need to modernise and further develop the technical solutions as well as the ICT solutions in the border points of Baltic countries to get border crossings in this region up to an acceptable standard.

Overall identification of mitigating measures in WP 3 and WP 4 to meet this bottleneck is given by the table below:

Bottleneck # 30: Customs clearance		
Short description of measure(s)	**GAP analysis**	**Potential greening impact**
- E-Administrative Systems – single window solutions, JUP, Fretis, Port community systems, VCO, ENSI - Implementation of state of the art technologies for customs clearance/control.	- Lack in harmonisation. Improvements may give better efficiency and thus overall economy. - Political reluctance to implement available technologies.	- More efficient transports, safer transports, less emissions.

4.2.4 Outdated waterway fleet (Strauss)

The average age of the European inland waterway fleet is rather high. A major reason for this is low profitability in this market which makes it challenging to order new vessels. Inland waterways transport is a very conservative business. When new vessels are ordered they are often built according to standard specifications and designs developed decades ago, partly with outdated technology to make the new vessels less costly as possible to build.

There are many available technologies which easily will improve the capabilities of new vessels related to hull resistance and sea keeping (improved hydrodynamics will reduce fuel consumption and thus emissions) as well as more efficient and environmental friendly propulsion systems. Alternative fuels as LNG may be a future-oriented energy alternative for river vessels where LNG bunkers stations may be easily deployed.

Overall identification of mitigating measures in WP 3 and WP 4 to meet this bottleneck is given by the table below:

Bottleneck # 31: Outdated waterway fleet		
Short description of measure(s)	**GAP analysis**	**Potential greening impact**
- New engine and propulsion systems - Fuels and sources of energy - Alternative maritime power - Vehicle concepts	- Present fleet and technology doesn't fulfil requirements for future-oriented vessels	- More efficient transports, safer transports, less emissions.

4.2.5 Bottlenecks in RIS (River Information System) (Strauss)

The main bottlenecks in the Rhine-Main-Danube corridor River Information Services (RIS) are:

- Real time depth data and dynamic water-level-models are only available in parts of the Inland Electronic Navigational Charts (IENCs), and should be developed for IWT in every respective country.
- Notices to skippers from administrations are provided at a national level, but need to be coordinated at a European level so that a skipper does not have to search all national RIS centres along the entire route to get a descent overview of the situation. A dedicated task force is already in progress.

- Electronic Reporting of cargo and voyage data needs to be further developed and harmonised along the route to reduce administrative burden and streamline information exchange with authorities.
- Vessel Tracking and Tracing is carried out by means of the Inland Automatic Identification System (Inland AIS). A recent survey showed that most vessels will be equipped with such devices by 2013. A corresponding and complementary shore-infrastructure is required for tracking and tracing of logistics services, but will not be ready by then.

Overall identification of mitigating measures in WP 3 and WP 4 to meet this bottleneck is given by the table below:

Bottleneck # 9, 26, 27, 32, 33: Bottlenecks in RIS		
Short description of measure(s)	**GAP analysis**	**Potential greening impact**
- Harmonised emission footprint calculator - E-Administrative Systems – single window solutions, JUP, Fretis, Port community systems, VCO, ENSI - Centralised transportation management system, ICT – VTMIS, VTS, AIS, ERTMS, Traffic flow optimisation, Optimar, Caesar - Broadcasting, monitoring and communication systems – AGHEERA, Smartbox, ITS - No technologies except ICT identified	- Lack of implementation of available and existing systems - Lack in harmonisation. - Lack of centralised/EU policy to implement suitable and dedicated systems	- More efficient transports, safer transports, less emissions.

4.3 Infrastructural bottlenecks

Infrastructure:

- *Congestion/ Capacity limitations of rail and road networks (Brenner, Edelweiss, Finis Terrae, Cloverleaf, Two Seas)*
- *Rail infrastructure: slot restriction, different gauges, non-electrified rail stretches, monorail tracks (Brenner, Cloverleaf, Edelweiss, Nureyev, Finis Terrae)*
- *Ports and port capacity (Nureyev, Mare Nostrum, Silk Way, Two Seas, Strauss)*
- *Road and rail hinterland connections of ports (Mare Nostrum, Two Seas, Nureyev)*
- *Railway terminals capability of handling long trains (Silk Way)*
- *Shallow- water sections,* insufficient lock capacities *(Strauss)*

Based on the work in WP 2, infrastructure bottlenecks have been identified in the following areas/fields: The Brenner Tunnel; Crossing of the Pyrenees; The Fehmarn strait; Ports of Patras, St. Petersburg & Hamburg; Paris area; West Coast Main Line; Klaipeda-Minsk; lock capacities on the river Meuse; Water depths on the Danube; Rail connection Europe-Asia.

4.3.1 Congestion/ Capacity limitations of rail and road networks (Brenner, Edelweiss, Finis Terrae, Cloverleaf, Two Seas)

Across Europe there are frequent traffic jams and congestions due to capacity limitations in the road infrastructure. Some examples are:

- The Brenner Tunnel. Between Forli-Bologna and Klaipeda-Minsk two main highways for trucks are crossing the Pyrenees. The road capacity is close to its maximum causing serious congestion problems.
- The West Coast Main Line (WCML) connecting Liverpool to the Midlands (Birmingham), and the London South Ring road are both facing capacity problems caused by mutual competition for capacity between freight and passenger transport.
- The Fehmarn strait between Denmark and Germany is a major bottleneck. Today there are several ferry lines connecting these two countries, but with limited capacity causing serious delays.
- Urban areas like London (the M25), the Kennedy Tunnel in Antwerp, and other major ring roads including the one in Venlo (the Netherlands), being one of the biggest logistics centres in Europe.

Currently, technical solutions already exist for introducing traffic control systems. However, a harmonisation of such systems across transport modes is necessary for improving the supply chain performance. As an example, the introduction of VMS (Variable Message Signs) can give early warnings to drivers a problem (traffic congestion, delays, bottlenecks on road, etc.), so that they can make new decisions for re-routing the transport. ICT technologies and systems should also be applied for better distribution of the traffic flow, thus reducing congestions (especially due to capacity limitations of rail and road networks). Relevant technologies are: E-Administrative Systems- Single Window solutions, JUP, Fretis, Port community systems, VCO, ENSI.

Overall identification of mitigating measures in WP 3 and WP 4 to meet this bottleneck is given by the table below:

Bottleneck # 1, 16: Congestion/ Capacity limitations of rail and road networks		
Short description of measure(s)	**GAP analysis**	**Potential greening impact**
- E-Administrative Systems – single window solutions, JUP, Fretis, Port community systems, VCO, ENSI - ICT technologies to reduce congestion and improve capacity utilisation in infrastructure.	- Measures for improving distribution of traffic flow in present infrastructure. - Measures for rising load factors, optimizing train length and weight for best use of available paths.	- More efficient transports, safer transports, less emissions.

4.3.2 Rail infrastructure: slot restriction, different gauges, non-electrified rail stretches, monorail tracks (Brenner, Cloverleaf, Edelweiss, Nureyev, Finis Terrae)

Journey time is a key driver and a barrier for growth in capacity in many railway networks. Capacity restrictions in the railway network cause tremendous delays in transit times for cargo trains waiting for slot times in passing loops allowing express passenger services with higher priority to pass. There are slot restrictions for example in the Milan area, between Verona and Wörgl and between Munich and Nürnberg.

There are incompatibilities in rail gauge in different areas in Europe. For example, rail transport between the Iberian Peninsula and the rest of Europe is hampered by the Spanish and Portuguese networks, which have different gauges. The rail gauge of the Finnish and Russian networks is different from the gauge of the Swedish network, which is like the Central European standard.

Single track is a major bottleneck in rail operations which causes big restrictions in capacity. For example the single track at the Finnish Russian border reduces the capacity tremendously in an area with heavy cargo volumes in transit between the two countries. Missing electrification of railways network is another infrastructural bottleneck. As an example only 33% of the British railway network is currently electrified.

It is therefore obvious that insufficient railway infrastructure, slot restrictions, and incompatibility in rail gauges are some major drivers causing congestions and capacity limitations in the railway network. Implementation of a common and harmonised rail traffic management system in Europe may alleviate some of the negative effects of limitations in the railway infrastructure.

Overall identification of mitigating measures in WP 3 and WP 4 to meet this bottleneck is given by the table below:

Bottleneck # 17, 19: Rail infrastructure: slot restriction, different gauges, non-electrified rail stretches, monorail tracks		
Short description of measure(s)	**GAP analysis**	**Potential greening impact**
- Common and centralised transportation management systems; ERTMS on a pan-European level, traffic flow optimisation, AIS. Technology and software. - Implementation and harmonisation of technology	- Problems with distribution of traffic flow in present infrastructure. Improvements may give better efficiency and traffic flow.	- More efficient transports, safer transports, less emissions.

4.3.3 Ports and port capacity (Nureyev, Mare Nostrum, Silk Way, Two Seas, Strauss)

Congestion is a problem in many European ports, and particularly during peak seasons this causes capacity problems and delays. As ports are critical nodes in maritime based transport networks, insufficient cargo loading/unloading and handling capacities may cause considerable delays, undermining the efficiency of the overall transport chain. In turn this may lead to less cargo volumes being shifted to waterborne transports, and thereby hampering the development of more sustainable and environmentally friendly transport solutions. As an example, Port of Hamburg has reached its limits with respect to container handling capacity, and the localisation of the Greek port of Patras inside the urban centre of the city causes problems to meet the increase in passenger and freight traffic. In Russian ports lacking capacity is a serious bottleneck that causes big problems especially for import traffic. As a consequence, a lot of Russian traffic goes through Finland and other countries.

Although there is a future need for infrastructure development and investment in cargo handling equipment in many ports, development and implementation of dedicated ICT solutions are considered to contribute positively to improve this bottleneck.

An example of an ICT system being developed is a decision support system allowing the vessel to perform speed adjustments prior to calling the port, where the basis for the speed adjustment is port capacity and level of congestion. This approach for developing 'slot times' for the maritime industry, in addition to focusing more on fleet optimisation and scheduling, contributes to mitigate this bottleneck.

The greening potential of such measures is considered to be substantial since the energy consumption at sea will be more optimal, while also reducing local pollution by reducing the waiting time in ports. Hence, the overall efficiency of the supply chain will improve.

Overall identification of mitigating measures in WP 3 and WP 4 to meet this bottleneck is given by the table below:

Bottleneck # 20: Ports and port capacity		
Short description of measure(s)	**GAP analysis**	**Potential greening impact**
- E-Administrative Systems – single window solutions, JUP, Fretis, Port community systems, VCO, ENSI, Scheduling tools. - ICT technologies to reduce congestion and improve capacity utilisation in infrastructure. - Cargo handling technology.	- Lack in harmonisation. - Increase capacity utilisation; will give better efficiency and thus overall economy. - Improve distribution of traffic flow in present infrastructure; will give better efficiency and traffic flow.	- More efficient transports, safer transports, less emissions.

4.3.4 Road and rail hinterland connections of ports (Mare Nostrum, Two Seas, Nureyev)

Hinterland connections are vital for the efficiency in co-modality and intermodal transports. Insufficient capacity of such connections causes serious congestion problems not only in the surrounding areas to the ports, but in most cases also to the ports themselves. In the Baltic Sea region several ports need improvements in their connections to hinterland, especially with regards to railway and inland waterway connections. The road connections to Polish ports need also to be improved. Further, Port of Hamburg faces enormous problems with hinterland transports in general due to the fact that the capacity of the port has outgrown the capacity of the hinterland connections.

When discussing future development needs the provision of freight oriented road and rail connections to the ports has been suggested as a possible solution to this problem. However, the availability of land around the ports and the acceptance of the public opinion to build new transport infrastructure in urban areas is a great challenge for further development.

This bottleneck is more related to policy recommendations rather than ICT and technology. However, some efficiency effects may be obtained by further deployment of ICT for better planning and utilisation.

Continued emphasis on initiatives such as laid down in the "Transport White paper[4]" is considered very important for ensuring a long-term view and strategic planning of the utilisation and development of existing port infrastructure.

Overall identification of mitigating measures in WP 3 and WP 4 to meet this bottleneck is given by the table below:

Bottleneck # 24: Road and rail hinterland connections of ports		
Short description of measure(s)	**GAP analysis**	**Potential greening impact**
- E-Administrative Systems – single window solutions, JUP, Fretis, Port community systems, VCO, ENSI, Scheduling tools.	- Improved distribution of traffic flow in present infrastructure. Improvements may give better efficiency and traffic flow. - More efficient hinterland connections; remote gateways and transport connections	- More efficient transports, safer transports, less emissions.

4.3.5 Railway terminals' capability of handling long trains (Silk Way)

Some railway terminals need to split long freight trains into smaller segments before being able to start the unloading/loading process. To what extent this bottleneck negatively impacts this particular service needs to be further elaborated. New technology and infrastructure solutions are needed for resolving this problem.

In the SuperGreen transport corridors this bottleneck is particularly relevant for the Silk Way, where long trains arriving from China/ Russia must be split upon arrival in Europe. Technologies and solutions for rail cargo handling must be further studied, and more pilots are required to obtain robust and reliable operational technology. Study of such technologies has been the issue of WP 3, and is the basis for the evaluations concerning this bottleneck. Among the technologies are Metrocargo (an innovative solution for container cargo handling in electrified railways with catenary lines) and Trainloader system (a concept based on self (un)loading of units using a roll-on/roll-off system with a special train of platform cars).

Overall identification of mitigating measures in WP 3 and WP 4 to meet this bottleneck is given by the table below:

Bottleneck # 25: Railway terminals capability of handling long trains		
Short description of measure(s)	**GAP analysis**	**Potential greening impact**
- Technology for container handling along the mainline serving trains of any lengths, under the catenary. - Technology for more efficient split of trains in marshalling yards.	- Harmonisation and renovation in transport chain is needed	- More efficient transports, safer transports, less emissions.

4 http://ec.europa.eu/transport/strategies/2001_white_paper_en.htm

4.3.6 Shallow- water sections, insufficient lock capacities (Strauss)

Limitations in lock capacities in the river Meuse and the restricted water depths in Danube are major bottlenecks in Central European Inland Waterways Transports. Although these bottlenecks do not hinder navigation, a removal will significantly improve the capacity. Currently there are on-going initiatives such as the "River Engineering project" on the Danube East of Vienna.

Concerning the limitations in lock capacity, the efforts on the River Information Service (RIS) contribute to mitigate this problem. An ICT application named "Traffic Management" (TM) in charge of the waterway administrations aiming at optimal utilisation of the infrastructures and safe navigation may alleviate the bottleneck. Further, another application is a component named "Information for Transport Logistics" enabling improved slot management. There are several other components that may help alleviate the bottleneck, which are described in more details in WP 4.

With regards the shallow water bottleneck the RIS could be used to ensure a better information flow and to improve the planning process. Another useful system is the "Fairway Information Service" (FIS) which contains geographical, hydrological and administrative data for the fairways. It provides dynamic as well as static information about the use and status of the inland waterway (see WP 4 for more details).

Overall identification of mitigating measures in WP 3 and WP 4 to meet this bottleneck is given by the table below:

Bottleneck # 22: Shallow- water sections, insufficient lock capacities		
Short description of measure(s)	**GAP analysis**	**Potential greening impact**
- ICT systems that enable relevant online information. - Navigation technologies to support navigation in shallow waters.	- Lack of relevant online information	- More efficient transports, safer transports, less emissions.

4.4 Bottlenecks related to policies, legislations and regulations

Policies, legislation and regulations:

- *Lack of harmonization of national regulations (Brenner, Finis Terrae, Strauss, Silk Way)*
- *Border crossings (Nureyev, Mare Nostrum)*
- *Inadequate capacity of facilities at the border crossing (Two Seas)*
- *Inland vessel certification, new quality systems (Strauss)*
- *Complex rules on carriage of dangerous goods by sea (Mare Nostrum)*
- *New quality requirements for maritime fuels (Nureyev)*

4.4.1 Lack of harmonisation of national regulations (Brenner, Finis Terrae, Strauss, Silk Way)

Permits and regulations vary between countries. Different countries have different regulations and operational standards which indeed is a bottleneck in terms of missing harmonisation. EU and "Commonwealth of Independent States" (CIS) countries use different bill of ladings in rail transports; EU according to CIM law (Uniform Rules concerning the Contract of International Carriage of Goods by Rail), and Eastern Europe according to SMGS law (Agreement on International Goods Transport by Rail). Poland accepts bill of ladings compliant with both laws. Furthermore, related to inland navigation and certification, a study of administrative barriers concluded that in a number of countries companies are not satisfied with the performance of the inspection authorities. Long delays in obtaining certificates, mistakes etc. were commonly experienced, and considered to be a significant barrier.

Since 2003, rail organisations such as "Organisation for International Carriage by Rail" (OTIF, CIT), and "Organisation for Cooperation of Railways" (OSShD), are jointly working together with the EU commission on developing joint bill of ladings which will also comply with the needs of the customs.

Although ICT solutions can assist in simplifying the exchange of transport documents, the most pressing issue is though to agree on a harmonised format for bill of lading that can seamlessly and effectively be transferred throughout the chain to avoid delays

Harmonisation of national regulations on operational standards, and certification of the professional skills of transport personnel, should be implemented on a pan-European basis.

Lack of standard/ harmonised job profiles corresponding to manning/ crew requirements is also seen as a barrier in some countries. The problem with non-compliance with regulations regarding running and resting times in different countries is considered as an issue of unfair competition between countries and companies, and should be harmonised.

Policies need to be developed for harmonisation of rules and regulation throughout Europe. This is about policy implications in WP 6 rather than basis for further research.

Overall identification of mitigating measures in WP 3 and WP 4 to meet this bottleneck is given by the table below:

Bottleneck #9: Lack of harmonisation of national regulations		
Short description of measure(s)	**GAP analysis**	**Potential greening impact**
- ICT systems to support harmonisation of relevant issues throughout Europe. - Broadcasting, monitoring & communication systems – AGHEERA, Smartbox, ITS - Centralised transport management systems – VTMIS, VTS, AIS, ERTMS, Traffic flow optimisation, Optimar, Caesar	- Need for harmonisation and appropriate implementation of relevant ICT systems. - Need to harmonise transport chain - Lack of centralised national/EU policy to implement suitable ICT systems	- More efficient transports, safer transports, less emissions.

4.4.2 Border crossings (Nureyev, Mare Nostrum)

Border crossings between EU and non-EU countries in general represent a major bottleneck. Along the Russian border huge delays are experienced due to inefficiency in the Russian Customs.

A tremendous set of EU directives and legislations concerning among others customs and transport rules, veterinary and plant-protection regulations, formalities for vessels arriving in or departing from European ports, is a serious bottleneck and hindrance to the efficiency in intra-EU maritime transport.

Again, harmonisation in rules and regulations and ICT solutions may contribute to alleviate the situation as elaborated in WP 4. Albeit, the most important measure for alleviating inefficiency in border crossings is about policy and policy implications which are currently being addressed in among others the strategic initiative "European Maritime Transport Space without barriers". Policy implications are topic in the SuperGreen WP 6.

Overall identification of mitigating measures in WP 3 and WP 4 to meet this bottleneck is given by the table below:

Bottleneck #4: Border crossings		
Short description of measure(s)	**GAP analysis**	**Potential greening impact**
- ICT systems to support harmonisation of relevant issues throughout Europe. - Broadcasting, monitoring & communication systems – AGHEERA, Smartbox, ITS	- Need for harmonisation and appropriate implementation of relevant ICT systems. - Need to harmonise the transport chain - Lack of centralised national/EU policy to implement suitable ICT systems	- More efficient transports, safer transports, less emissions.

4.4.3 Inadequate capacity of facilities at the border crossing (Two Seas)

Many problems have been pointed out along the border crossing due to inadequate capacity of clearance facilities, meticulous bureaucratic custom clearance procedures, inadequate opening hours, and understaffed custom offices.

The harmonisation of formalities in customs between EU and countries outside EU is more or less a political question; it's a matter of policy implications. However, development of a common framework for supporting procedures and document exchange, as well as supportive and tailored ICT systems can help to bring this area forward. The on-going initiatives within single window developments contribute to meeting this challenge.

Overall identification of mitigating measures in WP 3 and WP 4 to meet this bottleneck is given by the table below:

Bottleneck #13: Inadequate capacity of facilities at the border crossing		
Short description of measure(s)	**GAP analysis**	**Potential greening impact**
- ICT systems to support harmonisation of relevant issues throughout Europe.	- Need for harmonisation and appropriate implementation of relevant ICT systems. - Lack of centralised national/EU policy to implement suitable ICT systems	- More efficient transports, safer transports, less emissions.

4.4.4 Inland vessel certification, new quality systems (Strauss)

Quality systems like GMP, EBIS, ISO-systems, waste transport requirements, dangerous goods treatment etc. are considered a barrier or bottleneck for inland waterway transport (IWT). For further details see WP4. The nature of these rules and administrative requirements are very much commercial (internal control implemented by the market itself).

Many Member States have also taken measures to reduce the administrative burden of the IWT-industry. However, the possibility to reduce this burden is limited as far as the industry imposes restrictions on themselves by commercially driven internal control measures.

New policies are needed for development of quality systems taking into account the economical, operational and as well as the environmental efficiency of transport chains.

As elaborated in WP4 there are several European initiatives aiming at developing single window solutions for co-modal networks, IWT inclusive. The challenge is, however, that as single window solutions evolve on a national level, there is still a long way to go before single window solutions are implemented on a pan-European level. This is about harmonisation and European policies to support this development towards a common European goal.

Overall identification of mitigating measures in WP 3 and WP 4 to meet this bottleneck is given by the table below:

Bottleneck #12: Inland vessel certification, new quality systems		
Short description of measure(s)	**GAP analysis**	**Potential greening impact**
- ICT systems and regulations to support harmonisation of relevant issues throughout Europe.	- Need for harmonisation and appropriate implementation of relevant ICT systems. - Lack of centralised national/EU policy to implement suitable ICT systems	- More efficient transports, safer transports, less emissions.

4.4.5 Complex rules on carriage of dangerous goods by sea (Mare Nostrum)

Regulations on dangerous goods are less favourable for waterborne transport than for road and rail. This fact, combined with a certain degree of overlap between bodies and authorities of technical legislation and regulations, often excludes sea transport as an option for transport of hazardous goods.

The regulations for transport of hazardous goods should be harmonised between modes to the extent possible, so as to make transport of dangerous goods safer and more environmental friendly by means of a shift towards sustainable waterborne transports.

Overall identification of mitigating measures in WP 3 and WP 4 to meet this bottleneck is given by the table below:

Bottleneck #14: Complex rules on carriage of dangerous goods by sea		
Short description of measure(s)	**GAP analysis**	**Potential greening impact**
- E-Administrative Systems – single window solutions, JUP, Fretis, Port community systems, VCO, ENSI, Scheduling tools.	- Need for harmonisation and uniform European procedures for hazardous goods between modes.	- More efficient transports, safer transports, less emissions.

4.4.6 New quality requirements for maritime fuels (Nureyev)

IMO (International Maritime Organisation) is implementing new quality requirements for maritime fuels. For the Baltic Sea this will result in a reduction of the sulphur content of ship fuel to 0,1% by 2015 (currently the cap is 1,5%). This requirement will also be implemented in the North Sea and in the English Channel (Sulphur Emission Controlled Areas, SECA). This issue may be considered more a requirement rather than a bottleneck.

Although this is a political decision for reducing the environmental footprint of the maritime industry, voices argue that more time should be given to the maritime industry to prepare for this new regime. Otherwise a modal shift from sea to road may be the consequence on some transport routes due to unequal regulations on fuels in disfavour of waterborne transport.

A physical restriction that affects the new regime for marine bunker oil is limitations in available refinery capacity to meet the demand.

Possible measures to meet this development is more a question of harmonising regulations to obtain equal rules for competition rather than a question of ICT solutions and technology, and is therefore more of the nature of policy implications.

4.5 Other bottlenecks

Other:
- *Alps and the Pyrenees (Brenner, Finis Terrae)*
- *Winter weather/ ice conditions (Brenner, Edelweiss, Nureyev)*

The Alps are a major natural geographical barrier. Steep slopes negatively affect the average speed of transports. The Pyrenees form a natural border between France and Spain and are like the Alps a major geographical barrier. Low mountain passes are missing, and high elevation of mountain passes is typical in the Pyrenean scenery.

During the winter season especially the Northern part of the Baltic Sea may have severe ice conditions in periods, which make the operations very challenging with a need for ice breaker support. There are not enough adequate ice breakers in the Baltic countries or in Russia to handle an extreme situation, causing even greater problems. The waters around St Petersburg is similarly challenging during the winter, due to heavy traffic that can only operate in a single fairway. The ice conditions usually last for 2–3 months, but during harsh winters even longer. Harsh weather conditions during winter with snow, storms and blizzards may sometimes cause problem as well, with delays and traffic problems in all modes of transport.

The challenges caused by ice and rough weather conditions may to some extent be alleviated by dedicated use of ICT and technologies. However, the question of single fairways in ice covered waters is a matter of policy.

Overall identification of mitigating measures in WP 3 and WP 4 to meet this bottleneck is given by the table below:

Bottleneck #35: Winter weather/ ice conditions		
Short description of measure(s)	**GAP analysis**	**Potential greening impact**
- Centralised transportation management systems – VTMIS, VTS, AIS, ERTMS, Traffic flow optimisation, Optimar, Caesar. How to assign icebreakers to other vessels.	- Insufficient implementation of available planning systems for assigning icebreakers to vessels. (IBNet or similar)	- More efficient transports, safer transports, less emissions.

5 General grouping of common development needs

Based on the defined set of Key Performance Indicators for Green Corridors, the SuperGreen project has identified the most important areas for reducing emissions and for improving the ecological footprint of transports in the SuperGreen transport corridors used as case scenarios for this project.

As presented in figure 2, WP 2 developed the overall needs necessary to meet and mitigate the identified bottlenecks. These were outlined and categorised into the following main groups:

- Improvement of green supply chain design and management
- Harmonisation and development of ICT solutions and transport documents
- Harmonisation and development of policies and regulations
- Development and harmonisation of transport infrastructure
- Development and harmonisation of transport technology
- Availability of qualified personnel
- Transparency of information and increased co-operation in co-modal supply chains

These groups represent the starting point for the mapping of available ICT and technologies for being able to identify the gaps that hamper further mitigation of the bottlenecks. Bottlenecks that have an impact on the various groups of development needs are identified. This is considered a simple indicator for the relative importance of the individual bottlenecks.

The synthesis of this elaboration constitutes the basis for the R&D recommendations presented in Task 5.2 of the SuperGreen project. Note that the numbering of the different bottlenecks mentioned in the various sections below corresponds to the ones given in figure 3.

5.1 Improvement of green supply chain design and management

General
A vast majority of the identified bottlenecks are related to this category, which is then considered to be among those with the biggest potential for improvement (see Table 3). The following bottlenecks should were acknowledged: (1) Congestion, (3) modal shift from road to rail, (4) border crossings, (7) complex, administrative processes and shortage of maritime professionals, (11) complex administrative procedures, (14) complex rules on carriage of dangerous goods by sea, (15) different bills of loading, (16) capacity limitations on road and rail networks, (23) increased traffic volume in Hamburg and Thessaloniki ports, (24) road and rail hinterland connections of ports, (32) Need for satellite-based ICT applications (e.g. cargo tracking and tracing, e-maritime/e-freight/e-customs, distance learning), (33) Combining data reception and measures of intervention, need for platform for routing and T&T information, and (37) Security issues (piracy) (Silk Way).
Mitigating ICT and technologies identified
Concerning ICT there are a few available solutions that will have a positive impact on the bottlenecks. These are E-Administrative Systems- Single Window solutions, JUP, Fretis, VCO,

ENSI, the Swedish "The Virtual Customs Office" (VCO), the Finish ENSI system, and Port community systems, **IBNet** (IceBreakerNet). Emissions footprint calculator systems (depersonalised sensor data gateway etc.) Concerning technologies identified those with the highest potential for contributing to improvements are energy production and fuels (e.g. diesel-mechanic propulsion with high speed engines, hybrid, natural gas, and electric vehicles, renewables), cargo handling and transfer (e.g. container trans-lifters, and trainloader systems), and vehicle concepts (e.g. vessel modular designs, sea-river concepts, and hybrid technology). Some of them will have a direct impact on improving the supply chain management; others will limit the energy consumption and contribute to greener operations.
Gap Analysis
- Lack of in detail analysis of case by case in order to define specific needs and requirements for securing industry up-take of ICT systems. - ICT solutions applied in road and rail networks or in nodes (ports and freight villages) already exist (e.g. VTS, ERTMS and VMS). It is necessary to implement technologies in more segments or critical nodes in order to improve distribution of traffic flow and reduce congestions (especially due to capacity restrictions on rail and road networks) - Harmonisation of emission calculators
Potential Greening impact
- Reduced energy consumption and thus emissions. - ICT technologies mentioned may improve logistics planning and hence distributions of traffic flow. In environmental terms it will result in reduced emissions as a function of decreased congestion, and economically through better utilisation of transport resources, reduction in loss of time, and possibly reduction of accidents. The latter having both a social and economical dimension. - In terms of technology, mains-powered RTGs transfer the power generation from the engine of the yard crane to a far more efficient power station. The power station can be up to 40% more efficient than equipment engine. Upfront capital cost is higher and further investigations are needed to assess its greening potential on a larger scale.
SuperGreen input to R&D recommendations
- 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. - There is also a need for increased emphasis on implementation throughout the chain. - There is a continuous need for further development of vital technologies that improve benchmarks (energy production and fuels, cargo handling and transfer, vehicle concepts). E.g.: o In terms of cargo handling and transfer, efforts should be directed towards developing more 'low emission engines', and efficient diesel to electric power convertors (e.g. for RTGs). o Within railway, an increased focus on braking energy recovery and on-board energy storage systems are considered important for further work. o In terms of vehicle concepts, the use of hybrid technology can reduce exhaust emissions and energy consumption, while providing an adequate or equitable amount of power to operate.

5.2 Harmonisation and development of ICT solutions and transport documents

General
Different transport nodes use different ICT standards and protocols and that causes incompatibility and luck of information succession. Closely connected to this is the lack of integration of different ICT systems across transport systems, and transportation stakeholders often are not aware of the benefits from the ability to access and exploit information flows. In terms of bottlenecks the

following have an impact on this group (see Table 3): (1), congestion, (26) need to develop new ICT systems, (27) Introduction of VMS (Variable Message Signs, beforehand information on traffic situation and bottlenecks), (29) Implementation of ERTMS (European Railway Traffic Management System), (32) Need for satellite-based ICT applications (e.g. cargo tracking and tracing, e-maritime/e-freight/e-customs, distance learning), (33) Combining data reception and measures of intervention, need for platform for routing and T&T information.
Mitigating ICT and technologies identified
- E-administrative Systems – Single window solutions, JUP, Fretis, VCO, ENSI, Port community systems - Centralised transportation management systems, ICT: **IBNet** (IceBreakerNet) for accident prevention and optimisation of resource/ asset management.
Gap Analysis
- Available ICT systems do not fulfil overall requirements; need to cover co-modal requirements. - Still a huge lack in implementation of available ICT systems, albeit they do not fulfil overall requirements. - Further, in order to enhance interoperability and transport harmonization within Europe there is a need to continue the effort towards simplifying document handling, customs procedures, and contracts.
Potential Greening impact
- Reduction of waiting times, increased throughput and efficiency, less emissions - Less emission as a consequence of monitoring and measurements. Measurements to be carried out on individual vehicles.
SuperGreen input to R&D recommendations
- Available systems still need to be further developed to meet overall and co-modal requirements. In terms of navigation technologies, WP3 identified promising ICT technologies such as AIS, GNSS and WiMax, thus constituting the core of further work. - Further implementation of available planning systems for assigning icebreakers to vessels. (IBNet or similar). Implementation of new functionality in existing systems, if needed. - In terms of document handling, although the objective of "no paper at all" is attainable, more research must be focused towards harmonizing paperwork/e-paperwork and reducing the number of transport documents.

5.3 Harmonisation and development of policies and regulation

General
Harmonisation of policies and regulations is an issue for policy implications rather than for research and development within ICT and technology. Policy implications are the subject of WP 6 in the SuperGreen project. Regarding bottlenecks affected, the majority of the ones listed in the overview table apply for operations all along the supply chain. However, in particular bottleneck number (8) Regulations and policies for pollution management, and (9) Lack of harmonisation of national regulations (operational standards, certification of personnel, are relevant to highlight.
Mitigating ICT and technologies identified
n/a
Gap Analysis
This is a policy issue and more about the willingness and the ability of all involved actors and stakeholders to implement what is already there in terms of harmonised procedures and regulations.
Potential Greening impact
As policies and regulations carry the potential for improving transport efficiency on a variety of fronts, the greening impact is wide ranging and therefore difficult to quantify. However, it is evident that harmonised policies and regulations will lead to less energy consumption, less emissions, increase in fleet utilisation and efficiency, decrease in accidents, easier flow of cargo

through Europe, i.e. increased safety and security etc.
SuperGreen input to R&D recommendations
- Elaborate on actions and measures that could reduce obstacles and improve stakeholder's ability to adopt them. Promote benefits. - Existing policies and regulations on a Pan-European level should be analysed with the aim of harmonisation throughout Europe. Throughout Europe there are different national regulations being applied across many areas of transport. These differences constitute barriers to the seamless and flexible interoperability which intermodal transport depends upon. Research is therefore required for synchronizing such regulations across Europe.

5.4 Development and harmonisation of transport infrastructure

General
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 harmonise the overall efficiency. In terms of bottlenecks related to this area, SuperGreen analysis have identified; (4) border crossings, (16) capacity limitations of rail and road networks, (17) slot restriction on the rail network and different gauges, (18) road congestion, insufficient road infrastructure capacity, (24) road and hinterland connections of ports, and (25) railway terminals capability to handle long trains.
Mitigating ICT and technologies identified
- Identify infrastructure technologies for seamless flow of cargo throughout the logistics chain - Identify ICT solutions for the same - Infrastructure technologies need to be developed for efficient and seamless flow of cargo throughout the logistics chain and corridors. As an example, horizontal container handling systems (e.g. Metrocrago[5]) represent innovative system of freight transfer, also being a new way of conceiving and organizing the intermodal transport of goods. - Fluent interchange between modes in the network must be ensured, i.e. interoperability issues.
Gap Analysis
- Application and verification of interoperable technologies for railways is on-going - Fast hinterland connections for import and export traffic are necessary, remote gateways and their transport connections likewise - Interoperability issues must be strengthened and ensured. However, to make the interoperability between modes possible, investments are required in infrastructure, equipment and information systems in order to improve the transfer of loading units between the various modes of transport. - Harmonisation in transport chain is needed. Revisions for upgrading of infrastructure to meet future requirements are needed. - Cargo transfer technology with improved energy efficiency, while also supporting co-modality
Potential Greening impact
- Harmonised infrastructure technologies will improve efficiency and thus benchmarks and environmental footprint. It is necessary to have: standardized intermodal equipment, transfer nodes, consistent regulations, IT System, simplification of document handling, customs procedures, and systems of transfer.

- [5] Metrocargo: It consists of a network of scheduled cargo trains and a number of terminals, in which cargo units are horizontally transferred from one train to another and/or to trucks. This solution provides a reduction of transport costs and delivery times. The system can transfer significant volumes of traffic from the road to the rail and is compatible with new logistic concepts, such as the "Highways of the Sea" involving cargo ferries.

- Interoperability: The increase of traffic flows and transport worldwide increase the carbon footprint of transport. Thus, advancing intermodality is an important approach for more optimized utilisation of transport modes and reduced overall energy consumption.
- ICT technologies can contribute to improve utilisation of infrastructure, thus increase efficiency and reduce emissions. Will contribute to mitigate bottlenecks.

SuperGreen input to R&D recommendations

- Smaller ports should be developed to be the preferred ports for European Short Sea Shipping by means of tailored functionality and equipment, as they are often more efficient for this kind of services than bigger ports.
- Cargo handling technologies that will improve the efficiency in the physical cargo flow (cargo handling and interoperability).

5.5 Development and harmonisation of transport technology

General

Harmonisation of transport technologies and ICT is about improving the interoperability in the supply chains. The interconnections between modes and with terminals are therefore key issues to address for advancing the development. The focus is on ICT solutions which meet overall co-modal requirements and on cargo handling and transfer technology. Transport technologies should be developed to meet operability requirements for co-modal services throughout the supply chain. Harmonisation of transport technology is a must and thus a driver in the development of technologies. Of relevant bottlenecks connected to this development area are: (2) interoperability problems on railways, (24) road and rail hinterland connections of ports, (27) Introduction of VMS, (29) implementation of ERMTS, and (31) affordable technologies for fleet modernisation, particularly for IWT. In addition, there is the issue of improving modal shifts and cargo transfer.

Mitigating ICT and technologies identified

- There is a variety of existing ICT solutions that could contribute to solve the above mentioned bottlenecks. Some are mentioned in the text (ERMTS and VMS deployment, etc.)

Gap Analysis

- Moreover, among the conclusions concerning gaps is lack of harmonisation and interoperability with respect to ICT as well as technology. There are many incompatibility issues among the candidate list of ICT systems making integration a difficult scope, making it a key obstacle and challenge.
- Increase the use of remote gateways for alleviating port and terminal bottlenecks (ref EIA publication "innovative intermodal transport", fact sheet 20).
- Developing a standard loading unit is central to efficient intermodal transport, and the use of different standards reduces interoperability. Research is required into the design and implementation of a worldwide compatible loading unit.

Potential Greening impact

- On a general basis all bottlenecks will benefit from ICT integration and implementation (e.g. less energy consumption, less emissions, increase of fleet utilisation, reduction of waiting times, decrease of accidents, etc.).
- Goal oriented ICT solutions will contribute to the mitigation of most relevant bottlenecks, and thus have a positive impact on the greening potential.
- Transport technology which improves the co-modal interoperability in the supply chain similarly increases the efficiency and improves the greening benchmarks.

SuperGreen input to R&D recommendations

- Examine all measures and actions that could solve incompatibility issues, enhance ICT integration and ensure interoperability.
- Technologies, 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. Technologies that will improve the efficiency in the physical cargo flow (cargo handling and interoperability).

- Develop systems to compare energy use and emissions on a harmonised level for all transport modes.

5.6 Availability of qualified personnel

Although being an important topic, this issue has not been elaborated in SuperGreen. Possible alleviating measures in terms of ICT and technology to meet this challenge will not be further evaluated.

The following issues should, however, be considered to meet the situation:

- Implementation of uniform European procedures as e.g. a uniform European CV to classify the training and skills of personnel at a European level.
- In order to face the shortage of maritime 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.

5.7 Transparency of information and increased co-operation in co-modal supply chains

General
Albeit considerable efforts are taking place in developing e-Freight systems to support and promote co-modal and sustainable logistics throughout Europe, there is still an enormous need for further developing and implementing new ICT applications to meet the market demands. The fact that co-modality will grow is a major driver in the development of ICT systems. The functional requirements to ICT solutions are continuously increasing to meet the demands for online decision support. Interoperability throughout the logistics chain and deviation handling are key issues, and transparency in information to all stakeholders involved from consignor to consignee is a prerequisite for successful development and implementation. Specific bottlenecks related to this development area are (but not limited to): (1) congestion, (2) interoperability problems on railways, (3) modal shift from road to rail, (5) increase of maritime transport, thus bigger risk of accidents, (9) lack of harmonisation of national regulations, (23) Increased traffic volume in Hamburg and Thessaloniki, (29) Implementation of ERMTS, (32) Need for satellite based ICT applications, (33) combining data reception and measures for intervention.
Mitigating ICT and technologies identified
- E-Administrative Systems – single window solutions, JUP, Fretis, VCO, ENSI, the Swedish "The Virtual Customs Office" (VCO), the Finish ENSI system, Port community systems - Centralised transportation management system, ICT – VTMIS, VTS, AIS, ERTMS, Traffic flow optimisation, Optimar, Caesar, **IBNet** (IceBreakerNet) - Broadcasting, monitoring and communication systems – AGHEERA, Smartbox, ITS - Any existing green technologies that can contribute to reaching corridor benchmarks, what technologies can contribute to cooperation and co-modality (existing cargo handling technologies, heating and cooling, innovative units,)? -
Gap Analysis
- Harmonise the transportation chain, solve co-modal compatibility issues along the supply chain. Examine regulatory measures for implementing dedicated ICTs. - Lack of common national/EU policies to implement suitable ICT systems. - Lack of in detail analysis of corridor specific needs and requirements
- **Potential Greening impact**

-	These systems implement and add information and communication technology to transport means and infrastructure and to the interconnections between them to promote interoperability. Typical information is e.g. loads, routes, transportation times, and fuel consumption. Opens the possibility for improved asset management, scheduling, tracking and tracing, i.e. better information to re-optimise production/ supply plans in real time. Thus reduced emissions.
-	Improved planning processes and follow up of transports in sensitive areas, e.g. in the Aegean Sea and in the Baltic Sea. Collision avoidance, on-line control of ship traffic, aids to navigation, follow up of potential accidents
-	**SuperGreen input to R&D recommendations**
-	Existing ICT systems need to be further developed to meet overall co-modal interoperability requirements and for implementing new functionality.
-	Measures for implementing new ICT systems must be taken
-	Further policy actions on harmonisation issues required (WP 6)
-	Technologies that will improve the efficiency in the physical cargo flow (cargo handling and interoperability).

6 Areas for further investigation and input to T5.2

Based on the work with identification of unsolved bottlenecks concerning further greening of transport corridors in work packages 3 and 4, respectively, a set of overall and aggregated areas has been identified as key input to Task 5.2 – Define and submit R&D recommendations, 1st version.

The work with Task 5.1 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. However, in many cases it's rather a matter of policies and harmonisation of regulations, and political reluctance to implement what is already available in terms of ICT systems and technologies, than a question of need for new developments.

The identification of unsolved bottlenecks has been categorised according to some overall needs for mitigating measures. Gaps as basis for R&D recommendations in Task 5.2 are identified according to these needs for mitigating measures based on what is available of technologies and ICT. In case gaps are considered as policy issues, this will be taken care of in WP 6.

In this first year activity of Task 5.1 (M13 – M24) bottlenecks have been identified on an overall an aggregated level. Still a lot of work remains to be accomplished to further break down the high level definitions of unsolved bottlenecks into more concrete, precise and goal-oriented definitions. This will be the main issue of the work in Task 5.1 for the last period of its activities (M25 - M36).

The main outputs from Task 5.1 are summarised in Table 8 below:

Table 8: 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. 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. In some areas there is a reluctance to implement available technologies and solutions that would improve the efficiency of e.g. border crossings. Further efforts should be accomplished for piloting of available technologies and solutions in regions to improve efficiency.

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. Smaller ports should be developed to be the preferred ports for European Short Sea Shipping by means of tailored functionality and equipment, as they are often more efficient for this kind of services than bigger ports.

8. Develop and implement through piloting decision support systems to benchmark and compare energy use and emissions on a uniform level for all transport modes, also in co-modal solutions.

9. 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.

10. Within the rail industry measures are also needed for raising load factors, optimizing train length and weight for best use of available paths.