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Innovative Logistics Practices for Sustainable Transportation: Drivers and Barriers

Master's Thesis in the Master Degree Programme

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CHALMERS UNIVERSITY OF TECHNOLOGY
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ABSTRACT

This Master's thesis has been conducted in collaboration within the section of Logistics and Transportation at Chalmers University of Technology in regards to Innovative Logistics Practices (ILP) and the features of the main projects on going across the European territory that respond to this term.

Through exhaustive literature review, the specific characteristics of this type of supply chain practices have been classified and analysed in order to get a better understanding of the driver mechanisms surrounding them and what is to be done in the future to overcome existing barriers that tend to delay the implementation of these ventures.

Four types of ILP have been drawn and analysed: e-Freight, co-modality, UFT and intralogistics. These types are contextualized in the different project ventures that deal with their type of ILP in order to identify specific drivers and barriers. A great amount of coincidences had been observed as common drivers and barriers that have been classified and discussed separately in order to better highlight the relevant aspects of each of them. Economic, social and environmental aspects can be drawn as the main responsible topics with a clear interaction with technology and stakeholders positions in the surveyed project. At Findings, the different drivers and barriers are analysed in a theoretical context with specific observations and recommendations for each type of related ILP.

Last, a case study has been carried out in order to better asses which parameters affect the environmental advantages of co-modality, which are often regarded as the most environmental advantage. It true that economies of scale and the use of electricity entails a lower socio-environmental cost for transportation, different aspects of the transport scenarios are further discussed in order to debate critical points and the feasibility of co-modality in the future as socio-environmental competitive solution.

Key words: Barriers, Drivers, Innovative Logistics Practices, Life Cycle Assessment, Logistics, Transportation, Sustainability.

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Notations

BSRP	Baltic Sea Region Programme
CAFE	Clean Air for Europe programme
CARE	Community database on road accidents
CH_4	Methane
CHP	Combined Heat and Power
CO_2	Carbon dioxide
EC	European Commission
EEA	European Environmental Agency
EEA	Other European Economic Area members: Iceland, Liechtenstein, Norway
EFTA	Other European Free Trade Association: Switzerland
EIRAC	European Intermodal Research Advisory Council
ERDF	European Regional Development Funds
EU	European Economic Area + EEA + EFTA
EU27	European Economic Area
GDP	Gross Domestic Product
GHG	Greenhouse gases
GNI	Gross National Income
h	hour
ICT	Information and Communications Technology
IEA	International Energy Agency
ILP	Innovative Logistics practices
IPCC	Intergovernmental Panel for Climate Change
ISO	International Organisation for Standardisation
LCA	Life Cycle Assessment
LP	Logistics Practices
Mtoe	Million tonnes of oil equivalent

NMVOC	Non-Methane Volatile Organic Compounds
NOx	Nitrogen oxides, mainly NO_2
NTM	Network for Transport and Environment
PM_{10}	Particulate Matter
SOx	Sulphur oxides, mainly SO_2
t	Tonne
UFT	Urban Freight Transport
UNDA	United Nations Development Account
VAT	Value Added Tax
VOC	Volatile Organic Compounds
W	Watt
WHO	World Health Organisation

1 Introduction

This section aims to introduce the reader to the general aspects of Innovative Logistics Practices, ILP, and main topic of the present thesis; and clarify the reasons that support the development of this project.

1.1 Background

Today's society makes an intensive use of products and services. This event puts a remarkable share of responsibility for supply chain management to cover the increasing demands of mobility. At the same time, this society is shaping itself into a global and multidimensional environment that requires from up to date practices to keep up with changing specifications while maintaining cost competitive advantages.

Furthermore, environmental concerns arisen by the scientific community have settled in the public opinion. This public opinion has the power to modify the politic and economic frames at which supply chains take place adding dimensions to the patterns of competitive advantages.

Inside of this complex reality, supply chain management is responsible of influencing products and services in regards to their relation to customers via the channels by which they are targeted or the expectations that they set in the logistics steps. These phenomena occurs in logistic practices where the success of a project will often depend on several external factors such as the market frame situation or the location specific circumstances, independently of the nature of the project.

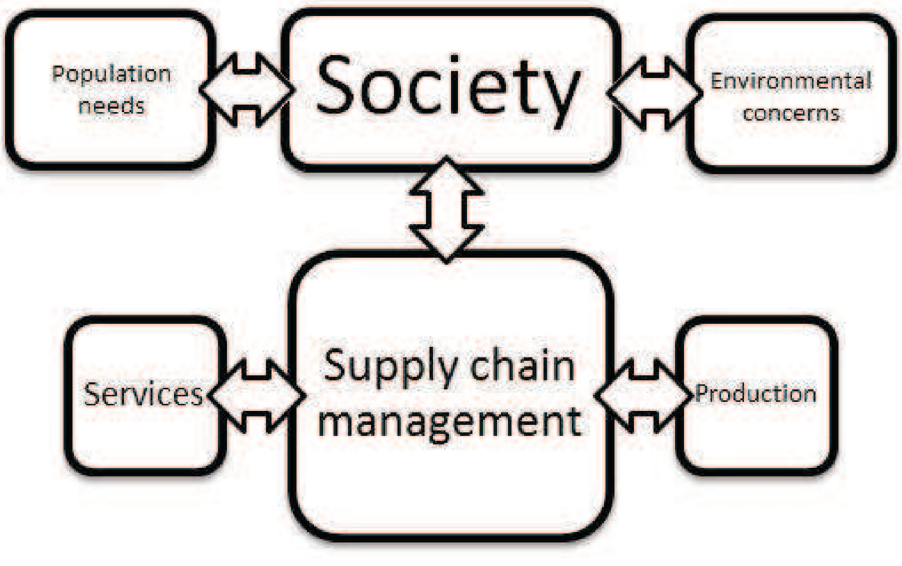

Figure 1 - Multidimensional perspective of societal satisfaction.

As can be seen in Figure 1, supply chain practices are in charge of delivering products and services to society but can be altered by all stakeholders involved. This flexibility is what entails supply chain management as a powerful tool by which one is able to reach relevant pressure members of the chain.

In this sense, the present project aims to identify suitable practices, and analyse the framework necessary for them to develop successfully, in order to keep customer satisfaction without compromising the environment in the line of European recent policy measures and efforts (EEA, 2012)

1.1.1 Sustainability concerns

Human activity is causing a multidimensional footprint in the environment that deteriorates the quality of living species on the planet and has serious future risks for the economies, as of the health and safety of their citizens (IPCC, 1990). A need for change in current development practices has been targeted as the only available option for the environment to cope with this activity (IPCC, 1996).

Sustainability is defined by four principles that establish that the environment should not be sistematically subjected to deterioration by society (in the shape of extractions, emissions and degradation of biosphere) and that society should not undermine people's capacity of meeting their basic needs (Dresner, 2008).

From this estrict definition, it is easy to understand that today's society is not cappable to reach the fullfillment of any of these principles without compromising the rest, but that it has an undeniable internal ability to improve each and every of them by an improved management of available resources given the current technological means.

Figure 2 illustrates the desirable multidimensional nature of any activity carried out in society in which the combination of the principles is met: Equitable, bearable and feasible, thus, sustainable.

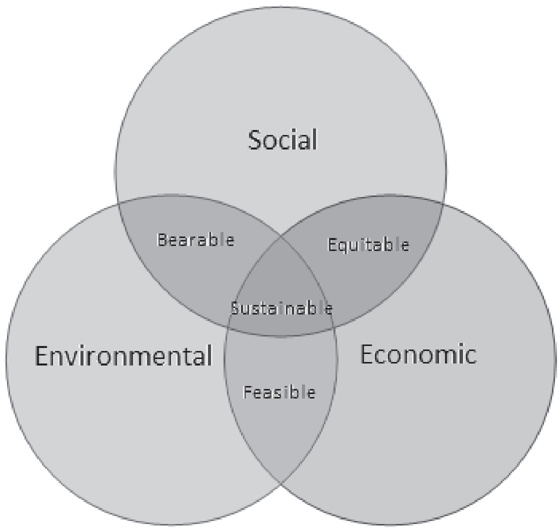

Figure 2 – Schematic interpretation of sustainability principles applied to activities.

Some factors responsible of the increased awareness on environmental concerns are the violation of these principles across the world in the shape of population growth and consequent life quality decrease in some societies or environmental deterioration based on economic interests which have pushed the claims arisen by the scientific community for decades to a common knowledge.

It is known that society devours energy in many different ways: growing and consuming food, creating products for the commodity of the population, generating power to supply these commodities and of course, transporting them. As a whole, it needs to cover the "basic needs" of many more people given the same amount of limited resources as we count today. Not entering the discussion on what are "basic needs", as this will entail a socio-economic thesis by itself, it is undeniable the fact that society as an entity needs to increase its efficiency when using common resources. Furthermore, this challenge increases its size over time with the previously mentioned growing population but also with consumers demand trends for products and services.

Following, Figure 3 illustrates on the distribution of energy consumption in the EU. Here, it can be highlighted the relevance of energy usage in regards to transportation, entailing this sector as one of the most relevant ones when targeting sustainability.

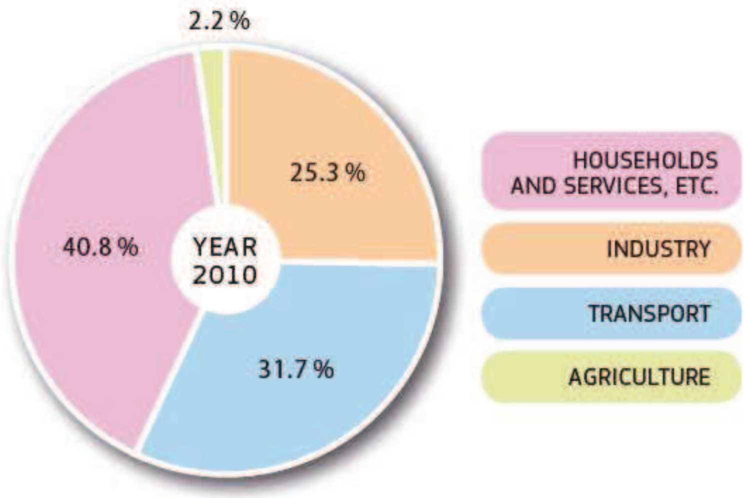

Figure 3 – Final Energy Consumption EU27 by sector from a total of 1153.3Mtoe (European Commission, 2012).

Among all of the man-made sources of environmental damage, emissions of greenhouse gases, GHG, have been targeted by the scientific community as the main threat against life on the planet (IPCC, 1990). This statement is based on long term perspectives and secondary effects that will influence not only the natural media but also socio-economic reality. The transportation sector alone, accounts for more than 13% of the global GHG emissions by sector (IPCC, 1996).

When looking at the shares in modes of transportation of these emissions in Europe, a clear dominant source can be targeted: road transport. Figure 4 shows this trend. It must be highlighted that railway emissions in this figure do not take into account the emissions related to energy production. In Findings the implications of this assumption are further discussed.

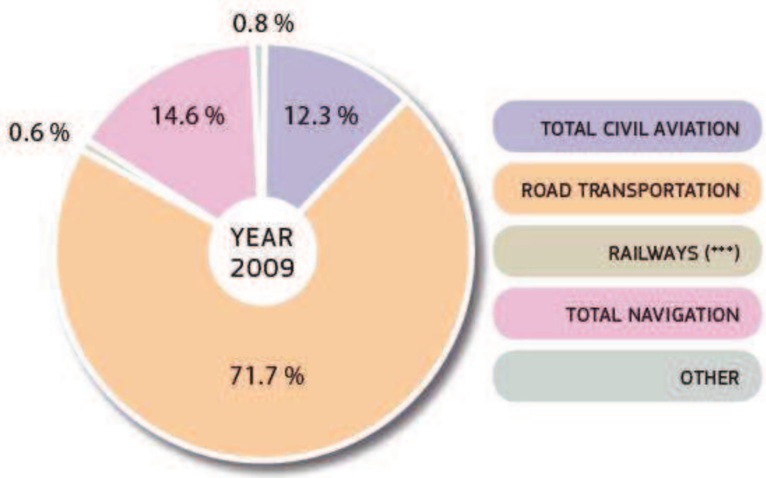

Figure 4 – GHG emissions from transport sector in the EU27 by mode (European Commission, 2012).

1.1.2 Business as usual

As part of supply chain management, logistics practices, LP, are found as the compilation of several activities described in Figure 5; and as society and its circumstances evolve, so need to do LP.

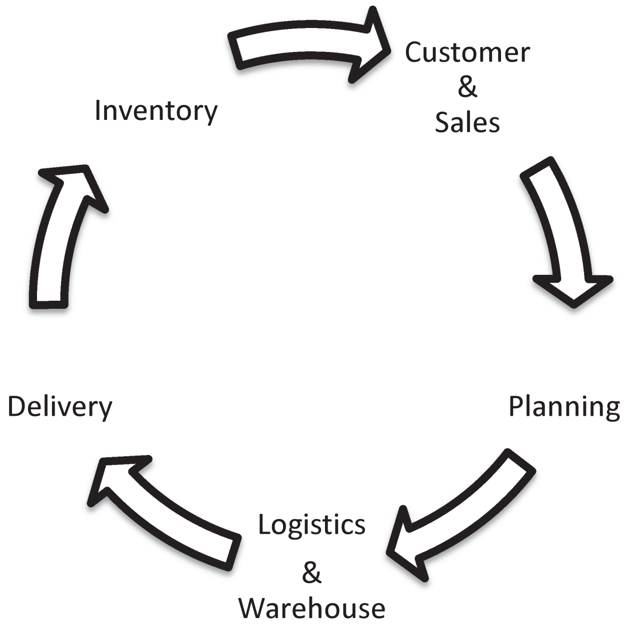

Figure 5 – Basics of Logistics Practices.

Some experts explain "evolution in LP" as a anticipation to the dissatisfaction of the customer, which make necessary the search for new approaches to the situation often based on model expectations rather than empirical, yet not available, results. These changes are described as purposeful and goal-oriented (Gammelgaard, 2010), which sometimes represent window options for "less suitable" or unsustainable solutions. The here-called "less suitable" unsustainable practices are often just old LP business models that are systematically applied in relevant stakeholders' facilities until socio-economic factors become an unsolvable incompatibility to "business as usual".

This definition of "business as usual" way of practicing could be summed as energy intensive, inflexible mono-modality, often structured in a straight push flow that generates itself large amounts of production waste. As previously mentioned in 1.1.1, these practices shall be considered obsolete given the current technological improvements available and unacceptable from the sustainability perspective.

Figure 6 hereby illustrates this "business as usual" trend as the development of transportation expressed in CO_2 equivalent emissions (as it is further explained and analysed in Methodology, this is a common unit when dealing with the energy and environmental aspects of transportation). Hereby, it can be seen the historical growth of sectors like aviation and the general growth of the total transportation activity.

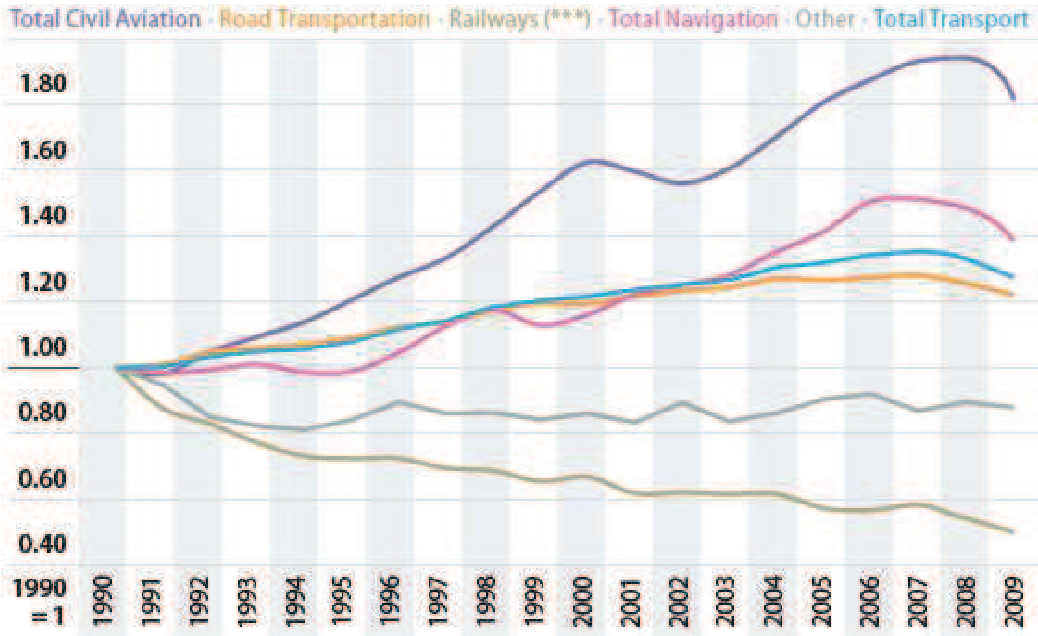

Figure 6 – Development of transportation measured as million tonnes CO_2 equivalent (European Commission, 2012).

In opposition to this "business as usual" definition, innovative practices are found. It is interesting to remark that "innovation is not necessarily something new to the world but new to the user" (Flint, 2005). Although research on logistics innovation is still in its infancy (Wagner, 2008), efforts are being put on defining and identifying innovation in the logistics sector by professionals worldwide.

Innovative Logistics Practices, ILP, could be considered a key piece of this necessary and on-going supply chain modernisation. Figure 7 shows the enhanced logistic value chain that entails ILP at which flexibility, optimisation and multimodality are some of the main desirable features.

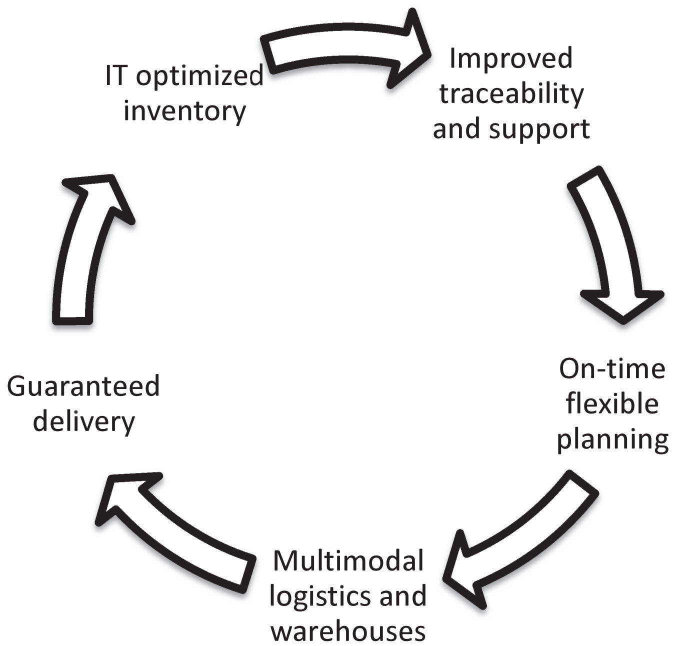

Figure 7 - Basics of Innovative Logistics Practices.

In general terms, ILP practices consist in increasing the efficiency of the logistic procedures based on:

- Increased use of sustainable[1] energy sources
- Load factor increase[2]: packaging, loading, booking…
- Improved management, routing and positioning of resources
- Increased flexibility, multimodality and holistic approach to transportation

1.1.3 Safety

Given the importance of economic and social aspects for supply chain management, it is worth to mention a key issue of "business as usual" past practices that has been targeted as one of the most relevant sectors in need of immediate action in Europe (Eurostat, 2008). This is the safety across transport infrastrustures with special importance of road transport, both commercial and personal.

Although vehicle safety development has shown to decrease the number of fatalities in the past decades, the health and safety of the citizens is still reason of concern for authorities as the trends on road accidents do not reach the intended targets, as it can be seen in Figure 8. Road accidents caused the death of more than 40.000 people per year (data from 1991 to 2007), and entails the first cause of dead of young aged people in Europe (Eurostat, 2008).

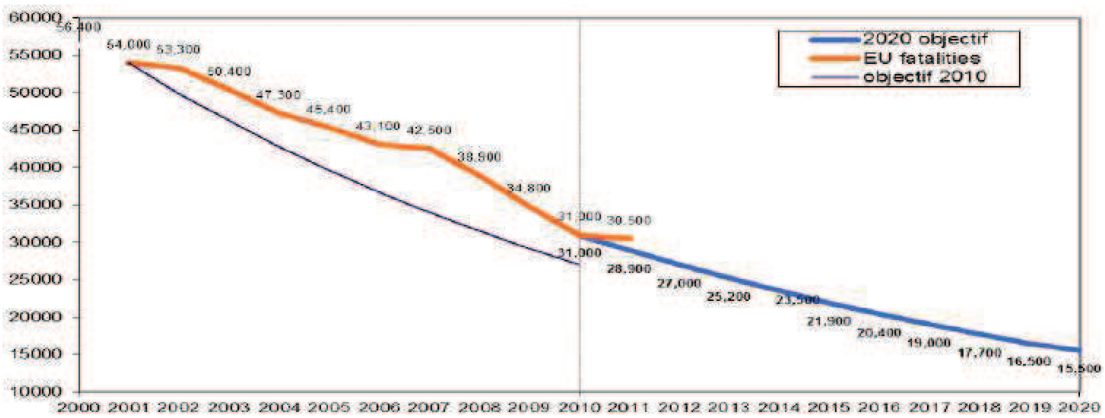

Figure 8 – EU statistics on road fatalities and targets for 2010 -2020 (CARE, 2012).

The saturation of European roads represents a risk for transport sector itself and in this sense, LP have a great influence in the topic given the large differences in the share of volume transportation by modes (Figure 6 above).

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[1] Some sectors of ILP focus on alternative energies enhancing while others the environmental advantage is achieved through transport load efficiency increase and therefore energy use reduction.

[2] Load factor increase can be regarded as a type of transport efficiency increase.

1.2 Purpose

The previously explained factors are just some of the main reasons that reinforce the necessity for improved supply chain solutions. The sector has been setting up ambitious projects to evaluate, inform and implement modernisation through transportation actors and companies within EU (European Commission, 2005) with relevant interest and collaboration from authorities. ILP have been identified as desirable practices and gathered the attention of these authorities (European Commission, 2008).

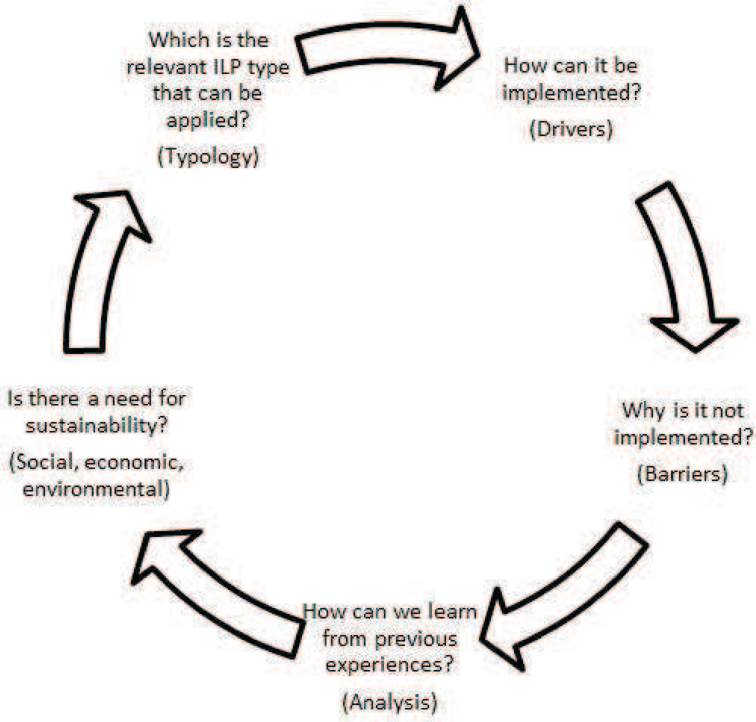

Figure 9 – Relevant purpose questions and their relations that shape this project.

This project aims to shed light about ILP and their interaction with the relevant stakeholders in order to better understand the drivers and barriers that concern them, improve sustainability awareness and learn from previous business models and experiences as shown in Figure 9 above.

Moreover, through the analysis of sustainability and environmental concerns regarding ILP, the relevant aspects in assessing sustainability is further highlighted and discussed with the purpose of clarifying the existing relationship between sustainability and supply chain management.

The following research lines can be drawn, also see Figure 10:

- Research line 1: Which are the relevant ILP practices to the most common logistic issues?
- Research line 2: Which are the relevant stakeholders and the actions taken to push ILP previous experiences forward?
- Research line 3: What were the main barriers to the implementation of these ILP? How can these barriers get overcome in the future?
- Research line 4: How does sustainability relate to ILP?

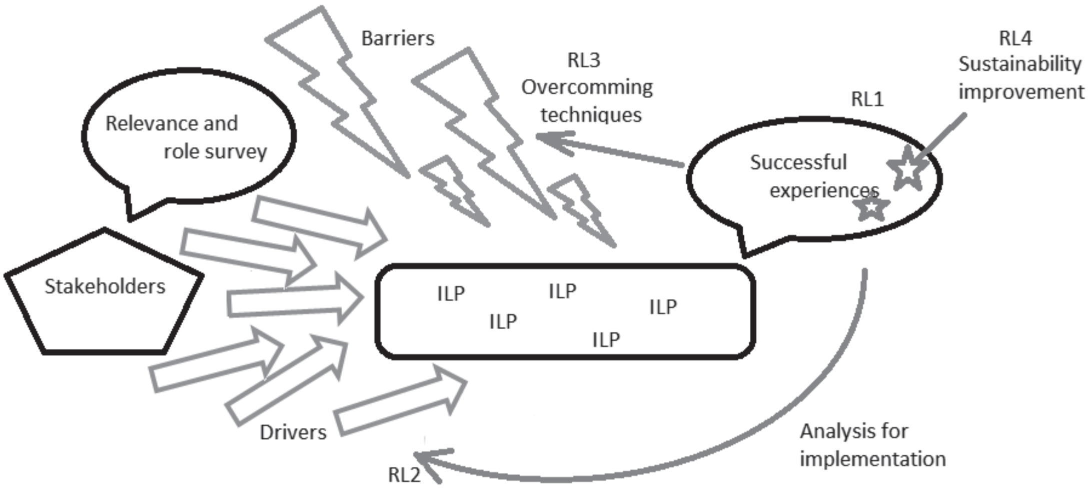

Figure 10 – Research lines graphical schema.

1.3 Scope

This thesis explores within selected types of ILP relevant for the LP modernisation and improvement of sustainability that can be found under Appendix A. These projects take place across the European territories, both with national or international relevance. This is representative for the background and drivers analysis specially, given the frame of European policies and data that has been used in the project.

In regards of overcoming of barriers, scope is limited to EU territories but it could be translated to overseas contexts if the policy-driver implantation is of similar circumstances. This exportation is out of the scope in this thesis. As of sustainability scope, Life Cycle Assessment is the base tool for the analysis of the projects and their comparison. Among the many environmental tools available nowadays, LCA is consider to be a straight forward method to be implemented that counts with increasing popularity and a large number of professionals that support the use of it (EEA, 1997).

1.4 Outline

In the present report, Chapter One contains the introductory background and the purpose of this thesis. Chapter Two induces the reader further in the definitions of LP and ILP. In Chapter three, methodology is explain continuing with Chapter Four, where the finding of this project are explained thoroughly divided in drivers, barriers and sustainability study with definitions and examples relevant. Chapter Five aims to analyse further the barriers encountered and shed some light on how to approach them in further practices. Finally, Chapter Six contains the final highlights of the discussion and conclusions.

2 Frame of reference

In this chapter, the main concepts used in the development of the project are defined as well as their relevance in current logistic trends.

Innovation is a widely used term when it comes to novelty events. The changing needs of society seem to carve for these so-called innovative products and services as if the only fact of being "new" was a value added to the purchase of a certain item. In this sense, the efforts of many researchers have been set on to defining innovation in multidisciplinary contexts trying to understand what is innovation and how does it interact with current society.

The first definitions of innovation date back to the 18th century with Schumpeter analysing the precursors of change and the actors involved. It is said that innovation is an effort that individuals make in order to produce an economical gain (Sundbo, 1998). Common types of innovations are new materials, services, products and processes. At the same time, these innovations need of the appropriate media at which grow from ideas into the desired products.

Experts agree that the increased dynamism of markets arise this interest for innovation (Baregheh, Rowley, & Sambrook, 2008). In this environment, companies are forced to innovate in order to follow quick emerging trends and lifestyles. In order to capitalize the opportunities that these trends suppose, current structures and dynamics are questioned. Of how this innovation is managed will itself entail a new influence to the reality of the company, as Figure 11 represents.

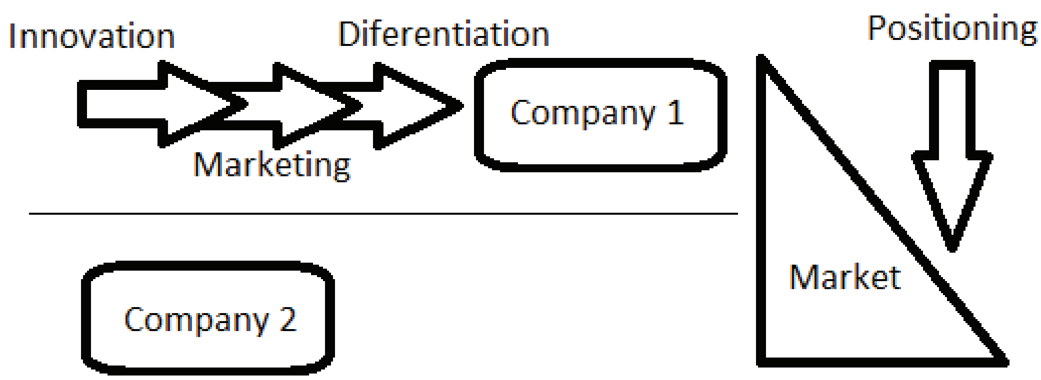

Figure 11 – Graphical description of competitive advantages of innovation and innovation related mechanisms.

Following, Figure 12 illustrates the multidisciplinary definition of innovation that many experts agree on. Hereby, it is recognized that different dimensions need to co-exist in order for a change to entail an innovation. At the same time, innovation is presented in many forms that involve the entire society.

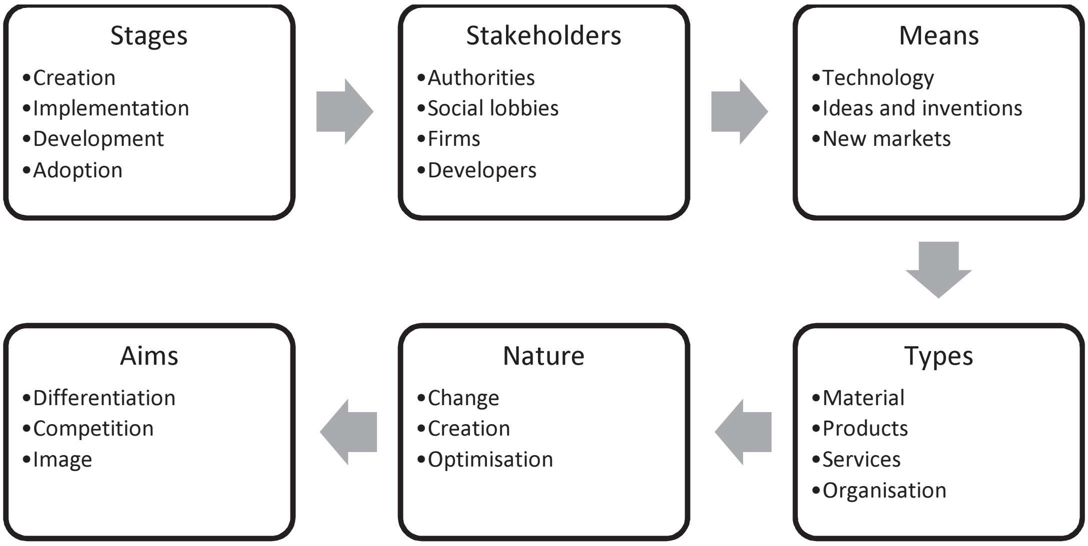

Figure 12 – Graphic definition of innovation (Baregheh, Rowley, & Sambrook, 2008).

It is highlighted here that innovation deals with new types of organisation that will change existing practices into a broad new scenario. This organisational innovation applied to the logistics practices within supply chain management is what we can define as ILP: the change applied to the context of market networks that surrounds production activities taking place along the whole value chain.

2.1 Best Practices

ILP are currently gathering the EU attention as researchers and practitioners develop new business models across international companies with their correspondent impact, and often, large competitive advantage increases. These stories of success are often shown by the media and awarded by public opinion, which establishes such innovative companies as good examples to the rest. This re-bound effect is therefore a good business strategy nowadays. Such experiences are labelled as "best practice" by the experts. This term is still currently being developed, and could be summarized as a name to describe the most convenient ways of doing things to contrast "inferior" practices.

A "best practice" within ILP could be defined as a practice that is feasible, proven and known by its success, independently evaluated or that has entitled a strong high-level outcome testimony (Paul, 2009). Through the analyses of these successful experiences, and the previous testimony of experts, it can be highlighted that supply chain represents significant opportunities for potential improvements (Gammelgaard, 2010), making of special interest to explore further the circumstances that contribute to the adoption of these practices.

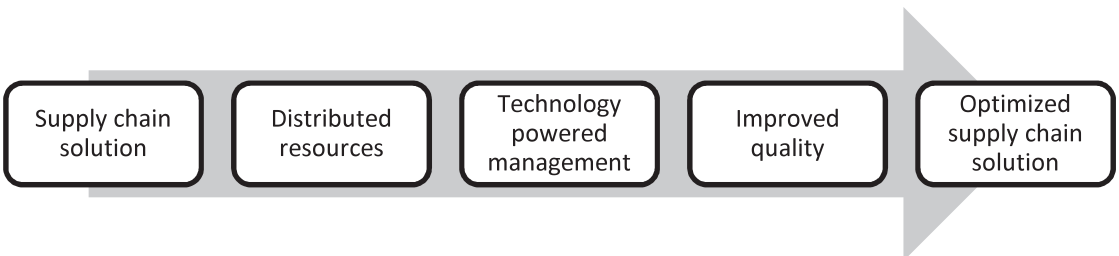

Figure 13 – Best practice sequential chain.

Nevertheless, whether or not something is a best practice will depend on the context in which it is applied. In Figure 13, the value chain for ILP "best practising" is schematized. The projects on which this research is based have been selected by their proven "best practice" implementation following this chain. All selected projects involve innovation (Flint, 2005), efficiency improvement and productivity increase for freight transport despite the large differences in the nature of each of them.

Some of the most relevant areas have been identified and classified as follows:

- E-Freight: the challenges arisen by societal development have created a new scenario for international freight transport. The determinant characteristic of eFreight is the maximisation of the benefits from information technologies.
- Co-modality: this array of modality is described in contrast to a seamless use of several different modes in one chain. Co-modality is a step further to achieve the efficiency and integration by smoothing the transit from one mode to another towards the optimal and most sustainable utilisation of resources.
- Urban Freight Transportation, UFT: these activities are concerned with delivering and collecting goods in urban centres. Urban freight deals mainly with the end of supply chain, being mostly configured by small loads in frequent trips and resulting in large quantities of vehicle kilometres.
- Intralogistics: describes the organisation, realisation and optimisation of internal material flows and logistic technologies along the complete value-added chain. These practices cover internal flows between hubs such as distribution centres, airports, seaports, etc.; as well as their related information flows.

Figure 14 summarizes the relevant key concepts that entail this classification.

eFreight	Comodality
• IT based • Information enhacement • Standarised	• Multimodality • Compatibility • Flexibility
UFT	**Intralogistics**
• Local solution • Air quality • Optimisation	• Communication • Organisation • Optimisation

Figure 14 – Key concepts of ILP practices.

This classification is maintained through Appendix A and during the analyses of the ILP concerns for an improved experiences when targeting common drivers and establishing specific strategies to overcome barriers.

2.2 Actors

Involved with ILP, several groups of relevant stakeholders can be found. In order to better analyse the influence of each, they have been classified (as previously done with "best practices") regardless of their internal function but of their position around ILP adoption. The classification is the following:

- Authorities: Interested group composed of EU policy makers such as the European Commission; each national, regional and local representatives of the respective EU involved countries and environmental authorities such as the IPCC.
- Social lobbies: This group could be regarded as the "market" side, including customers (forwarders and receivers) but also the public opinion, environmental associations without EU authority, residents, retailers and in general small-medium social based groups interested in the adoption of a certain ILP.
- Firms: Inside of this term all logistics practitioners are enclosed. From different types of operators to the companies owning transport lines or facilities, these stakeholders are the technical and physical part of the adoption of the ILP as well as the interested party in economic regards.
- Developers: Finally, developers group is composed by the technical solutions creators that do not belong to specific firms. IT developers, technical consultants or business specialized in implementation or modernisations are some of the examples of this group's representatives.

3 Methodology

This section presents the methods followed and tools used in order to develop the present project and reflect on relevant data collection aspects in order to better illustrate the reader about specific method related aspects of the research.

3.1 Research process

The research process has its core reason in the need to get an overview of the circumstances of ILP in the EU. A list containing previously identified LP candidates to ILP was provided by the division of Logistics and Transportation. Based on this list, the identification of the main types of relevant ILP was made and set as previously explained in section Best Practices. After exhaustive literature review and problem description, terms such as “business as usual” and “best practices” were elaborated. Based on this terminology the establishment of the final list was made, as in Appendix A.

During the elaboration of the Appendix A, main characteristics of the projects were highlighted in order to better express the information and enable its management.

Thanks to the classification, common drivers and barriers have been identified and divided into sections in order to analyse them separately with the relevant background study of each and every of these circumstances.

Following, the LCA methodology was applied to some relevant cases of co-modality best practices to get a better understanding of implications of sustainability in best practices. Co-modality projects have been selecting because of their international relevance, the long distances and volumes that they deal with and the different nature of the modes they involve.

This present report’s process has been summarized in Figure 15 as follows:

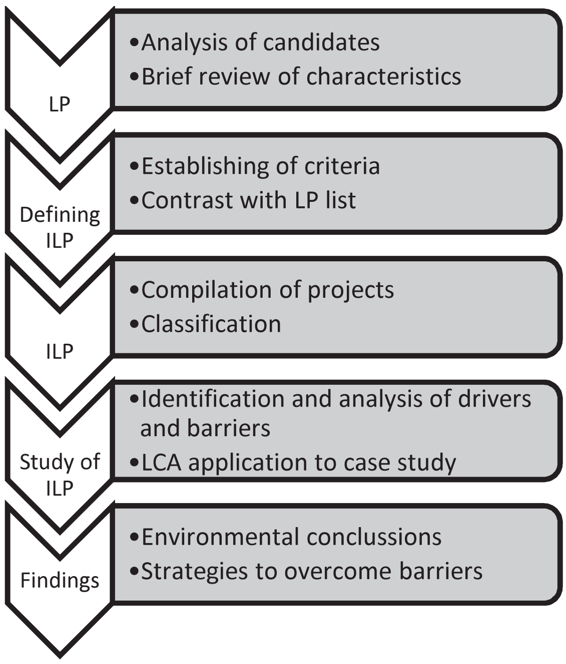

Figure 15 – Research steps and main activities involved.

3.2 Life cycle assessment

LCA entails a powerful tool that counts with the support of the EEA (EEA, 1997). It made its first steps back in the late 60s after publications such as Silent Spring (Carson, 1962) started the environmental awareness current that is familiar to society today. During this cradle period, the Society of Environmental Toxicology and Chemistry (SETAC) were established, first in the USA and later in EU. The SETAC created the first standards and procedures related to LCA. Thanks to the consecutive efforts of many involved environmental organisations, both governmental and scientific, LCA finally became a renowned method and was certified on credibility with ISO standards (ISO14048:2002, ISO 14040:2006, ISO14044:2006).

LCA, consist in the evaluation of a product system through all stages of its life cycle. It embraces all of the activities that are involved when making, transporting, using and disposing of each product (EEA, 1997). This tool can be used to evaluate the impact of a certain activity along its supply chain or to investigate in future improvements. In this sense, LCA has gathered special attention lately from the different industrial sectors that found in LCA a great procedure to evaluate their operations, reaching even the status of competitive advantage when dealing with certain LCA related symbols such as eco-labelling (Rubik & Scheer, 2008). As it can be seen in Figure 16, life cycle thinking includes many different disciplinary activities and therefore has relevance in the whole value chain. This fact is shared with LP, also present and relevant during the whole value chain and that in Figure 16 is symbolized as arrows that represent the necessary transportation activity.

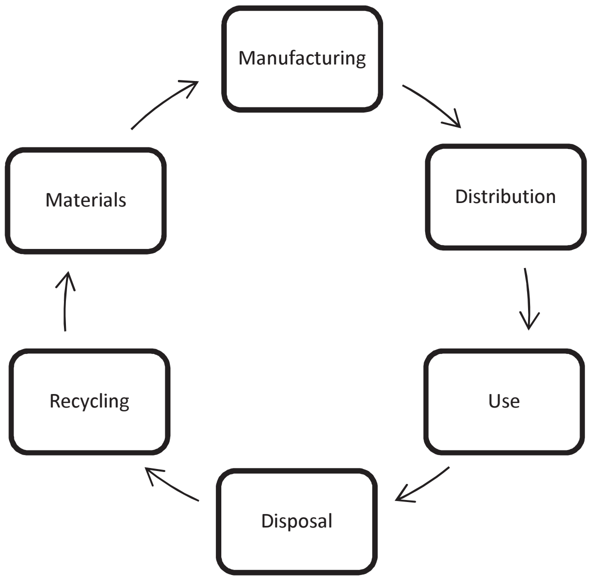

Figure 16 – Life cycle thinking graphical description.

The transport activities involved are the ones in the scope of this study. Of great importance given their presence up- and down-stream, transport practices are often neglected in the LCA studies and merely represented as a distance to be covered by the different raw materials, products or waste by a vehicle with the correspondent emissions factors (Baumann & Tillman, 2004). This treatment simplifies largely then study of a life cycle when it is required to focus on certain other aspects or when dealing with certain products at which the main energy-emissions take place in a certain step of the productive chain or the disposal.

Nevertheless, when evaluating environmental improvements of LP, the key inputs are these transport necessities and the modes used to supply this service. This makes necessary to look separately at fuels, vehicles and their efficiency and make certain number of assumptions of occupancy.

Some solutions given by the industry, of LCA in regards to transportation, are the popular footprint calculators. Supply chain parties have increased the offer of these environmental evaluating services and even the cushioning of the impact created as market strategies towards sustainable seeking customer satisfaction. But the assumptions on which these methods are based are not clear to the user as well as the risky assumption (marketing based) that the impact of a transport can be mitigated by replenishment of forest. The different effects of pollutants in different contexts are the key of LCA and therefore these generic products are not adequate for the scope of ILP.

3.2.1 Applying LCA to the transportation context

This section aims to clarify LCA partitioning to the reader and highlight the relation between LCA and ILP and the NTM methodology that was created in this regards.

Life cycle assessment procedure is divided into three main parts that relate with each other with a constant need for data interpretation: goal & scope definition, life cycle inventory and interpretation as shown in Figure 17.

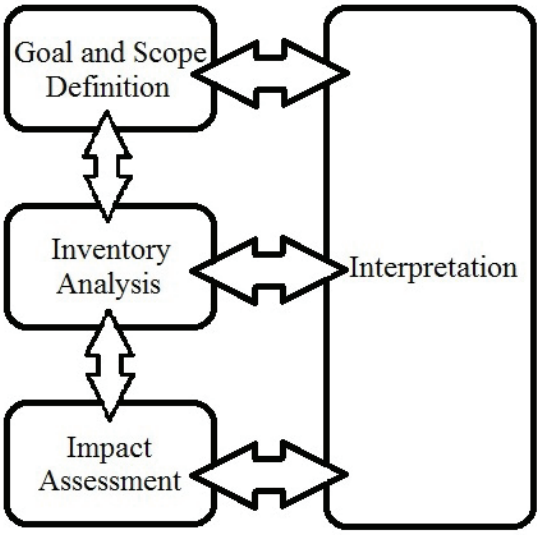

Figure 17 – Life cycle assessment basic steps.

Due to this interpretation necessary during the process, different LCA studies conducted on the same product may differ largely. Results can be “digested” in several ways without entailing violation of the ISO standards on the procedure. Thus, it is worth to mention hereby the potential, both positive and negative, of LCA interpretation and the necessity of following the established methods as well as keeping a high level of transparency in pro of the achievement of high quality results.

It is expected that the interpretation carried out by the developers of environmental calculators will lead into different results for the same transport practice or that the environmental advantage that the implementation of an ILP might differ as well. These differences expected are further discussed and evaluated in order to remark the important steps on interpretation as well as relevant recommendations.

3.2.1.1 Goal & Scope

During the first phase, goal and scope of the study are defined. Often, the goals of LCA procedures include the comparison of environmental effects assignable to products and services for product development purposes. Attributional LCAs describe the burdens associated to the existing product while Consequential LCAs are focused on the implications of a certain change in the system.

In this sense, it is more of interest from the point of view of ILP to look at Consequential LCAs. The goal in this case is assessing the most environmentally suitable transport solution for the given life cycle of a certain production. It must be highlighted that if the entire production process, with current up- and down-streams, is not featured as such in the study the results of any LCA can be compromised. It is the duty of the LCA practitioner to estimate the impact of its own interpretation decisions and evaluate the possible final impact of such.

The hereby proposed LCA application for ILP attempts to evaluate the actual environmental advantage of a certain type of logistics "best practice" by focusing only in the transport phase. This selection of scope is done in order to establish a better evaluation of the LP instead of the life cycle of the product carried. Without entailing a very case-specific example, the case study aims to shed some light about LCA related highlights that the logistics sector might want to be aware of. It arises from the general claim that environmental advantages are "always" achieved when "best practices" are implemented. The case study calculations and discussion following, attempt to reflect on certain aspects that are often neglected by logistics practitioners in regards of environmental aspects. It is of great interest to the general public as well, as it can be further developed and adapted to eco-labelling of ILPs dealing with the same products or functional units. This type of study could as well be catalogued of life cycle thinking transportation evaluation and have great interest for the further development of environmental transportation calculators applied to a more holistic view of the environmental impacts of LP.

3.2.1.2 Functional unit

The functional unit of an LCA defines exactly what is being analysed in the study. This acts as a reference to which flows are translated in order to be accountable for the later inventory phase.

It is important to select a relevant functional unit so that 1) the results are relevant with the intention of the study, and 2) the flows are feasible to be translated into the functional unit by technical data available.

In the case of the ILP study, the adequate functional units for each Consequential LCA can be used as the transportation of products, raw materials and sub products will therefore represent a different share of the total impact depending on the logistic solution adopted. For this reason, in the case study of this present report we will establish a very specific functional unit based in the total impact of substance per tonne of products transported and distance in km.

3.2.1.3 System boundaries

The system boundaries of an ILP focused life cycle assessment are of special importance. As previously mentioned, often, transport related activities are only accounted for a certain energy/fuel consumption that is out of the scope of the LCA to evaluate further. This trend has its source in the history of LCA studies that have been focused in material intensive, energy intensive production processes and waste management concerning products at which the transportation will not contribute to the great share of the impact (Baumann & Tillman, 2004).

For the interest of ILP stakeholders, the environmental evaluation of these projects should be focused on the available options of each supply chain practice.

- Load factor: depending on the usage of the capacity of the vehicle, emissions per unit of good may vary largely depending on packaging strategy that it is of great interest in LP (Chan, Chan, & Choy, 2005). Although relevant for the environmental assessment, this aspect is out of the scope in the present energy evaluation as it entails a project by itself.
- Technical vehicle features: including energy efficiency measures, driving techniques, types of selected fuels (and their whole LCA) or types of vehicles to be used are some of the technical aspects that have impact in the final energy/emissions accounting for LP. These characteristics, although of great importance, are set aside of the scope of this report give the complexity of the matter.
- Routing: given a certain infrastructure, the routing of a LP will largely influence in the energy intensity of the service and therefore have a direct emissions impact. Of special importance is routing for UFT projects, for example. In these cases, the only routing management can entail a decongestive and environmental measure by itself (Dell' Amico & Hadjidimitriou, 2012).
- Energy consumption/sourcing: of special relevance and included in this report is the environmental aspects related to energy management. Of special importance in the correct environmental impact of an activity is the type of energy used but also the source of this energy. In this sense, energy mix of the different territories in EU is discussed in order to clarify future consideration regarding for example electricity consumption.

For a complete ILP focused LCA study, these fields need to be included together with the activities related to transportation. Nevertheless, including and evaluating all of these aspects as well as the relations between them would have resulted time consuming and of a size that would exceed the present scope of this report. It is understandable how simplifications need to be made in this multidimensional and complicated reality, for stakeholders to be able to offer understandable calculation products.

3.2.1.4 Impact categories and NTM

Relevant impact categories have been selected as the more relevant in regards to the effects to be expected when LP and electricity production activities take place from the ones recommended by the European Environment Agency references (EEA, 1997).

These include relevant categories in regards of transportation impacts:

- Global warming, human toxicity and photochemical oxidant formation: environmental impacts that result of the production or emission of several gases including CO2, NOx, SOx or VOCs. These emissions take place directly in the combustion engines of the different modes of transportation or as a sub-product of electrical power generation among others, therefore are be included in this study.

- Acidification and eutrophication: could be summarized as the deterioration of ecosystems related to emissions of potential acids and oxygen detrimental substances. These emissions take place in transport modes and electricity production in the shape of NOx and SOx mainly.

Nevertheless, LCA application method to transportation NTM aggregates levels from categories into impact assessment in the shape of cost of externalities. In this reviewed LCA methodology, developed by relevant stakeholders and experts in transportation, external costs are the only output. In this case €/functional unit given the fact that is based on most EU national prices and the Euro is the most common currency. Here, transport main impact categories focus on the nature of the locations where emissions take place (urban, semi-urban…) and in air pollution outputs and their related effects. Relevant effects include impacts on health; these are calculated independently per country based on national statistics. Cost values, therefore, are based on population density and GDP per territory.

It is discussable whether disregarding intermediate categories and select such an aggregated method of evaluation is correct for the case study. In this sense, NTM guidelines offer specific guidance on technical details focusing the study on the performance of the supply chain and must, therefore, be regarded as exhaustive technically detailed for emissions accounting in compensation to the aggregation level of the impacts. Furthermore, this aggregation is understandable applied to the supply chain context where environmental technicalities fall in second place and aggregated external costs are compared in order to assess economical cost competitiveness (NTM, 2008).

3.2.1.5 Inventory analysis

Once the goal and scope are set, the inventory takes into consideration the energy and material flows within the activities of the life cycle of the product and evaluates the impact that has been done per selected functional unit.

This step is of importance when analysing the effects of an ILP implementation. While material flows may remain constant in the LP, the implementation of a “best practice” will have a direct impact in energy consumption having the tendency to reduce it. This energy consumption is translated into substances during the inventory analysis and it allows the practitioner to reflect on the differences between territories or energy mixes.

For the present case study, regarding transportation and the effects of co-modality implementation, transport specific guidelines for LCA have been followed (NTM, 2008). As of the energy mix for each country, data has been collected from the last International Energy Agency statistics report[3].

[3] IEA energy statistics report from 2009 at www.iea.org.

3.2.1.6 Impact assessment

Last but not least, the mathematical results must be interpreted. Generally, is in this step where projects sharing data for a common study of a product might differ. This is due to different levels of aggregation, having each of these a certain data transparency loss. While transparency is desirable for technical readers intended studies, it might be difficult to reflect to the general public if some level of aggregation is not applied. These are the cases of eco-labelling or energy efficiency certifications (Baumann & Tillman, 2004). Carbon footprint calculators are another example of public directed aggregated information.

At the case study, the different aspects of aggregation have been discussed having in mind that the selected external cost methodology by NTM is the most common in supply chain evaluation practices.

4 Findings

In this section, the main findings related to the project are presented. First, the characteristics of the relevant surveyed ILP projects are explained. Following, the most observed drivers are analysed in depth. Finally, barriers experienced and highlighted by practitioners during these projects are described for further discussion.

Across the EU territories in the scope of the research, different countries and types of projects have different relevance. From a total of 39 different projects, 41 projects accounting[4].

Following, Table 1 illustrates on the incidence of the different types of ILP relevant for the research. In this table, it can be seen how UFT related projects are a great interest to the different stakeholders and a sector where efforts still need to be put, specially caused for urban health and safety concerns (European Commission, 2005).

Table 1 – Number of exclusive and related projects to each type of ILP.

Type	Exclusive[5] projects	Total related projects
E-Freight	6	13
Co-modality	8	16
UFT	16	19
Intralogistics	1	5

It is also remarkable how intralogistics projects have more presence when related to other types of ILP. This fact is sourced in the internal nature of intralogistics which makes this type of ILP of special interest in complete modernisation plans that are included often together with eFreight projects.

During the survey of the project list, it could also be noticed the following funding organisation's distribution, as in Table 2, with the predominant appearance of the European Commission. Following sections of the present research deal with the importance of this institution in regards to ILP.

Table 2 – Funding entities survey to ILP projects.

Funding entity	Number of projects
EC	29
ERDF	6
INTERREG IVB NWE	4
UNDA	1
BSRP	1

Moreover, a map of the incidence of ILP relevant surveyed projects has been drawn as in Figure 18. Hereby, some resemblance with the main historical corridors can be

[4] CIVITAS counts with 3 separate phases that have been considered separated in this chapter.

[5] "Exclusive projects" here refers to the amount of projects from the total on the right column that deals only with the indicated type of ILP.

highlighted. These historical via are the English Channel and the north-south corridor that joins Scandinavia with the Mediterranean.

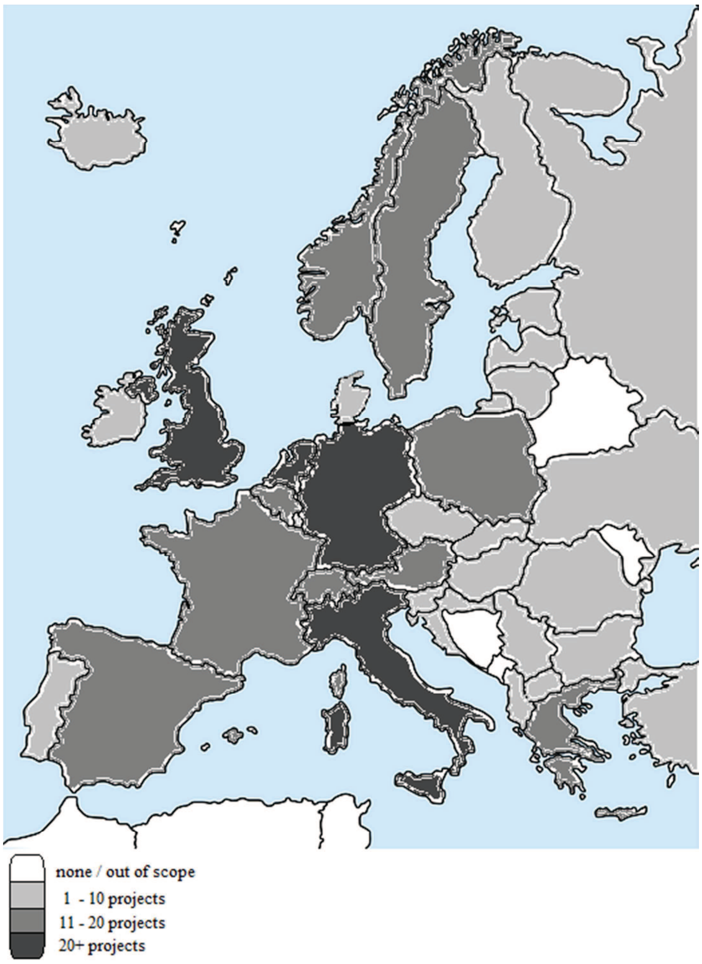

Figure 18 - European ILP incidence map.

Some other relevant countries are Poland and Spain. These territories, historically dominated by road traffic and with relevance for the access to Africa and Asia, are of special interest as they would set an example for the modernisation of other European areas such as Eastern Europe. This modernisation can also be illustrated as in Figure 19 where the trends on ILP incidence are shown by year.

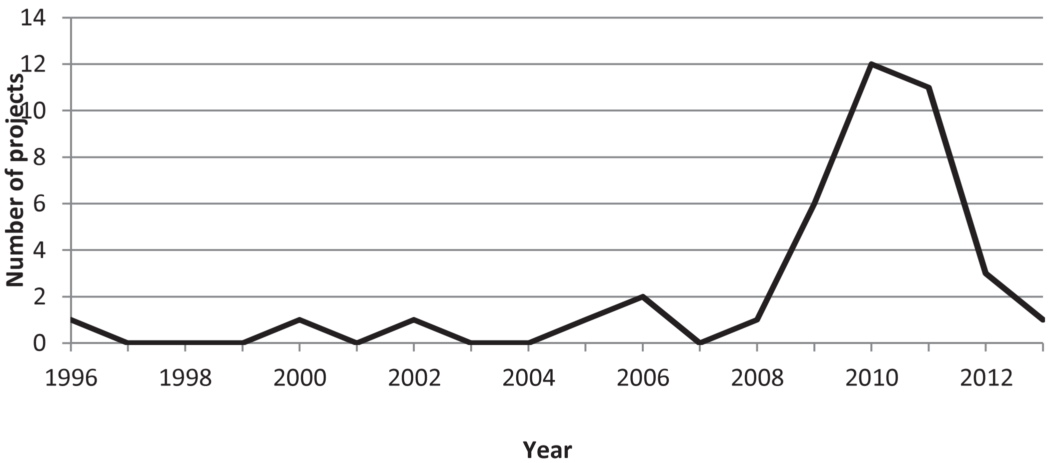

Figure 19 – Time developing of ILP graph.

ILP in Figure 19 is understood as the time development of LP where after a period of learning (Kemp, 1994), from 1996 to 2008, finally the concept develops and gets the dimension of “best practice” (expressed as the larger number of relevant successful incidences). This learning factor determining the increase in the incidence of relevant ILP is further studied in the drivers section.

4.1 Drivers accounting

Following, in Figure 20, the incidence of several driver markers is reflected. The different experiences survey has highlighted this four main categories that deal with the precursors to implementation of ILP in the following sections.

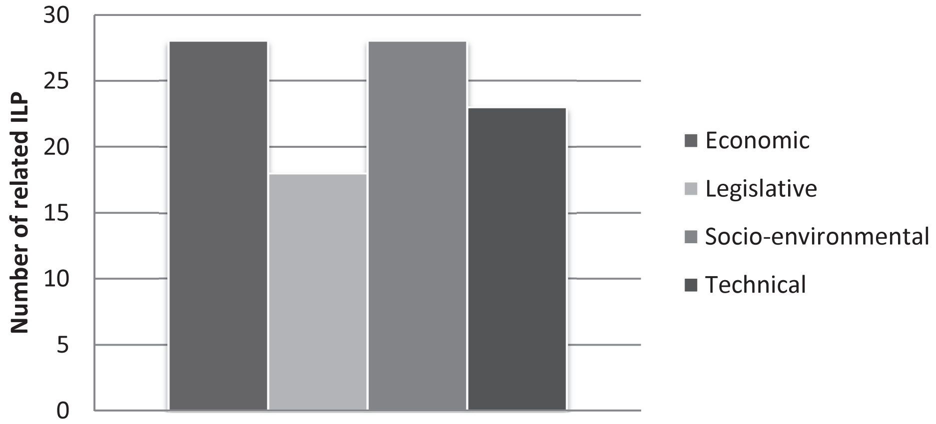

Figure 20 – Drivers incidence account per type of ILP.

It is worthy to highlight economic and socio-environmental incidences and the fact that socio-environmental concerns are of the same relevance as economic drivers. Following analyses of drivers will assess which types of socio-environmental concerns are associated and relevant aspects that reflect on this importance.

4.2 Barriers accounting

Figure 21, illustrates on the accounting developed among the ILP selected projects. Standardisation and cooperation appear as common lacking aspects in surveyed ILP.

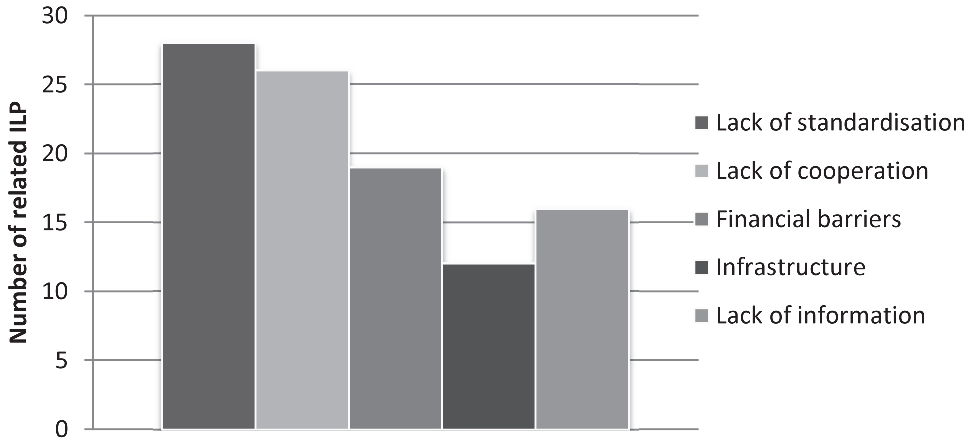

Figure 21 – Barriers incidence account per type of ILP.

Standardisation lacks could be understood of part of the process of implementation of innovation where first experiences set the basis for regulations that tend to benefit and speed up the following experiences. On the other hand, lack of cooperation is an overall negative aspect in regards to ILP or the implementation of any sort of project due to the necessity of involved actors to work together. These barriers are further characterised and analysed in order to reflect on positive overcoming experiences of the same and how to export overcoming techniques in order to benefit the entire ILP scope.

4.3 E-Freight

E-freight is generally understood as the electronic paper-free modernisation of LP. It makes intensive use of information flows enabling real time logistics solutions.

4.3.1 Definitions

Featuring some leading projects like e-Freight Europe, Appendix A, the eFreight related initiatives have a common goal: optimisation of the supply chain by modernisation of techniques based on electronic systems and acquiring competitive advantages from IT integration (Loebbecke & Powell, 1998).

As transport and logistics service providers perceive a need to streamline their internal operations in order to remain competitive (Loebbecke & Powell, 1998), eFreight has resulted in a successful advantage for those taking the lead in the current globalized and deregulated market at which competition has increase significantly over the past years.

Furthermore, actions taken on the topic have enabled these plans to entail a whole new business concept by themselves, as can be seen in Figure 22. These efforts gain relevance in the Freight Logistics Action Plan (European Commission, 2007) or the Intelligent Transport Systems plan (European Commission, 2008) which led to a later directive of European relevance (European Parliament of the Council, 2010). They pursue strengthening internal European markets and increasing their competitiveness by improving the dynamism of the business environment. Sustainable development practices are also reached when these ILP are implemented.

Figure 22 - eFreight commercial from the International Air Transport Association (IATA, 2013).

The general frame consists of:

1. A standard framework for freight information exchange, including all transport modes. This step does not only simplify the information on the stakeholder's side but also represents a step forwards towards co-modality in the sense that standardized information on transport means smooth the transit between modes.
2. A European single transport document for carriage of goods, including all the necessary legislative support regardless of the mode. This characteristic enables the relations between EU territories and entails a step forward towards the economic integration of the members.
3. One single point of access for all administrative procedures of all modes. With the corresponding saving in local administrative efforts.
4. Accessibility reinforced border crossings for all modes across the EU members, representing great savings in time and contributing to establish secure and efficient corridors towards America and Asia from Europe.

Among the many technological new applications, timing and positioning services satellite-based are contemplated; as well all kinds of software support required for the enabling of the above explained key points. Some of the technical strength points associated to the use of this method are the traceability of the journey and the automatic exchange of cargo-related data for both regulatory and commercial purposes, thus, enhancing organisational responsiveness to the changing demands of customers (Loebbecke & Powell, 1998).

It should be mentioned that the well performance of such systems requires of a critical mass of users as only among a great number of partners a true value-added logistics chain can take place. These facts are discussed further in the drivers and barriers sections.

Innovation, therefore, lies in the new availability and user interface of the information of the logistic practice, which aims to offer increased customer services while bringing down the costs in the logistics chain.

4.3.2 Example: BestLog project on Telematics at SMEs

BestLog, platform for logistics best practice, developed an e-Freight experience for Sieber – Logistics retailer based in Switzerland.

The problem to be solved was that increasing importance of cost of fuel in the transport business and the increasing interest in on-time information of shipments by customers. The solution taken was to implement a telematics product that monitors trucks, analyses performance and allows direct communication with the drivers and route planning.

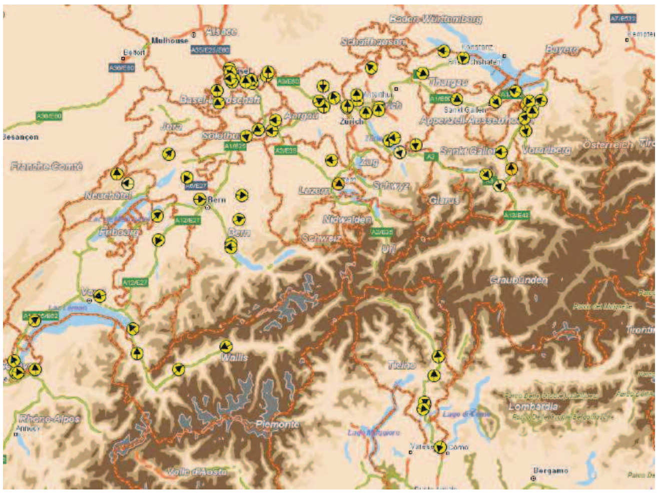

Figure 23 – Image of monitored traffic incidences across the Alps (BestLog).

Apart from economic reasons, the high impact that road transport has on the environment was another of the concerns of the firm and therefore reducing on fuel consumption was also targeted as secondary environmental measure. Some of the key steps towards the implementation were the integration of the employees, mainly drivers and the education put on them.

As a result, the new driving experience, graphically exemplified in Figure 23, did not only enable a higher amount of information flows towards customer car but also reduced consumption of fuel and components in an estimated 1.5-2 times rate.

4.4 Co-modality

Co-modality consists in joining transport technologies for improved compatibility and enhanced exploitation of each mode's best features.

4.4.1 Definitions

Co-modality was introduced as well by the European Commission as part of their efforts in the field of transport policies (European Commission, 2007). It is defined as the use of several means of transport on their own and in combination to each other with the aim of obtaining a sustainable and optimal utilisation of resources. It contrasts previous approaches on transport policies that targeted each different mode on their own and dealt with specific needs of each sector. Instead, current policies focus on exploiting the combinative options.

It was especially demanded by important stakeholders such as the European Intermodal Research Advisory Council (EIRAC) a group of relevant high level industry players related to European supply chains, which identified the need to increase the capacity utilisation of European freight transport. The fact is that statistics of the European territory reflect that vehicles are filled on average only up to 57% of their weight total capacity, and no less than 27% of vehicles run empty. This data comes from traditional logistics practices based on 1 to 1 contracts. Logistics practitioners create internal synergies when temporary and geographically possible, but the effects of such organisation are not comparable with the benefits of co-modality. Horizontal collaboration between companies, necessary for the successful implementation of co-modality, increases the opportunity to maximize vehicle capacity and reduce empty running.

In modelling experiences of co-modality, it was observed how costs have a tendency to decrease as volumes increase. These volumes need to be fairly constant for the proper management of the resources of a co-modality terminal given the high investment costs that these facilities suppose compared to the already mentioned traditional logistics. Figure 24 illustrates on the size of a co-modality project and the consequent investment and resources needed. Co-modality techniques require complicated installations on site, such as signalling of transhipment tracks, electrified switches and overhead junction crossings.

The bottom line of relevant studies highlights that effectiveness for these solutions depends on the capacity limitations. In this sense, the necessity of advanced operation forms is revealed. Night travelling modes that get served during the day, for example, allow the effective use of co-modality and enhance time saving due to this fast handling (Ballis & Golias, 2001). This fact combined with off-peak energy pricings bring down the costs of transport even further (Kaufman & Walker, 2010). This directly increases the productivity of the freight transport activity while reducing environmental impact from energy consumption reductions per product unit and service.

Figure 24 - Co-modality facility project at Port Salford, Manchester, UK (The Peel Group, 2013).

A key factor in this multidimensional approach to logistics is the trust and involvement of the interested parties. These and more aspects are discussed in the following sections: drivers and barriers.

4.4.2 Example: Spectrum rail freight solutions

Technical innovative solutions that enable co-modality to a new spectrum of actors thought adaptability implementation.

The necessity for more reliable, time-sensitive increased quantities of goods represents an opportunity to rail freight growth. Congestion on roads and "environmentally friendlier" modes of transport are other of the seen drivers for these projects.

The competitive advantage of rail lies in the great flexibility and faster transport times combined with lower prices and high capacity. Spectrum combines e-Freight with rail transport for an improved modal shift. Among the main technical solutions featured it can be found a new technology of more flexible vehicles with enhanced adaptability to other means of transport that are compatible with urban and passenger trains, as in Figure 25. This allows more extensive scheduling and opens more train networks and services including temperature controlled containers and high value goods.

Figure 25 – Example of mobility enhanced wagon solutions for truck-rail integration (Spectrum).

It counts with considerable ports and terminals available as well as relevant companies involved. Some of the further steps of the project include train driving management and routing optimisation for further energy intensity reduction.

4.5 Urban freight transport

UFT consists of different types of practices to improve local LP and urban environments.

4.5.1 Definitions

The so-called city logistics have been conceived in the setting of cleaner and healthier city initiatives. Needs for increase in the quality of air in urban areas have been set by relevant policy makers such as the European Commission in their Clean Air for Europe (CAFE) program (European Commission, 2005). Other relevant precursor for cleaner and safer cities is the World Health Organisation, WHO, that in recent publications have identified indoor and outdoor air pollution as the cause of more than 2 million deaths every year (World Health Organization, 2011).

Urban environments are characterized by high density of population combined with high consumption of goods and services. The most common nuisances in these locations are safety, congestion and noise together with pollution. This is due to the limited infrastructure by which products and services can be supplied. In this scene, traditional urban freight consists of heavy vehicles crossing these urban nodes to deliver often to a single point. Restrictions such as time-windows and environmental restrictions make it difficult to approach efficient solutions in many cases, while local authorities claim that carriers are not innovative and cooperating in their logistics operations (Quak, 2012).

Many initiatives have been carried out by actors rather than by the carriers. These are usually unable to directly influence the authorities' policy in various urban areas. So if they want to improve the sustainability of their operations they can only do so by innovations in their logistics organisation or by technical improvements (Quak, 2012). Some of these technical solutions include engine solutions, low-noise equipment or operative efficiency measures. Other examples are new vehicle concepts like in Figure 26.

Figure 26 - Cargohopper as UFT operative solution in the city of Utrecht (Cargohopper.nl)

In this sense, urban freight transport is characterized as:

1. Use of more environmentally friendly vehicle technologies that result optimal when used in urban context. This is the case of electrical vehicles or compressed natural gas engine ones. These vehicles have certain limitations in mileage or drive train power when compared to other traditional delivery vehicles in long distance journeys but when applied to the dense urban context, the entail a competitive advantage towards implementation of congestion charges or low emission zoning of cities. Low emission zones are an environmental practice that consists in banning certain urban areas to high emission vehicles to reduce city pollution, which is taking great share of interest in European cities in special in Germany (Green Zones EU, 2007).

2. Standardisation and integration of informative on-time technologies that allow flexible vehicle routing. These systems, combined with a good partnership between relevant interested stakeholders, result in a higher occupancy of load spaces and a reduction of the mileage.
3. Optimized size and location of vehicles and storage places. As logistics in urban context consist of numerous but small deliveries often divided by specific sectors, many UFT projects focus on the management of resources by small sized facilities or vehicles. This type of proposed lay-outs requires of a more precise and scheduled planning when compared to traditional urban logistics.

4.5.2 Example: Smartfusion consortium

This technology development agreement is a tailor-made initiative for last mile environmental friendly deliveries.

This cooperative venture in the fields of urban logistics features the combination of cooperative problem solving with socio-environmental drivers for a better management of last mile deliveries.

The technical solution presents hybrid vehicles of second generation that will allow electrical-driven deliveries of last mile in 3 demonstration sites in Germany, Italy and the United Kingdom. Two international supply chain providers will develop and implement solutions for consolidation of urban centres and find out at which point is it most convenient to convert to electrical last mile vehicles on each case.

This project features as well a mentoring initiative that will export the experience and expertise in the fields to other regions of Europe.

4.6 Intralogistics

Intralogistics can be summarized as the use of technology for the optimisation of logistic hubs and resources of different natures.

4.6.1 Definitions

Intra-logistics describes the internal material flow between the different "logistic hubs" - from the material flow in production, in goods distribution centres and in airports and seaports - as well as the related information flow. The need for intra logistics arises from the performance change of economies towards richer managerial practices in manufacturing companies. These recent and on-going changes in the nature of logistics arises the interest in examining actual logistics processes performances expected today (Kisperska-Moron, 1994).

Intralogistics, therefore, covers all the processes and necessary resources (such as equipment, intelligent systems, raw materials or human resources...) to carry out the indoor logistics activities (warehousing, material handling, packaging or tracking and tracing among others), with an example shown in Figure 27.

Figure 27 – Intralogistics example based on conveyor belts (Montrac Technology, www.montractec.com).

This fast growing sector counts already with many providers. These are companies which supply technical systems and services for improved management. Some examples are hardware equipment, like cranes and other transport handlers, and software equipment, such as imbibed systems and their software solutions. Clients include industrial enterprisers, retailers and institutions that find in this product organisation a hands-on but yet externalized solution that ensures quality in procedures and the cost reduction they seek for towards gaining competitiveness in the markets.

Innovative integration requires of products that are designed for the task. Common traditional conveyor belts get a whole new role when integrated intelligent systems manage them with interconnected open interfaces that make compatible the hardware procurement with for example enhanced user safety. Greater flexibility is also achieved along with closer synchronisation of material and data flows, which at the same time enables the whole system to be adapted to new requirements in case of production changes (Löttner, 2005).

4.6.2 Example: TAPAS intralogistics

The implementation of innovative robotic solutions for logistics indoors is the main feature of this project.

This robotic-based technology projects aims to transform current factories into automatized high efficiency places of production. The key components are the development and optimisation of new logistic solutions for robots facilitating robust implementations of transformable automation.

Figure 28 – TAPAS assistive robot example currently on development (Tapas).

TAPAS will focus on automation of assistive tasks, as in Figure 28, preparatory tasks and port processing work. It aims to be adaptable to all sorts of workers towards a more effective streamline that will include the first steps in logistics.

4.7 Drivers

The following drivers have been observed during extensive literature review of the relevant ILP and related European publications and are considered of special interest for the future development of ILP related projects, as in Figure 29.

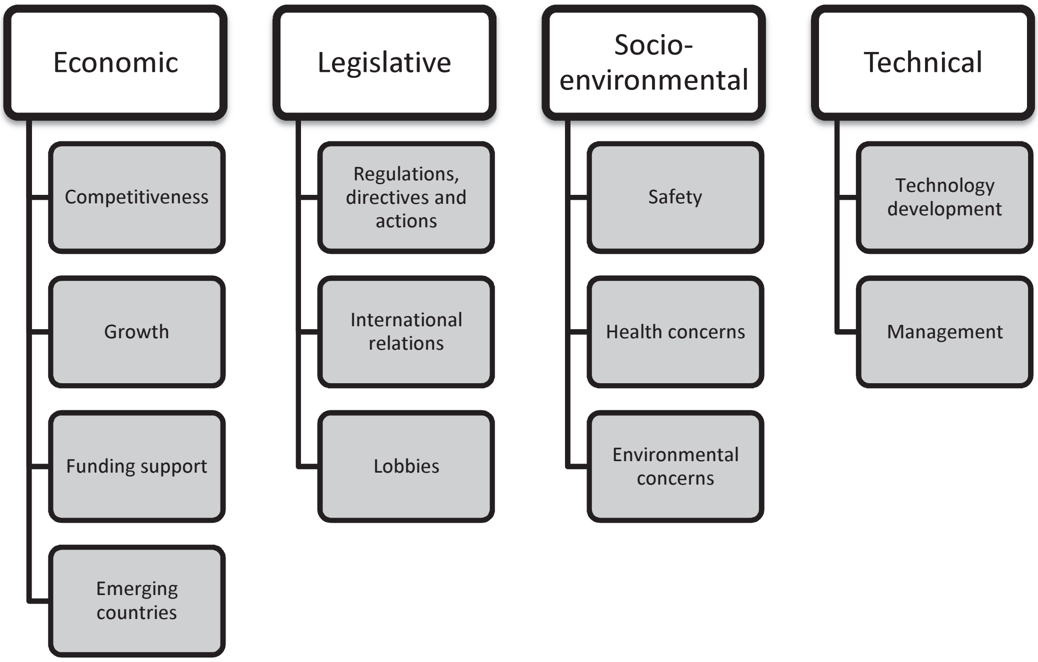

Figure 29 – Drivers brief summary as in this chapter.

4.7.1 Economic drivers

Findings indicate that most of ILP surveyed are strongly associated with economic incentives. Therefore, economic relevant aspects are studied.

4.7.1.1 Competitiveness

Competitiveness is a measure of the comparative advantage or disadvantage of a firm, industry, region, or country to sell and supply goods and services in a certain market (Amos, 2009). As experts recall, the role of transport towards economic development covers connecting and increased number of locations, reducing cost and time of travel, increase reliability of these means enhancing accessibility and increasing productivity. These aspects relate to all economic sectors, as supply chain is a role factor in economies and therefore, the incentive for competitiveness from ILP practitioners goes beyond their private interests of competitiveness respect of the rest of actors in their level but also the advantage that this competition supposes for the rest of the sectors.

As a driver in some of the ILP, there is the direct intention of entering this competition in order to gain or maintain market leadership. With increasing number of emerging economies, the competition gains yet another dimension between EU practitioners and overseas competitors. The following aspects of ILP can be highlighted as competitiveness enhancers:

- New markets penetration: Improved transport and logistics solutions can provide businesses with wider trade areas, increasing competitive pressure and offering consumers with more choices (Eddington, 2006). Examples are every co-modality initiative since the existing market, dominated by truck transport, is highly competitive to the entry of new modes. Intermodal solution provides both market opportunities and emerging countries' new markets.
- Stimulating new innovation: Competitiveness of the organisation relies on the performance of logistics sector whether new innovation are addressing or not. Creation of mobile robots with manipulators that is used in intralogistics type of ILPs is a good example of new innovation that wants to be competitive among the competitors. Other examples include the UFT integration of new fuels or energy carriers for transport solutions.
- Adopting new technologies: integration of supply chain activities and the technologies become competitive necessities in most industries (Patterson, Grimm, & Corsi, 2003). Adopting technologies improve information management and activity coordination by increasing operational efficiency and lowering the cost of the service. E-Freight are an example of ILPs that provide technology, services and data that customises quickly to meet the needs of individual companies by adoption of telematics and ICT systems.
- Promoting standards: Standards are important elements of the society providing a common and repeatable basis for developing tasks to meet the demands of the world (Stroyan & Brown, 2012). They also play critical role in economy by facilitating business interaction and access to markets. The use of standards and the involvement with standardisation support the competitiveness in the regions. E-freight projects are examples of ILPs that implement in order to provide standardized information from multiple data sources and parties.

As Figure 30 summarizes, these aspects can be used separately or in combination to entail strategy lines to benefit ILP from previous successful experiences.

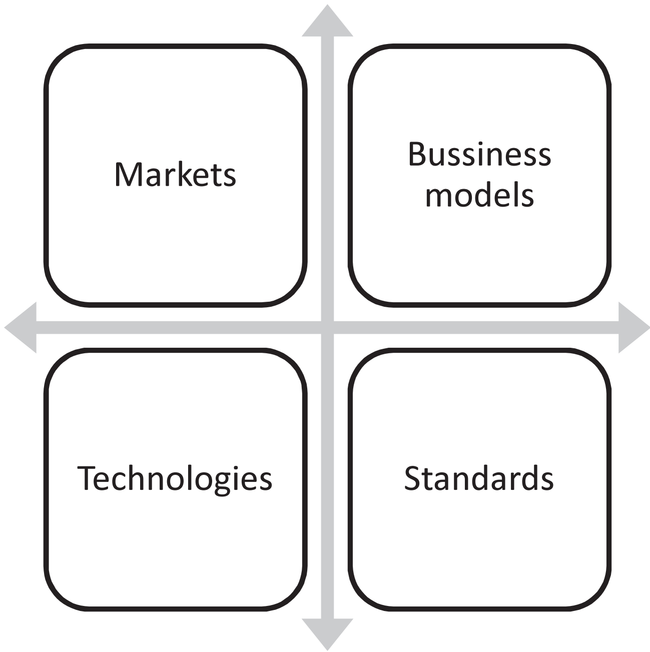

Figure 30 – Dimensions of competitiveness related to ILP.

4.7.1.2 Growth

The European Commission accounts transport industry generated profit as approximately 7% of the total GDP in the EU for the year 2009, entailing transport as a significant stakeholder of the EU economy (European Commission, 2009). The following aspects of transportation have enabled this sector to positions itself as a great actor in the EU:

- Migration: Transport has an important role in migrations, transforming the economic and social geography of many countries. Having an efficient transport can provide GDP extra growth and productivity benefits and opportunities to societal sectors that entail the new working forces of those territories they move to, in seek for better work/living conditions.
- Trade: Logistics may contribute to economic success by increasing domestic and international trade, supporting economies of scale, improving time-saving and reliability of all businesses including travellers, freight, and logistics operations to increase business efficiency and investment (Eddington, 2006).
- Cost reduction: From the findings extracted from the survey of appendix A, almost all of the initiatives aims include the target to reduce the costs in order to achieve economic growth. As an example, co-modality projects present several advantages in comparison to the road solutions in terms of cost savings both direct and indirect in reduction of externalities.

Systems that lack capacity or reliability can even have an economic cost, in regards to the potential economic damage that an incident in these indicators could cause. Therefore, inefficient supply chains that have high transport and logistics overall costs as they include the unsuccessful cases. Impediments to export and import flows may occur as well in a lack of reliability and capacity and increase cost for firms to compete in the international market (Pesut, 2009).

Some benefits of transportation growth are shown below (Rodrigue, 2009):

- Access to wider distribution markets and niches.
- Employment creation.
- Improved accessibility and fulfilling mobility needs.
- Time and cost savings as well as minimised loss or damage.
- Increasing productivity from the access to a larger and more diverse base of inputs and broader markets for diverse outputs.

4.7.1.3 Funding support

Monetary support from European Commission can be regarded as a driver towards the development of ILP schemes. The Commission is in charge of the funding budget that reaches organisations and companies in the form of calls for tender, grants and other financing programmes (European Commission, 2013).

This European budget comes from several sources: member's contribution from their gross national income (GNI) of each member country, import/export duties on products from outside the EU and a percentage of each country's value added tax (VAT) that depends on the GDP of each territory and their national policies (European Commission, 2012). This illustrates on the different relevance of each territory to the collective account, as powerful steady economies contribute more than emerging yet immature new members. The commission delivers then the direct financial contributions to support of projects that meet the interests of the members, contribute to the implementation of the different joint programmes or follow the implementation or adaptation to recent policies (European Commission, 2013). In this sense, it is to be addressed that those projects in line with EU programmes are more prone to receive this funding, as all initiatives compete with each other as they need to be selected and approved before granted.

From the experience gathered from the collection of Appendix A, lack of funding support can be identified as a limitation to the implementation of actions and projects. European Commission has funded most of the projects featuring the Seventh Framework Programme for Research and Technological Development (FP7). Other funders, related to the Commission are the Baltic Sea Region Programme or the Marco Polo programme. Despite each of the programmes have different purpose, they all aim to respond and improve transport in terms of socio-environmental improvements, urban development, infrastructure management and new technologies implementation, research and innovation. Targeting several of these aspects inside of an ILP project can entail a natural support towards obtaining funds.

Figure 31 shows the evolution of the Research Framework Programme Budgets. It reflects the high joint interests among researchers and policy-making institutions.

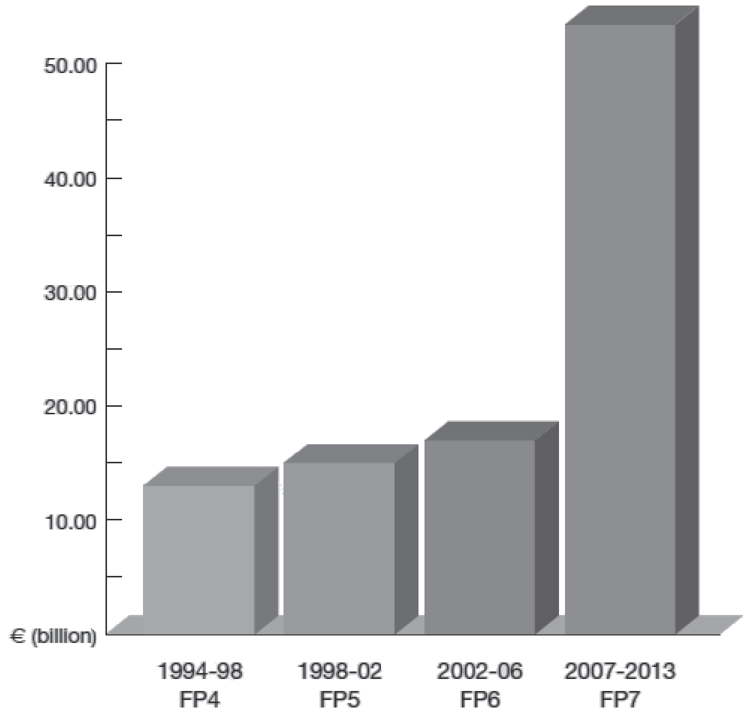

Figure 31 – Budget comparison for the evolution of the EU Research Framework Programmes (European Commission, 2007).

4.7.1.4 Emerging countries in EU

Emerging economies and new joint territories are crucial to the implementation of innovative logistics practices across the EU. This is due to the market openings the entail and the relevant investments that these countries receive as part of joining the Union towards a unified European territory in socio-economic terms. Some emerging countries relevant for the surveyed ILP are Czech Republic, Poland, Slovakian Republic, or Romania. These members are some of the latest to have joint the Union and are included in the EU27 indicator. Regarded as “Eastern Europe”, GDP growth or important infrastructure improvements are some of the common characteristics of these territories in favour of ILP implementation together with their strategic geographical location.

Emerging countries become an interesting opportunity for future coordinated investments and implementations reaching a higher interconnectivity at regional, national and international level. As experts highlight, expanding economic growth in “Eastern Europe” over the next decade will impact the logistics market and put increased pressure on the region’s infrastructure. Therefore, the development of a modern efficient road and rail network in Eastern Europe is important to helping it meet its true economic potential (Colliers, 2012). Is of interest to this report to mention the relevance of these territories, as in Figure 32, and highlight them as suitable target territories for joint implementations or nuclei towards development of ILP.

Figure 32 – Map of emerging European economies (ERSTE Asset Management - http://www.erste-am.at/)

4.7.2 Legislative drivers

Many ILP projects have direct relation to legislation and recent EU policies. There is a clear relation between UFT and Co-modality initiatives and EU policy trends. This chapter aims to reflect on these aspects.

4.7.2.1 EU actions and directives

Legislation in EU is responsibility of different organisms such as the European Commission, the European Parliament and the Council of the European Union. Their role is to make sure that member from different countries correctly comply with EU law that is compiled as part of joint actions for unification of different socio-economic and environmental aspects.

Three types of EU legislation can be highlighted:

- Regulations: similar to national law, these are compulsory items applicable to all EU members.
- Directives: general rules to be transferred into national law by each country, as they deem appropriate. This flexibility dies on the respect that the EU has on national autonomy.
- Decisions: deals with a particular issues and specifically mentioned collectives or organisations.

These different types illustrate on the different impacts that legislation can have depending on its strength. Legislation initiatives can help to ensure that standards are established and met, but in many previous cases it has been recorded that directives and decisions put in place fall in a second place of relevance in pro of mostly national targets or economic strategies moved sometimes by political orientations. An important recommendation lies in the compulsory nature of regulations across the EU. In order for all the territories to equally contribute and benefit from socio-environmental or economic advantages from implementation of ILP is necessary to reinforce the necessity of a joint action. Although positive experiences are concentrated in some territories (see Figure 18, page 34), the lack of interoperability or standards is general barriers seen in the Appendix A across EU. These barriers could be easily targeted from the EU representatives with the consequent resource and time savings for the future of joint implementations among others. Further sections of this report will as well highlight sectors where legislation may be required.

At the same time, there is an increase in demand for transport policies from relevant stakeholders. The consequence of the growth of transport has advantage towards the economy but also causes concerns that claim for a sustainable development strategy. Pressures are being increasingly put on to engage in sustainable management initiatives. As one of the most relevant EU's common strategies is transport development, it is fundamental to ensure the sustainability of this process to benefit the entire European society and to promote international cooperation and knowledge transfer to ease this path (European Commission, 2012).

Finally, another controversial related EU joint action is the Emissions Trading System, ETS. This is a system to control amount of industrial greenhouse gas emissions by putting a price on a carbon and enabling trade (European Commission, 2013). It aims to control the entire production of climate change substances in the territories and internalise the related externalities by pressuring only solvent agents instead of the entire population. By putting a price on CO_2 from industry[6], the competitiveness of alternative energies has benefit in some territories while in others, ETS meant just a need for buying permits to other countries in order to continue the "unsustainable development" in their nations. This fact illustrates on the delicate equilibrium of circumstances that can determine the success of an initiative regardless of its strength or content.

In regards to the implementation of ILP, as previously discussed, the success of the initiative might depend on the nature of itself or the strength of the legislation behind it. In general, it is recommended to implement the joint actions through strict regulation always based on simulated models powered by experts on the matter in order to finally achieve prominent progress[7] in the logistics sector at EU level.

4.7.2.1.1 International relations

In this inter-dependent world, international relations are an important driver when implementing the ILPs since it involves several countries. The importance of international relation is a study of interactions and relationships between countries and the roles of the governments and international organisation. The study concerns with powers and efforts of nations to gain best national interest. Nations face global challenges that are larger than its own territory jurisdiction to handle; such as concerns over the economic crisis, environment, diseases and terrorism. Therefore, international relations necessity lies in the positioning of nations to cooperate effectively to overcome

[6] Recent decisions have included aviation in the ETS. As of 2012, both European and non-European airlines participate in the trade and need to account on their emissions from operation of the aircrafts.

[7] It must be highlighted that logistics sector and supply chain practices in general do receive most of their development incentives from private initiatives, even when these are based on public funds. In this sense, this project targets the necessity of involvement of EU regulations to spread development equally across the EU.

these challenges. These could be highlighted as one among the pillars of EU's foundations.

International relations also play a key role in determining border control policies, regulating and controlling the flow of goods and information. The role of international relation is to define the requirements and limitations of cross-border trade. In transport sector of the European Commissions, White Paper on Transport is set out for international transport cooperation to focus on extending internal market rules through work in international organisations and promoting European safety, security and environmental standards (European Commission, 2012). Positive international relations promotes effective trade policies between nations, both in terms of importing natural resources and finished products and in terms of gaining access to the larger markets afforded by exports to foreign countries. In the co-modality initiative, for example, new infrastructure for transport corridor in emerging counties of Europe is constructed due to high import-export relation so emerging countries can expand their economic growth. Border controls in this ventures, require special coordination efforts to maintain the competitiveness of the transport solution.

Apart from the advantage gained from a national point of view, the advantage implemented has power in international relation. This influence can be coercive, attractive, cooperative, or competitive over other actors within the international affair; being attractiveness and cooperative efforts the most constructive and recommendable among EU members. The power to direct the decisions and actions depends on the amount of resources, derived from strength and will. Strength arises from the transformation of resources into capabilities. For example, in the observed ILPs, nations that have strong political, cultural and economic influence over neighbour nations; as well as leading territories such as Germany or the UK tend to lead joint EU ventures given their relevant size[8] inside of the EU. These countries have put a lot of power and effort to develop the ILPs entailing good mentors for further EU spread.

4.7.2.2 Lobbies

Lobbies are collectives of stakeholders with shared interest that develop actions aiming to influence the administrations' decisions in their favour. They represent mostly the private interests of a certain sector of society. In theory, these "government-private sector" relations are entirely legitimate, but in the past years certain controversial decisions by all sorts of administrations have gathered the attention of the media and acquired a large interest from the public opinion, as in Figure 33. In June 2008, the EU created the Transparency Register in order to collect information of all organisations and individuals related to the parliament, irrespective of their legal status in order to ensure the respect of the code of conduct of the European institutions and interact with the different sections of the Commission in full transparency and trustworthiness (European Commission, 2008).

[8] The size of a nation can be referred in this case to GDP, international relations, population or pure economical available assets.

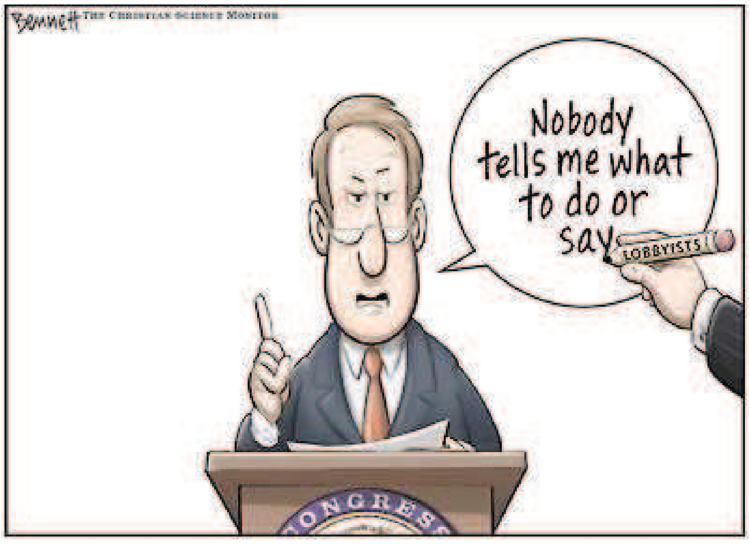

Figure 33 – Lobbies have a public image of having control on politicians (Clay Bennett, www.claybennett.com).

Lobbying practices are widely used, addressing the fact that interested parties around policy makers have a sustainable influence in a matter. Illustrative on how this practice has become part of the daily politics life for the top spheres of the EU and its relevance as possible driver for policies in favour of certain sectors.

Along the history of Europe, trade and employer associations enjoyed an important role in public policies:

- European free trade: part of the merit on achieving a united free trade European institution can be put in the big sectors of industry having international economic potentials in mind and supply chain parties as important roles in the economic development of Europe. Some relevant treaties on which European economies are based nowadays are based on the Paris and Rome treaties that brought together the funding members of the EU in a community whose aim was economic expansion through trade integration (European Commission, 2010). These agreements were greatly influences by agricultural, mining and energy sectors' economical interest on both competition and cooperation.
- Access to new markets: as the expansion in the number of members of the EU took place, so did the amount of interested economic actors. Different territories entailed new market targets and the access to extensive energy resources or raw materials, for example. In the nowadays EU, the focus is also being put in economic relations with borderline countries, sometimes potential candidates. In this sense, international companies take part in the decision making of integration of new territories and supply chain companies result specially benefited by the increase in territory as a direct expansion of operable markets.
- Competitiveness and deregulation: as of the competition among parties within a sector in the EU, both small and large stakeholders have historically pushed for common regulation in order to regulate/deregulate different markets and establish a gate of access to themselves. Deregulation in some large sectors of European economy has proven to expand the amount of companies in the sector, lower market prices and contribute to creating innovation and new business opportunities. This can be addressed as a genuine driver of interest of companies

and a direct connection between administration and the companies' lobby (Trade Journals, 1995).

In this sense, proven the good faith and trustworthiness towards the act of influencing the political sector, as described in the Transparency Register (European Commission, 2008), the action of a certain lobby is recommendable towards the implementation of certain policies to benefit ILP. The cooperation among several firms in a business section representing a relevant share of a certain market and to participate of the policy making process, as lobbies entail and do, is a good strategy for the success of an innovative initiative or for the enhancement of a new business model. As of overcoming the barriers encountered commonly in ILP, that the transport related companies would entail a lobby could act in favour of obtaining more funding for this innovative projects, legislation on how to proceed with local management policies (common barrier to UFT) or reinforce transparency enhancing relations between firms within the sector.

4.7.3 Socio-environmental drivers

Despite economic crisis in some of the territories since the year 2009, Socio-environmental concerns remain among the most relevant targets of the Union. This continuity entails the steady importance of society and the environment to the member countries.

Historically, the union of the funding member countries of the EU took place under commercial and economic circumstances but as the GDP of the main member countries has developed, so have the concerns for matters apart from economic expansion. The definition of prosperity has evolved during the years to the current definition that nowadays encompass social welfare and environmental awareness. In this section, the socio-environmental drivers observed in ILP for diverse initiatives in the EU are analysed in order to get a better understanding of key niche markets that ILP could target in order to allow these projects to obtain the required attention from the EU[9].

Figure 34 contains graphical information of the expenditure of the EC in health and consumer protection alone. It is worthy to highlight the distribution of countries that matches roughly with those countries in which most ILP projects take place (see Figure 18), as a reflection of the action focal countries in the EU.

[9] Commission is the main investor to ILP projects from the public sector. In this sense, it is hereby understood that not only economic attention is required from the authorities.

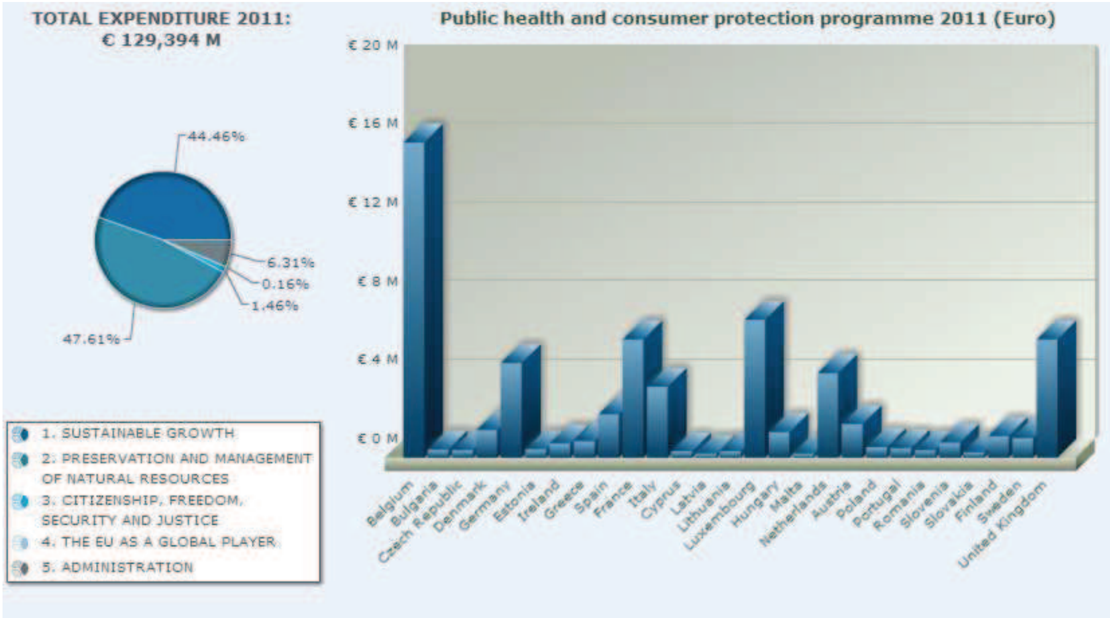

Figure 34 – Public health expenditure of EU27 figures by country in 2011 (European Commission, 2011).

In general terms, it has been seen that certain territories of the EU have greater interest in improving socio-environmental indicators, mostly countries with a high GDP among the EU members. When targeting these territories as future locations for implementation of ILP, it is of interest to highlight the socio-environmental advantage respect of the traditional practice.

As previously mentioned in Figure 20, drivers accounting, socio-environmental drivers have been extensively observed among the projects surveyed. In most of the ILP projects portfolios they were claims towards sustainable development and environmental concerns. Nevertheless, the scale of the involvement of these is different among projects. In some, it is mere citation of the EU target mentioning that this target are accounted in their own code of conduct but show no empirical results nor justify the involvement of socio-environmental advantages in their projects. Other projects, on the other hand, feature socio-environmental initiatives as the main body of their portfolios such as the case of alternative energies or city pollution targets in UFT projects.

4.7.3.1 Safety

The physical integrity and safety of the EU citizens is of important concern for the EC. Healthcare and safety practices receive relevant support not only in order to increase the quality of life of the citizens but also to reduce the large expending caused by accidents. Accidents are the fourth cause of death in the EU27 member states with an incidence of more than 30 deaths per 10.000 inhabitants (Eurostat, 2010).

As Figure 35 illustrates, accidents among transportation and logistics chain professionals are third in share of incidences and among the top safety concerns according to statistics.

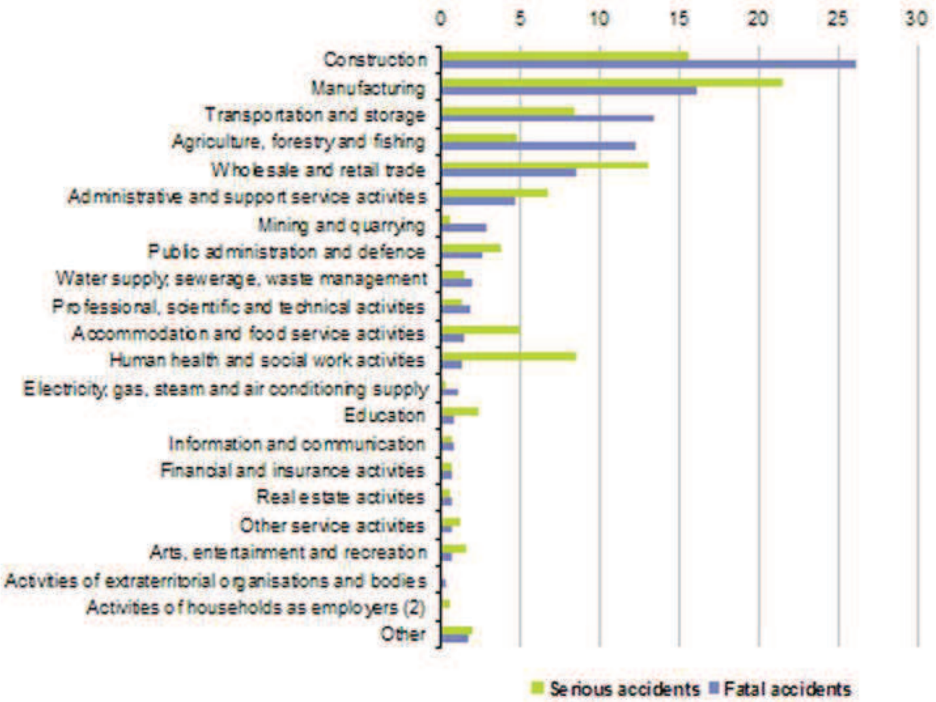

Figure 35 – Work related accidents by sector as % from total work accidents in 2009 (Eurostat, 2010).

Even though technical safety improvements have proven to decrease the amount of deaths[10] in transportation accidents, the number of accidents in the EU is still one of the indexes with most intensive targets on reduction of occurrence (CARE, 2012) (Eurostat, 2008). Technical solutions to accidents seem to have reached a stagnation point and experts agree on targeting traffic management as the next priority field for further improvements. It is highlighted in the publications of road management departments of the EC that "society cannot tolerate road fatalities" and further improvements need to take place in order to attract professionals into the sector as it is perceived as a risky sector in regards to working conditions (European Commission, 2012).

To target focal points of safety, both technical and managerial, contained in the several action plans for health in the EU can act as a driver towards cooperation or funding and achieving a good level of involvement from the authorities or the acceptance of change in certain sectors.

4.7.3.1.1 Road safety

Some of the targets in regards to road safety are set at infrastructure and improvement of the driving experience. Digital tachographs, on-time information systems (as of in e-Freight implementations) or an increased used of intermodality and resource distribution (as of in Co-modality implementations) are some of the specific plans targeting reducing road congestion and increasing road safety that can be directly related to ILP implementation.

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[10] The development of safety measures in vehicles has proven to reduce the amount of fatalities share from the total of accidents (CARE, 2012).

Figure 36 shows the incidence of road death per million habitants in the EU territories. These values tend to reduce yearly with the exception of east European countries at which the increase of transportation share by road[11] does not match the improvement rate of infrastructures. As a result, in the map, high incidence countries correspond to flourishing economies in EU such as Bulgaria, Poland or Romania.

Figure 36 – Road deaths per million inhabitants in 2009 (European Commission, 2012).

The improvement of infrastructure is one of the practices that the EU has put in place in these territories to combat accidents. But this solution does not change the fact that most of the traffic in Europe is of national road transport nature, nor resolves the total numbers of accidents in road transport in the EU that remain above targets in the upcoming years (CARE, 2012). Instead of investing large sums of money in existing solutions, Co-modality projects aim to release pressure off the roads by combining other means of transport and enabling the technical compatibility. This has been perceived as an indirect driver for road safety, given that the resulting de-congestion of truck transport from the roads favours private users. Other safety measures secondary to ILP can be found in e-Freight, where on-time management of routes allows more efficient transportation and less empty running thus a reduction of the total travels or congestion times.

[11] Economic and trade expansion has attracted a larger amount of transport in a short period in most of the East European countries.

4.7.3.1.2 Urban safety

Despite car is the most accident involved type of vehicle and private drivers entail the higher number of deaths in transport related accidents (European Commission, 2012), vulnerable vehicles and pedestrians represent a yet large number of accidents that occur mostly in urban and semi-urban areas.

Figure 37 shows the number and distribution of all sorts of vehicles. In some of the surveyed eastern European countries, this incidence is large in comparison to the total of the involved in accidents.

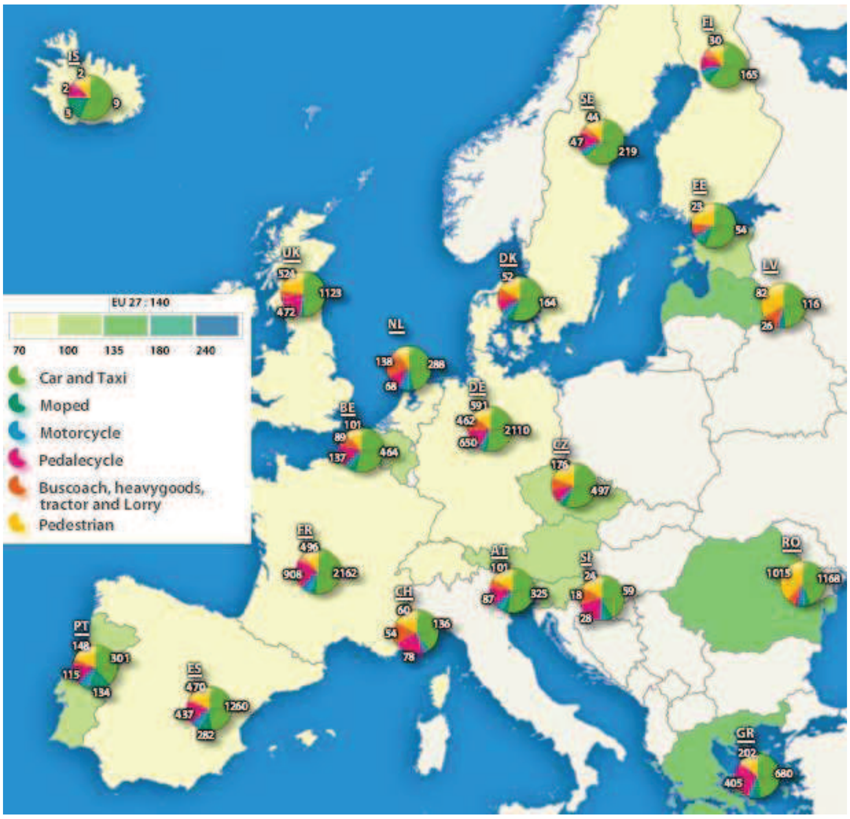

Figure 37 – Road deaths by transport mode in 2009 (European Commission, 2012).

As part of many UFT initiatives, these figures have been directly targeted as drivers for awareness of the public opinion and special precursor for local involvement. Urban safety is a local concern in contrast to the international importance of road traffic. In this sense, many UFT have succeeded in local initiatives of all sorts including the modernisation and education of the local population on urban safety measures. Partnering, mentoring and measures exporting are some of the spread mechanisms that have resulted successful in the implementation of safety related UFT projects. Some of the measures include infrastructure for vulnerable users such as pedestrians and cyclers or the improvement of public transport to reduce the total amount of vehicles on the roads. Other initiatives focus on the management of heavy traffic in order not to collide with vulnerable users in congestion hours or dense populated areas. These practices are some of the recommended drivers towards the involvement of local authorities, the main administrative targets (as they have also been identified as barriers to implementation by several surveyed projects) towards ILP acceptance and involvement.

4.7.3.2 Health concerns

The negative effects that pollution has on human health are well known by the authorities that work on the improvement of human environment at work places or urban areas in order to reduce the incidence of pollution related diseases. As previously seen in the health budget figures at Figure 34 above, the financial resources set for exclusively health concerns are significant, not to mention the interest of the WHO and other relevant health stakeholders into reducing pollution and other air quality related health concerns. The most common health affections caused by pollution are described in Figure 38. It is worth to mention the correspondence between air pollution and the most common causes of death in the EU territories: cardio-vascular and respiratory related illnesses (Eurostat, 2012).

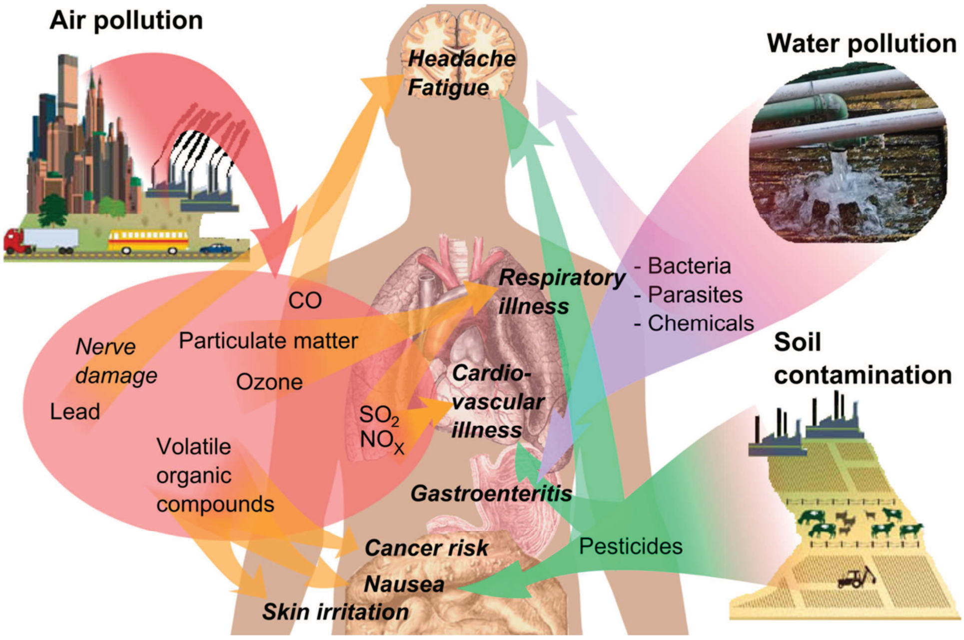

Figure 38 – Human health effects of different sources of pollution (World Resources Institute, 1999).

The exact amount of deaths directly related to air pollution is difficult to estimate given the complex scenario and the variety of sub-systems and differences among cities, but what is highlighted by the experts is that pollution increases the incidence and severity of these health affections (Eurostat, 2012). Moreover, several of these common pollutants have been regarded as direct health hazards and are monitored across EU as indicators of urban health. Figure 39, following, contain the amounts of PM_{10}[12] particulates, one of the most used indicators of air pollution.

[12] PM_{10} are particles >10µm of heavy metals and organic compounds as a result of combustion processes and chemical exposure. These, enter the human body through respiration being of special toxicity given their composition and size.

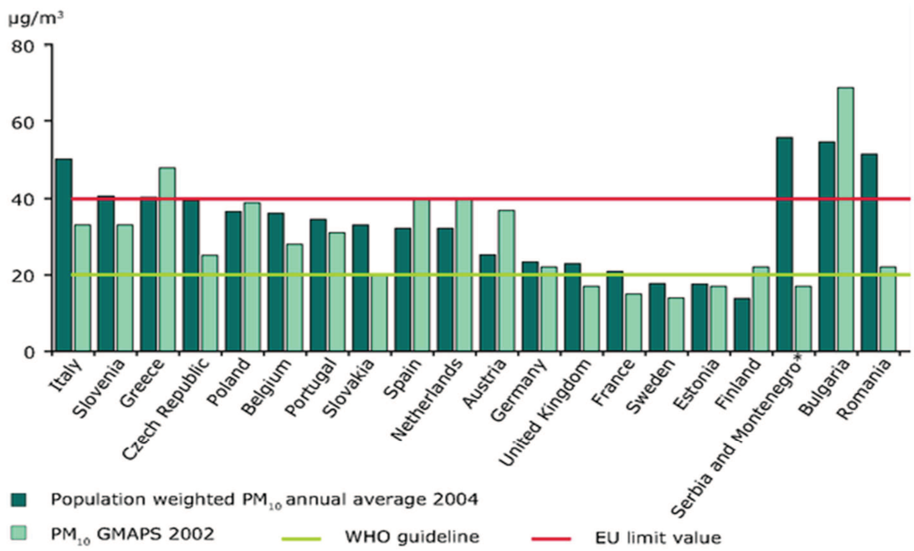

Figure 39 – Particulates matter (PM_{10}) average levels in some of the EU members

Local and regional legislation on the matter needs to be completed, in contrast to actual EU limits existing that entail economic penalties to infringement territories. Countries can suffer penalties if the air quality is not maintained as the CAFÉ directive stipulates. UFT environmental and air quality improvements are foreseen as great future potential business areas, given the increased share of urban population and the direct relation between fossil fuelled urban transport means and local pollution levels (European Commission, 2012). At the same time, there is a special attention of local opinion on this matter. As some studies by the European Environmental Agency show, quality of air is perceived as bad in many cities of Europe and this supposes a concern for citizens (EEA, 2009). For this reason, health improvements in urban and semi-urban areas should be targeted among the socio-environmental trends as driver for public opinion and a source of collective welfare.

4.7.3.3 Environmental concerns

Last but not least, the importance that environmental issues have in the EU targets has increased in the last decade. In this sense, some initiatives have had a great outcome from EU recognition to local implementation and spread of the same across territories. From the point of view of ILP, in special UFT as can be seen in this chapter, these initiatives represent good instruments towards niche markets penetration of new technologies[13] and the opportunities to gather the attention and financial support from the administration.

4.7.3.3.1 Congestion charging

Congestion issues have been recently targeted and regulated in some European main cities such as London, Milan or Stockholm. Environmental authorities of the EU recall that congestion is not just a nuisance for users but it also results in an enormous waste

[13] In this sense, technologies such as electrical driven or fuel cell vehicles or alternative fuels such as biodiesel or biogas are considered "new" given the low current penetration in the market in most European territories.

of fuel and productivity (European Commission, 2012). Therefore, it is not only a matter of environmental effects but also an impediment for economic activity as many supply chain activities depend on just-in-time deliveries and the efficient flow of production goods.

Table 3 – Changes to emissions of several substances after congestion charging implementation in London (Transport of London, 2006).

Area	**Charging Zone**			**City Centre**		
Substance	NOx	PM_{10}	CO_2	NOx	PM_{10}	CO_2
Overall traffic emissions 2002-03	-13.4	-15.5	-16.4	-6.9	-6.8	-5.4
Overall traffic emissions 2003-04	-5.2	-6.9	-0.9	-5.6	-6.3	-0.8

As it can be seen in Table 3, congestion charging implementation in the city of London resulted in an overall reduction of pollutants in the London case. Similar results have been reported from other cities with the same initiative in the following years to implementation. Nevertheless, population and number of city vehicles are also growing in these cities resulting in compensation in the reduction as it can be seen comparing the 2003-04 data with 2002-03.

This shows that congestion charging does not solve the environmental issue in cities by itself. Instead, joint implementation of UFT together with economic measures such as congestion charging may represent a competitive advantage to alternative modes of mobility against private car use. Therefore, congestion charging can be addressed as a complementary mechanism to enhance the positive aspects of ILP related environmental drivers in urban and semi-urban areas.

4.7.3.3.2 Environmental zoning

The so-called "green-zones" in Europe are urban areas that have been engaged to a pollution reduction plan based on the emission levels of the vehicles going into the city. With pioneer partners in Germany, Italy or Scandinavian capitals, these UFT based initiatives have resulted in the overall increase in the environmental requirements of fossil fuelled cars (LEZ Europe) but do not specially reflect on environmental awareness increase or the reduction of private car use.

As it can be seen in Table 4, private cars get a colour code informative tag associated with emission levels. These colour code needs to be present at the front of the car and it is the "access pass" to different areas of the designed cities. Vehicles with higher polluting levels than the specified by the code can be fined if they enter the environmental zone corresponding.

Table 4 – Environmental zone symbols and colour stickers for private diesel vehicles (Umwelt-plakette.de).

Pollutant Class	1	2	3	4
Sticker	Not eligible for a sticker	2 S-UM43	3 S-UM43	4 S-UM43
Emissions Requirement (Diesel Vehicles)	Euro 1 or older	Euro 2 or Euro 1 + Particulate Filter	Euro 3 or Euro 2 + Particulate Filter	Euro 4 or Euro 3 + Particulate Filter

This environmental zone intuitive follows the line of restrictive management solutions, such the ones that appear in some UFT regarding time-zone restrictions of heavy vehicles into city centres. Therefore, this instrument is foreseen as a good measure prior to some UFT implementation given the imposed performance requirements that might result into a competitive enhancement of alternative types of vehicles.

4.7.3.3.3 Alternative energy sources

When it comes to the discussion on alternative energy sources, UFT related projects tend to suffer from the same issues as the technologies themselves. From the point of view of LCA and economics, most of the alternative fuels are yet not a sustainable option given that cradle-to-user related emissions are in many cases above fossil alternatives or the fact that implementation of the infrastructure does not compensate from expected sells given the high competition of the market and the yet low penetration of such technologies in private fleets in most countries.

In regards to competition, it is of special interest to look at the different options of biofuels available and the many sources that they can be sourced from. It may be this large availability of options what diverts industries and actors into their preferred option. The market of alternative fuels is full of scattered solutions that up to today do not represent a relevant share compared to fossil fuels at any European country despite the efforts put into implementation (EEA, 2012). Figure 40 illustrates on the total share of penetration of all the alternatives to fossil fuels in some territories in EU. It is worthy to highlight the achievements of leading countries present at the bottom of the chart in spite of the overall EU27 unaccomplished targets.

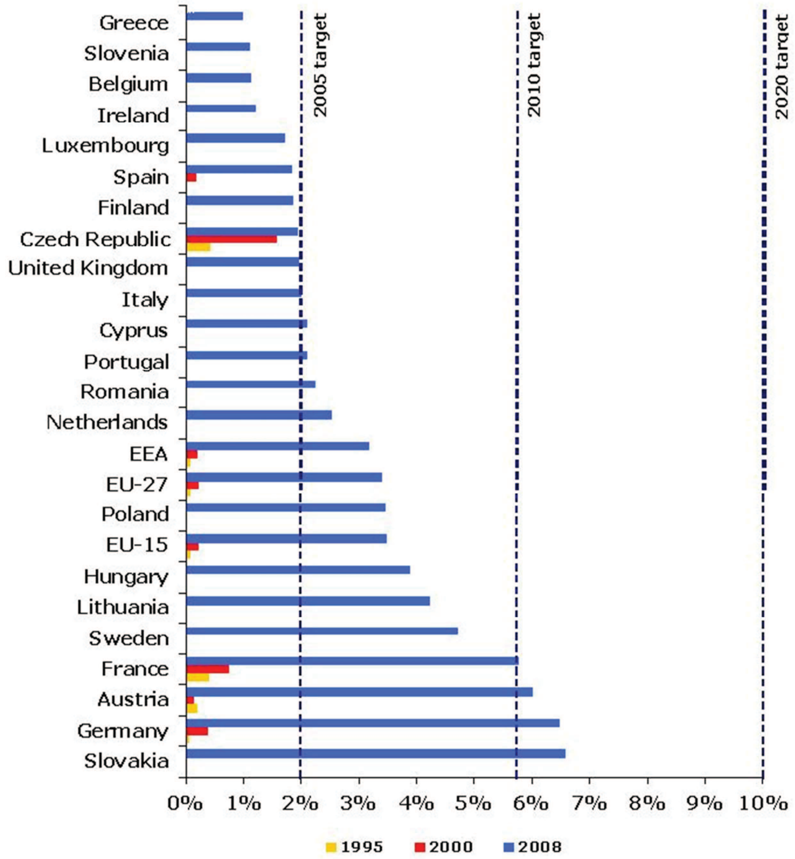

Figure 40 – Share of penetration of all alternative energies together in some EU territories (EEA, 2012).

Despite the efforts put into investments and policies to promote alternative fuels increase and evolve continuously in the EU, nowadays alternative technologies do not entail a driver towards the success of UFT. After the extensive literature review of the projects, not enough successful experiences focused on alternative fuels are seen to recommend the inclusion of alternative energies in UFT for strategic reasons[14].

4.7.3.3.4 Effects on the environment

Sustainable development arguments and environmentally "friendlier" initiatives are some of the most seen characteristics along the literature survey. It appears to the reader that almost any type of ILP is going to entail a certain environmental advantage. It is not strange to see this classification featuring LP as transportation is targeted as the second energy and emissions intensive sector of society only after household expenses. There are as well substantial efforts being put in improving policies and achieving targets of penetration of sustainable options for energy and services to the point that "environmental friendly" designation is set in many ILP without a substantial research behind the headlines to support the argument.

[14] This statement must not be regarded as a critique to the use of alternative energies but as a highlight of the difficulties that these technologies currently experience and the fact that they do not entail a driver for UFT.

These “environmental friendly” solutions, generally, come associated with a smaller need of energy/waste intensive activity as secondary effects from improved management of resources, modal shift or enhanced technical efficiency. It is true that less energy intensive activities result in the reduction of the total impact of society into the environment, but the nature of resources or tertiary issues must not be disregarded. In this sense, the present report includes a case study assessing sustainability of a co-modality project.

Often, among ILP, co-modality initiatives claim to entail environmental improvements when transferring transportation activities from trucks to high capacity trains. This assertion is true in regards of capacity of vehicles and energy use per tonne and km transported. But sometimes the use of electricity is regarded as a clean technology as there is no emission “at the end of the pipe” disregarding that despite the environmental advantage, electricity generation requires resources as well, sometimes even carbon intensive. Emissions from production of electricity and allocation issues are regarded in the case study of the present report in order to shed some light towards transparency in environmental statements.

Allocation is the key to understanding the real environmental impact as different activities entail diverse impacts depending on where do emissions take place and the total efficiency of conversion from energy source to service. As an example, a comparison between electrical driven delivery vehicle and its diesel alternative can be made. There are 3 main cases:

1. The country where the activity takes place is sourced with a great share of renewable energies and lower emissions result from running the car on electricity.
2. The country bases its power generation in coal[15] or other fossil fuels resulting on a higher emission result from the electrical vehicle given the energy losses inherent to any technical system[16].
3. Emissions result similar in both cases and the issue becomes where it is acceptable to allocate the emissions, in a high density populated area as the fossil fuelled vehicle or a remote location where electricity is produced as the electrical alternative.

Yet, it could be also discussed that the implementation of a relevant share of transportation to electrical supply may lead into a change in the energy mix of a country. The implications of such actions are discussed during the case study.

All in all, environmental “advantages” must be regarded with care before used as socio-environmental drivers and be based on technical studies rather than on general assumptions that might not fit the real circumstances and entail a mere marketing strategy.

[15] Carbon content of coal differs along the spectra of coal minerals from Anthracite to Lignite, 90% to 60% of weight.

[16] These losses take place mainly during energy conversion at the power plant (generation) and the drive train (transmission).

4.7.4 Technical management

Since there is a need for common technical supportive infrastructure, effective management and technological innovation for the continuous development of logistics practices in the EU, there is an influence of technical related drivers noticed during survey.

Technical, technological and managerial aspects do often fall in second or third places when discussing the implementation of projects. The real feasibility of a project is not clear when the same starts to be planned or even implemented. This practice, caused mainly by the different difficulties in the interaction between economic and technical aspects, can doom a great initiative in the paper give unforeseen obstacles. During the survey of the related ILP projects of this report, it has been noticed how technical and managerial aspects are often neglected, unclear or simply obviated from specific project planning. In this section, technical and managerial aspects and obstacles are regarded as part of the learning process towards the implementation of ILP.

4.7.4.1 Technology development

Economists often fail to see the complexity of technology when designing a project. Technology development is regarded as a black box with immediate productive outputs. Therefore, it is of great surprise when projects come to difficulties during implementation of technical aspects or even when the project results not successful due to lack of certain technical solution. Technical solutions are complicated to integrate even when the technology is in place and available. Instead of the economical black box, the technological system it is a complex system including production systems, users, techniques, institutions and interactions with other technologies (Bijker, 2001). This means that the mere purchasing of an existing technological solution is no guarantee to the implementation and success of a project. The required infrastructure needs to be in place around the technical aspects of the new system, users need to have the need for the innovation, be aware of the new implementation and be attracted and satisfied by the outcome and finally, the innovation needs to take a spot in the competitive market in order to enter the business. The difficulty of technological implementation lies on the necessity of these facts to happen contemporary. From invention to innovation and then to real diffusion, technology suffers from changes in its nature and in its environment. It is important to identify the real state of development of a technology in order to evaluate the potential of the same in the system it wants to be implemented in.

Demand is a great driver for technology and innovation. When customers require a product and this technical solution is available, this invention is more likely to develop inside of the niche market in which is needed and improve through feedback mechanisms inherent to development. These mechanisms consist of the so-called “learn by doing”. These phenomena occurs in all levels of technology where the constant gain in maturity and spread of competing developers generates sufficient improvements to benefit the entire invention and therefore reach a significant level of implementation (Arthur, 1989). This has been graphically explained in Figure 41.

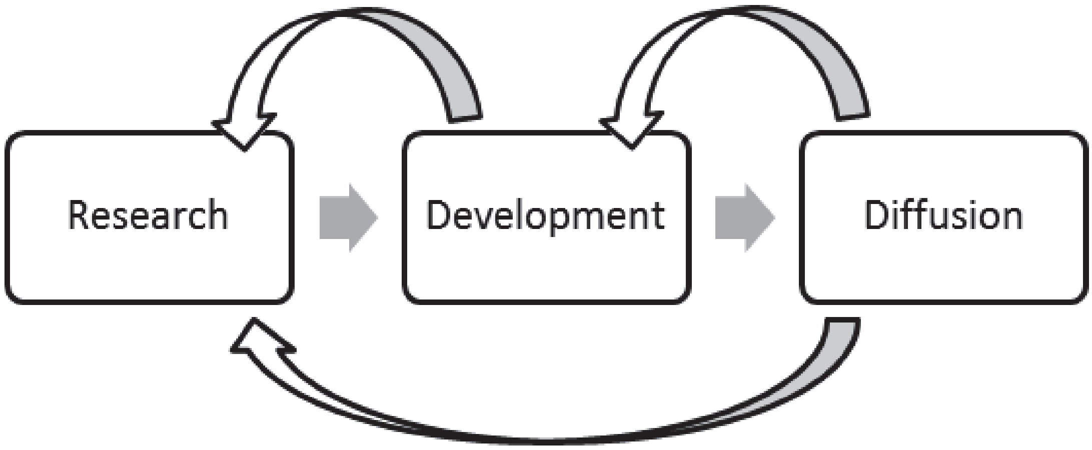

Figure 41 – Feedback mechanisms scheme on technology development.

Niche markets are essential for technology development. In this sense, ILP projects can act as niche markets for certain technologies given the involvement of different actor in the implementation of the same. As an example, UFT initiatives for local last mile deliveries (Cargohopper) result a niche market for small haul electrical cargo vehicles. The further development of infrastructure for these vehicles could reach the private sector and push this type of vehicles and practices forward as of the action of feedback mechanisms. At the same time, technology development and maturity might be required to be compatible with ILP, given the economical main drivers that will make investors reluctant to rely in immature technologies. This could be the case of e-Freight. Given the information sensitive IT solutions, stakeholders may not be willing to implement such solution if they do not count with a successful reputation. This fact is one of the encountered barriers that are discussed in following chapters; actors are reluctant to implement technologies without a documented expected outcome and therefore innovations result damaged by their nature[17].

As of the driver concern, it is of interest to target the growth phase of inventions due to the consecutive lower in costs and expansion to larger markets that is to be expected from a successful technology growth. Other positive mechanisms include advocacy groups, institutional adaptation, reduction of uncertainties, better service, greater value creation and increase attractiveness.

Therefore, technology by itself may entail a driver for ILP if the state of the technical solution fits the state of the market and the expectations of the different systems. It is of special recommendation to combine technology with other drivers, in special the social systems and make intensive use of institutions and advocacy groups give the necessity of penetration in the market and the possibility to perform this by creating demand for the ILP.

[17] Here, it is understood that innovative practices are based on new technologies and management strategies that have not yet been documented and monitored in many cases.

4.7.4.2 Management

Management consists of planning, organising, staffing, leading and controlling resources in order to accomplish desired goals and objectives (Koontz & Weihrich, 2006). Efficiency and effectiveness are also to be expected from "Best Practice" management and therefore from ILP projects. Transport management, by definition, integrates processes such as transportation planning, strategic and operation planning. These activities have impact on the use of resources and therefore a certain impact on the environment, society, and economy. Good managerial processes will determine the achievement of continuous improvements that can help preserving the environment while simultaneously meeting cost and efficiency objectives (Wu & Dunn, 1995).

From the surveyed projects, the entire managerial procedures can be extracted to define the steps planned for each initiative. Inside the work packages, the objectives, description of activities, timetables with milestones, outputs and deliverables are presented. ILP management encompasses the processes, functions, standards and technologies that enable high effectiveness and performance of the logistics practices to be implemented successfully. ILP projects reflect high targets and goals over the research of logistics sector to respond to the needs of society in term of economic and environment perspectives. Since some ILP involves several actors in different cultures, the tasks become unique and difficult to have a detailed scheme for how to implement in order to achieve the desired outcome. So, it is critical in organisation that everyone has the same attitude towards projects as primary goals and secondary goals for each division. The attitude and the initial work done to launch the project is the foundation for getting the project task going.

Coordination is one of the key tasks of management that is involved in all sorts of supply chain activities. These efforts and forces affect the projects' success from internal and external factors. For example, in a co-modality initiative that requires well interregional and international cooperation relationship among the countries in the corridor, coordination is a pre-requisite in order to share information, improve the efficiency of operations, and connect different regions not only physically but in term of management alignment. Another example is the effective management in UFT projects. In UFT initiatives, coordination is base of the strategy that targets to improve sustainability and increase efficiency in the field of urban delivery of goods. The small extension, intensity of the activity and short time windows are some relevant factors that require optimal managerial strategies to be set in place.

As the technology industry has changed rapidly over the years, technological support is required to adapt and improve the organisation to respond to the changes. In ILP projects, information technology management plays important role in number of ways. It enables collaboration and information sharing within and beyond the organisation. It helps in improving efficiency and performance. One example could be to establish a platform (or an international network forum) to exchange and share knowledge. Planning, organising and controlling are also key points that are sought to be implemented by means of e-freight and intralogistics. These types of ILP concentrate on indoors or internal managerial aspects that can benefit the business not only in economic terms but in indirectly in resource management and therefore affect socio-environmental previous numbers too.

Management in term of resource optimisation is also important. Resources determine how successful firms are as well as how successful project are. Resources can be both tangible i.e. physical assets and material, and intangible i.e. knowledge and reputation.

Insufficient in resource management may result in financial deficit and other loss. Therefore, resources must be considered carefully and economically to use.

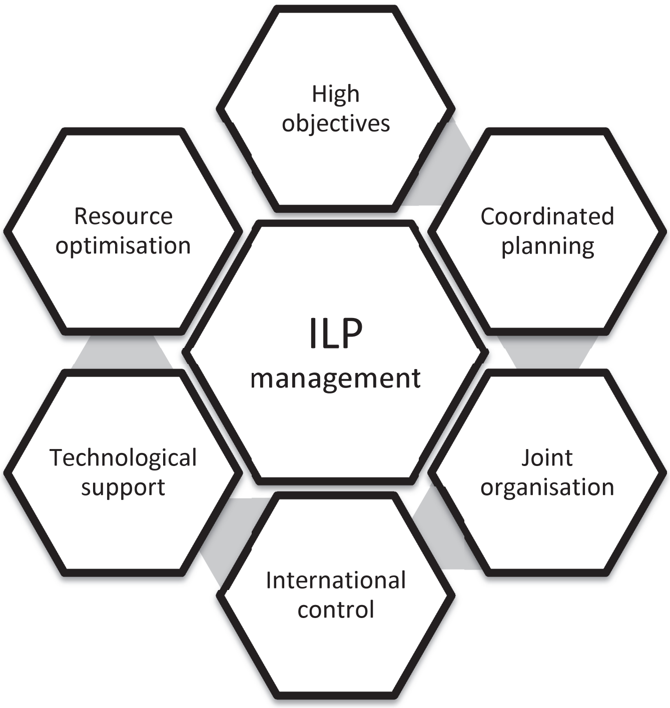

Figure 42 – Smart management from ILP projects.

All in all, it has been seen that ILP and what can smart management, described in Figure 42, walk together in pursuing business opportunities and implementation success. It is recommended to highlight these aspects of ILP when targeting the acceptance and attention focus to these initiatives since the quality of business and managerial models can improve logistics efficiency compared to the "business as usual" models. This facts can also entail marketing strategies towards the different stakeholders of the sector towards the expansion of ILP, such as intralogistics or e-freight, across the entire sector; factor that will enhance the overall benefits.

4.8 Barriers

A project that is theoretically feasible well supported and entails a great societal advantage can still be delayed during its implementation due to unforeseen barriers and impediments of very diverse natures. In this chapter, surveyed barriers are identified and explained in order to contribute to ILP initiatives.

4.8.1 Lack of standards

Often disregarded, standards entail the reason why it is possible to carry out business activity at the current international level. Legislation and technical requirements meet in these necessary documents in order to enable stakeholders to work in a comparable framework.

4.8.1.1 Data[18]

Data from relevant stakeholders is always a source of interest. Necessary data for ILP implementation includes administrative procedures, contacts, project portfolios and budgets including all their supply chain related activities, schedules, permits, environmental certificates or labour contracts among others. All this relevant data documents are sensitive pieces of information in regards to the development of the projects and can cause a relevant delay if not in place, if agreements are withdrawn or simply by the lack of transparency between parties that makes agreements tense and slow difficult procedures. There are some categories that data barriers can be divided into, these are quality, reliability and interoperability. These, have been identified as the main causes for difficulty in information matters during the related ILP, in Appendix A.

4.8.1.1.1 Data quality

The quality of data used by stakeholders will determine the quality of the decisions that are taken after the deliberation of such information (Pipino, Lee, & Wang, 2002). Experts maintain that if stakeholders assess the quality of data as poor, their behaviour is influenced by this assessment. At the same time, poor data quality can position one stakeholder far from its clients' interests if it is perceived negligence or a misuse of information with proven intention for benefit. Therefore data quality must be regarded as a crucial requirement towards transparency and profitable stakeholder relations.
Companies must deal with both the subjective perceptions of the individuals involved with the data, and the objective measurements (Pipino, Lee, & Wang, 2002). In order to diminish subjectivity, a recommended method is to proof information with the categories following at Table 5.

[18] It must be highlighted that in this chapter, data and information are terms used as synonyms in contrast with the chapter Lack of information, where information is regarded as project related knowledge while data refers to collected value for manipulation purposes.

Table 5 – Data quality dimensions (Pipino, Lee, & Wang, 2002).

Dimensions	Definitions
Accessibility	Extent to which the data is available to the stakeholder
Appropriate amount	Volume of data that is appropriate for the task
Believability	True and credible data, appropriately sourced
Completeness	Sufficient data without missing contents
Concise representation	Extent of representation of data, as compact as feasible
Ease manipulation	Data must be easy to deal for different tasks
Free of error	Correct and reliable data
Interpretability	Appropriate languages, symbols, units and definitions
Objectivity	Impartial data
Relevancy	Applicable and helpful for the task
Reputation	Regardless of the data, sources and content
Security	Appropriately secured information
Timeliness	Up-to-date data
Understandability	Easily comprehensible information
Value-added	Beneficial and advantage providing data

All of these categories and the relations that exists between them illustrates on what experts high light as "one size fits all", and how this wouldn't fit in data quality assessment (Pipino, Lee, & Wang, 2002). Instead, assessing the quality of data is an on-going process based on the principles exposed and in the placement of metric controls to keep a track of information development.

4.8.1.1.2 Data reliability

The human dimension of any project or process has a risk factor associated to the fact that humans make mistakes (Taylor-Adams & Kirwan, 1997). This opinion is extensively shared across society, but not so much the acceptance of mistakes in certain processes. An error caused by the misuse or misleading of information has a crucial role in the development of a project and it highlights that quality procedures are not set in places and often invalidates the entire information compiled to the moment or denies the credibility of the sources. As expected, this happening in an international project could also have further relationship detriment effects. Therefore, reliable information is a crucial asset for the development of any task. ILP as innovative actions have yet another dimension in the importance of reliability given the often new features that they present to the market and that the feasibility of an entire new system or technology with great prospects might depend on each and every single of the data that studies have been based on.

Data can be collected in regards to an error occurrence in order to estimate and predict past/future occurrences and calculate the degree of reliability remaining. Proper recording and manipulation of information sources can lead to diagnosing this issues and take corrective actions (Guitard, 1989). Despite methods and tools in place for this procedure are expensive and time consuming, neglecting of quality and reliability controls might lead to worse situations for the project. Therefore, is recommended to set objectives, clear forms that are easy to use by stakeholders, secure storing and confidentiality registers and clear paths of information distribution across the hierarchy of the project in order to mitigate possible reliability issues. The three main steps in each of them are as simple as analyse, report and follow up (Guitard, 1989). Daily used tools can complement these steps and ensure not only good communication but clear procedures and sources for the benefit of the ILP implementation.

4.8.1.2 IT interoperability

Interoperability, in the business definition, is the ability of a company to collaborate with others, or among internal organisational units, using information technologies (Irimia, 2011). It is understood that a sustainable company needs to be interoperable both externally and internally in order to optimise the use of resources or acquire necessary relations with the entire supply chain with smooth performance based on the modern IT solutions available in the market. In this sense, e-Freight and Intralogistics are the two most concerned surveyed types of ILP. The concerns for IT interoperability are not new or specific to supply chain management. From the creation of the World Wide Web and the availability of online digital content it has become more increasingly difficult to provide and maintain the media by which data can be used by the stakeholders in a similar frame (Smith, 2008). Current enterprise interoperability is targeted as a bottleneck for further globalisation and economic growth in the EU territories (Irimia, 2011).

The IT sector can be used as an analogy to the ILP interoperability issues given the relation that both have in the form of software, tools and hardware required in ILP that make an extensive use of IT resources. Experts highlight that with the growth of the sector and the increased amount of stakeholders, finding relevant solutions get only more complicated (Smith, 2008). This difficulty is graphically illustrated in Figure 43, as a puzzle that requires coordination and cooperation among the relevant users of the system. A significant improvement source may arise from standardisation and commercialisation of usable platforms to the reach of each interested parties. Still, competition and lack of prevalence option has left the market highly segmented.

Figure 43 – Interoperability among stakeholders graphical representation.

Common interoperable frameworks shall be considered and explored in order to be able to access the data regardless of which segment of the sector one consumes products from (Smith, 2008). It has been highlighted that cooperation is crucial in this step given then intricate nature of IT solutions and the rights existing in the content of each product and provider company. This sheds a light on the difficulty in the implementation of complete compatible solutions given the lack of cooperation from different segments of industry. Therefore, it is of great interest to carry of extensive research about platforms in use with relevant stakeholders prior to planning to foreseen possible IT interoperability issues. A great effort in negotiation might be necessary in most cases if this issue has not be brought to the discussion before given the neutrality of IT solutions (there is no "better" option and competing products have similar features). To start with, recommended targets include internal scope of standards, towards the adoption of international references; processes, that might occur systematically across the business and be audited regularly towards achieving excellence; document exchange, both in formats and exchange procedures and service integration through common platforms with the IT platforms in place homogeneously across these functions (Smith, 2008).

All format, language and technical standards will contribute towards harmonisation and convergence in pro of a gradual adaptation of stakeholders and their assets and systems enabling interoperability for both supply chain stakeholders and ILP projects.

4.8.2 Lack of cooperation among actors

As previously mentioned in Management, coordination is a grey tool towards the smart management of resources and can help a project achieve enhanced results. But coordination results difficult when there is a lack of cooperation among relevant actors.

Cooperation results critical in addressing a wide range of common highlighted challenges faced by surveyed ILPs including border consolidation and customs security crossing, trans-boundary water management, international or interdisciplinary infrastructure arrangements, trade and communications, good governance, sustainable development and security concerns (COJOCARIU & Radu, 2013). ILP success has been observed to come associated with a strong cooperation among relevant actors, since it requires multiple levels of involvement from local to national levels. Lack of cooperation, therefore, has been surveyed as a barrier towards the success of ILP. This lack of cooperation has been especially situated among institutional the actors such as governments not willing to implement not binding directives, private stakeholders with prominent shares of the market that tend to consider their competitiveness not in risk or the local opinion that tends to show rejection even to the most sustainable options if the right information via are not used to inform them along the implementation process.

This flexible relation in cooperative/non-cooperative sheds a light on how important negotiations and involvement are to the development of ILP. It is worthy to mention that as a general rule, there are many stakeholders involved including government, private stakeholders of all sizes not to mention customers, public opinion or technology developers. It is necessary to analyse each case in deep and determine valuable alliances that need to be fulfilled in advance and maintained during the implementation. The following main group of cooperation can be highlighted in ILP:

- Government**:** institutions have the role to lay the foundation for ILP through public opinion interest preparation, framework hosting or legislative support in all levels (local, regional, national, European). In surveyed ILPs, government authorities are the main support, especially local and regional authorities involved in local/regional development. These regional projects are limited applications of ILP through test experiences with a great share of local interest and public involvement. It has been observed how at regional level, cooperative partners are easily found given the common strong interest in the socio-economic development of the urban and semi-urban context. The most difficult government cooperation context occurs in International agreements. In these, the political interest that have a limited durability in scope compared to the scope of

ILP seem to have conflicting trends on which the sudden changes or withdrawal of agreements of cooperation among governments causes delay or unfinished projects to fail. In order to secure these procedures, letters of support and international cooperation are signed by the authorities with a medium-high level of implication but that is shown to be phased out if long delays in the projects take place or EU funds run out.

- Supply chain members**:** Lack of cooperation between terminal operators and logistic service providers becomes a barrier in implement in co-modality and UFT initiatives since the involved parties try to optimise their own business operation in detriment of a coordinated venture. There is also a privacy-seeking. Lack of cooperation, in this case, results in inefficiencies in operational processes as well as in information and communication flows.
- Competing companies: disloyal rivalry or unknown common benefits for the supply chain providers with different competences arises from the lack of information on the size of possible profit increase from cooperation schemes and integration of supply chain partners. In special, small practitioners or companies within the supply chain sector tend to dis-align with relevant market holder as pursue of competitiveness. Instead, they fall behind with obsolete practices and face greater modernisation challenges that in a cooperative relation with a big firm.
- Customs agencies, borderlines and controls: customs have a role and responsibility to control import-export goods and secure the safety at the borderlines as consequent extension of the safety of the territories. The problem that is found in this task is an inefficient clearance of goods at due to lack of coordination agencies. Standardised procedures at EU level at the border agencies will enable communication and bilateral control reducing clearance times and avoiding double tasks. It seems shocking to practitioners to have to face ineffectiveness in borderlines across the EU given the amount of organisms that are shared across the continent and the member states.

Surveyed reasons for difficulty in cooperation have been highlighted specially in co-modality projects where land and jurisprudence issues arises constantly and are time consuming as they need treaties and frameworks to be set in place. Some barriers for cooperation observed in these cases include the diverse institutional cultures, clustering projects, different policy makers' opinion (and the fact that politicians' scopes are normally shorter than ILPs' scopes), language and strongly rooted procedures.

In order to enhance cooperation and communicative manners of solving these impediments encountered, the levels of cooperation are described as:

1. Information-sharing: given an overall security and confidentiality agreements, information sharing for joint development should be a matter of harmonisation and standard application rather than a discussion among competitors with an immature view on the common benefits achievable.
2. Coordination of the stakeholders' strategies and projects: once it is clear the capacity and capabilities of the stakeholders, achievable projects arise from the homogeneous contribution of the actors. This level of cooperation enhances the efficient use of resources and reduces doubling of task or time consuming discussions on jurisprudence.

3. Identifying joint visions and goals: in this level, all stakeholders truly work together and produce a joint document that outlines a future that all seek for. This document entails the project outline containing visions and goals and should be accompanied with commitment treaties and time horizons.
4. Joint development and implementation of projects: if cooperation truly succeeds, this level should not entail more than a technical phase during which the construction of the project takes place. In previous levels are fulfilled, no delay should be expected from administration or stakeholders sides.
5. Joint institutional support: tight together with the fourth level, institutions join the cooperation in a higher level but necessary as frame and validating organism for the venture in an EU level out of the pure private interest. Long-term oriented policies are recommended as well and enhancing transparency in relation with high spheres and clear administrative paths towards successful implementation.

In most of the surveyed ILPs, difficulties are met already at levels one or two that continue in place during the progress of the project, often caused by private stakeholders. The difference between the private and the public stakeholders is that the private actors are usually committed as businessmen and their focus is immediate profit and not so how significant a project is to the territory. At the same time, city, regional and national politicians have a short residence time in the scope of ILP projects that can have validity up to 20+ years given the infrastructure or policy plans based on. This is sometimes reflected on lack of interest or change in the commitment from previous administrations as political positioning. For both private and politician sectors it is important to highlight not only the economic but more specifically the socio-environmental advantages that ILP entail and that will benefit largely the entire society for a longer period of time as their respective scopes. ILP are not only a supply chain related business opportunity but a great instrument towards reshaping actual energy intensive reality towards sustainable smart and efficient futures.

As mentioned, there are certain factors that influence organisations in their decision to contribute in cooperation (Thomson & Perry, 2006):

- Interdependency: in form of loyal competition and sharing outputs by which create cooperation among organisation parties. This factor is key for cooperation (Schermerhorn, 1975).
- Need for resources and risk sharing: when facing resource scarcity in economic and technological aspects, cooperation increases the chances of survival of a project. In the same line, when risks are assumed by a collaborative amount of partners, mutual support, capabilities and experience will minimise the effects towards the common achievement of the goals.
- Relationship: when relationships start and take place over time, there is an expected growth in trust that acts as positive feedback mechanism towards cooperation in the present project and in the future. Therefore, cooperation develops faster among organisations that have previously worked together. It is important to maintain these relationships and to export the benefits in clear advertising material to make other partnerships develop faster based on the achievable greater outcomes that can be expected.

All in all, ILP projects require interdependency of parties, risk sharing and long-term communicative relationships in order to have a strong cooperation mechanism to enhance the results of the venture among all actors to optimize time and resources. It is highly recommendable to contact previous partnerships and increase the level of experience share.

4.8.3 Financial barriers

From initial investments to pay-back time, different economic aspects of the funding of a project can act as a barrier towards the implementation or the expansion of a related technology.

Any organisation has the ability to improve the way in which projects are implemented to be more efficient. However, no matter how efficient a project is planned to be, if the project being implemented is not in alignment with the organisation's financial goals, there is a limit to how the organisation will get payback from the project. Budget restrictions limit the overall expenditure on the strategy and are often subject to change given the past profit figures or expected market reduction due to economic conflicts in the sector. As a result, projects get delayed and the costs overrun (Callahan, Stetz, & Brooks, 2007). In general, a project's budget must be based on current strategy and financial goals but flexible enough to be able to adapt to incoming trends and unforeseen issues. Information below is input into the budget process, but often neglected its importance compared to obtaining finding or other economic aspects:

- Detailed deliverables with timeframes and descriptions of scope and content.
- Set of tasks that describe the work necessary to complete the deliverables.
- List of resources needed for the completion the tasks, including personnel and other contracting assets.
- Estimates of the effort needed from the resources to complete the tasks, timeframes.
- Constraints including availability of resources or training necessary.
- Mile stoned schedule of each task that will lead to the finish date

The source of budget may come through general public, government and private foundations depending on several constraints such as the continuity of project (short-or long-term), amount of financial limits, and the involvement of different resources. This complexity, as previously mentioned often neglects the necessity for budget updated plans and communication of these to the stakeholders in order not to incur in risking the project.

Besides keeping in budget, the challenging financial bottlenecks have been identified as the following (European Commission, 2012):

- High risk of investments in research and innovation and difficulties of the financial sector to assess the potential of new technologies: this highlights the lack of cooperation between financial and technical sectors. Technical advice for finance decisions is recommendable for ILP giving the complexity of the supply chain solutions.
- Difficulties of accessibility to finance for innovative during the financial crisis since banks are more risk-averse: this can be seen in Figure 18, where the crisis hit in the EU can be clearly identified as break in the tendency of number of ILP investments.
- The unwillingness of financial institutions to lend money without collateral hampers innovation and the growth of innovative companies: this conflicts the

nature of innovation and reflects on the misconception of diffused invention and innovation as in Technology development, in page 64.

- Public financial support for research and development at national level is scarce, very fragmented and cyclical depending on the availability of budget resources in the EU members: this fact its enhanced by the fragmented technical sector that enabled unlimited solutions in terms of IT or transport new technologies that disables harmonised implementations across EU.

It can be clearly seen that there is high potential need for public support to leverage private sector and start-up funds to fill the gap where public research grants stop and private finance is not available yet due to the risks involved. It is also necessary to link technical development nature with financial aspects in order to better understand the scattered market of solutions available and the high risks associated to unilateral investments across EU for security of supply reasons. This awareness and collaborative relation could benefit largely ILPs financial barriers towards better risk assessment.

4.8.4 Infrastructure

Infrastructure entails the material means thanks to which productive processes and services can reach the entire industry and society. It is important to have the necessary infrastructure in place to implement ILP.

Infrastructure is defined as a basic framework needed for operation of a society (PricewaterhouseCoopers, 2009). Buildings, terminals, roads, communication networks and energy supply facilities are some examples of infrastructure. It entails a powerful long-term investment, with expanded life cycle, which involves significant amounts of lead-time to develop, plan and implement, not to mention maintenance investments for its continuity in time. Infrastructure of quality is associated to high cost investment and large time scales in proportion to the scale of the project. Therefore, when implementing ILP, infrastructure efforts become one of the barriers that have been found in most of the projects. Infrastructure has different meanings depending on the type of ILP:

1. E-freight infrastructure refers to data centres, computers and other physical facilities, secure data connections or networks among others. It plays a significant role in transferring, connecting, and accessing data; becoming barriers when implementing the ILP and when they are lack of reliable data, interoperability or availability of tools.
2. Co-modality initiatives require the implementation of large physical infrastructure and maintenance/adapting of the existing one that enable the compatibility among the different modes. The bottlenecks that have been found in co-modality are as follows:
    - Rail infrastructure limitations: capacity restrictions in the network, slot restrictions, single track, missing electrification of railways network, and incompatibilities in rail gauge in different areas of Europe.
    - Port congestion: capacity problems and delays, insufficient cargo loading/unloading and handling capacity.
    - Limited port hinterland connections: Insufficient capacity, the capacity of the port has exceeded the capacity of the hinterland connections, congestion, and lack of availability of access to land around the ports and the acceptance of the public opinion to build new transport infrastructure close to urban areas.

3. UFT initiatives follow rapid urbanisation in European cities. These growing and fast paces are key challenge when implementing the ILP since UFT involves applying technical platforms to existing limited available space. Those in support of efficient routing vehicles and demonstrating electric commercial vehicles became very popular among the initiatives, followed by a wide range of new fuels. Cities do not seem to be prepared for these high costs of investments, being these one of the main obstacle to this infrastructure. In spite of developments of electric mobility, long-haul road transport will continue consume fossil fuels. This brings up issues related to resource scarcity and the fluctuation of these fuels' pricing (as crude oil supplies are unavoidably reduction, worldwide oil consumption is likely to become higher and fuel prices are predictable to increase consequently). The success of these "new energy carriers" initiatives will depend in the payback of the infrastructure that will at the same time depend on fossil fuel price fluctuation.
4. Intralogistics are based in high technology solutions that cannot be proved unless already implemented, for this reason and because the effects cannot be foreseen or implementation requires the facilities of the business to be put apart and in place again, most of the supply chain actors do not invest in intralogistics as long as their business as usual is still profitable.

Countries involved in ILP development is concerned about the need to build strong infrastructures combined with the issue of allocating sufficient capital resources to such projects. There are varies opportunities and availability of capital for investment in transport infrastructure from country to country. It becomes the task of governments to manage supply and demand and balance between funding and financing of new and maintaining and upgrading of existing infrastructure in order to deliver sustainable urban areas. A certain amount of legislation, as previously mentioned, would be necessary to elevate the concern to the EU level and act as a harmonising force across the territories. Otherwise, the segmentation present in the sector or the isolation of projects will continue as previous experiences.

On the other hand, logistic service providers have a role to rethink city delivery services programmes and develop innovative city logistics solutions for example, last-mile services and home deliveries in UFT that have a great potential but a low collaborative incidence among small practitioners.

As of emerging countries, the difficulty lies in the rapid construction of new basic transport infrastructure capacity that is based in obsolete models already proved unsustainable in the rest of Europe. While more developed countries face maintenance and modernisation issues, emerging economies have the opportunity to learn from the mistakes made in the past by their predecessor economies and implement sustainable and modern solutions taking advantage of the availability of funding attracted by their view as new markets.

4.8.5 Lack of information

Information is often taken for granted in nowadays society. But information can be the key to the implementation of ILP and must be properly addressed. It is not only necessary to analyse the character of the information but the use and access of it towards successful business experiences.

4.8.5.1 Effectiveness

As important as an efficient use of information is an effective application of the content of it to the socio-economic aspects of a project.

In cost benefit analyses, the decision rule is straight forward: when possible benefits exceed planned costs a project will be implemented and otherwise rejected. Nevertheless, limiting decision making to monetary aspects may incur in error when dealing with socio-environmental aspects of projects. Decision making is made easy in some circumstances in order to put a numerical value on aspects like quality of life or safety and then decide whether or not to implement. Besides the ethical discussion, this is also a difficult matter from the point of view of calculation. Studies stating the value of socio-economical assets such as biodiversity, climate change or human health are estimations that often need to be contextualized to the real situation of the country future prospects or the societal current needs. Some argue that setting thresholds lower than the real value of these assets could lead to uncontrolled expenditure growth and that offsetting calculation assumption by small numbers leads into great differences in cost (Briggs & Gray, 2000). In this sense, for the future benefit of ILP projects, more effective and accurate information systems and evaluations are necessary in order to cope with socio-environmental systems and their future development. ILP projects, as visible parts of supply chain systems close to society and featuring sustainable initiatives, are great candidates to lead this path in combination with the hereby highlighted necessary improved decision making process based in effective information as this adjustment will tend to increase the value of socio-environmental systems and therefore reinforce the competitiveness of ILP initiatives. It is worth to mention that the implementation of such new methods is at reach by gradually adapting current measuring levels to more realistic values in sync with scientific predictions.

4.8.5.2 Complexity in administration

One of the most common difficulties in the projects surveyed was disguised in the shape of “framework requirements in conjunction with authorities” or “cooperation efforts towards interoperability”. From the repeated appearance of these sentences is of interest to comment on the fact that administration seems to be a critical issue rather than the lack of cooperation or authorities support in some cases, given the fact that EU is putting great efforts in funding and many international successful experiences are met in supply chain systems.

Administrative complexity can be due to two main components: decision or information overloads (Kerridge, 1997). These normally come together in the case studies presented in which the decision making is based in many documents that need to be contrasted, analysed and considered. Mistakes are not out of the picture when administration is of local, national or international nature. A governmental decision maker has normally abundance of such case studies of different natures and often little or no technical knowledge apart from consultants. At the entrepreneurial side, this difficult in overcoming administrative barriers tend to withdraw entrepreneurs from presenting their projects or to abandon the fight once started and faced too many unforeseen obstacles. Furthermore, this complexity has been said to have risen significantly in developed countries due to increasing demands from governments (van Stel & Stunnenberg, 2006). A good proof of this arisen complexity is the current organisation of the EU, in which several sections relate to each other in decision matters as illustrated in Figure 44.

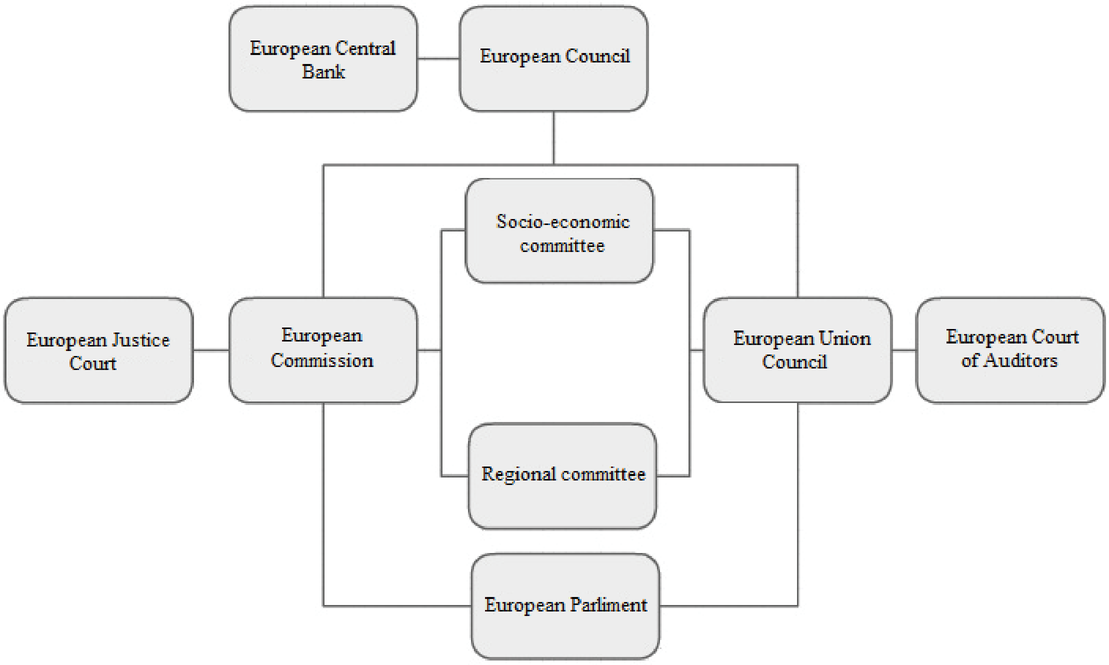

Figure 44 – Organisation chart of European Union (based on information from EU Council website).

Administrative complexity is targeted in other sectors as cost-effective impediment to the smooth management of resources such as medical care. Here, the time spent by staff in fulfilling forms or procedures with several different standards in places, negotiation time, claims or contract negotiations accounts for a reasonably significant sum in order to be targeted as an issue (Pope, 2004). These facts could be easily translated into the supply chain sector without incurring in generalisation error. For example, large sums of time are spent in "old-fashioned" systems, customs or filling different information standards that are often not compatible among each other and disable communication flows in detriment of the logistics activities. This is one of the precursors for e-freight itself. Negotiations are part of the business, but often the difficulty rises when dealing with international authorities and much more when different inter-territorial agreements are necessary in order to obtain permits, contracts or mere strategy alignments. Therefore, and since time is money in this fast moving economy of EU nowadays, it is necessary to foresee administration and push for improved methods for the future of ILP. It results difficult to believe that the joint EU nations could result sometimes in such competing and inflexible separate organisations especially when the immediate economic benefits of enhanced logistics are in prospect. The efforts put in designing an ILP will not result productive if the administrative steps to be followed are not simplified, clarified and of easy access in order to forecast during the premature steps of the project.

The recommendation in this line is to work closely with regulations and standardisation in order to improve strategic alignment. One effective way to reduce administrative and bureaucracy related complexity is basic quality's principle of establishing control charts (Kerridge, 1997). As quality controls' standardisation, these principles are relatively easy to implement and could result in a great overall benefit for administration in EU.

4.8.5.3 Public opinion

Public opinion is one of the most powerful and fluctuating forces in social-related systems. It is important to address this importance and not disregard the information channels to population.

Public opinion is the aggregate of the individual attitudes and beliefs of the population summed in an orientation[19] that may be regarded as the general consensus. This collective behaviour can play an important role in decisions and act as propaganda for the accepted themes. An informed public opinion could result positive in reinforcing a socio-economic or socio-environmental initiative towards getting the relevant governmental attention or support. Research lines on public opinion focus on the effects of deliberation. These demonstrated that allowing population to deliberate does cause changes in opinions and increases political and technical knowledge, increasing opinion consistency. It also benefits society from increased mutual understanding and broader tolerance and participation (Hansen, 2007). The great majority of the public is able to weigh the various arguments presented when competing alternatives are presented against the common conception that public opinion is rather unsophisticated. An informed society[20] is more capable of assimilating the pros and cons of each alternative and will tend to present positive approaches to suitable options.

Political trends tend to modify the arguments, determining predisposition to follow the option most related to the person's own political beliefs (Hansen, 2007). Therefore, is of importance to discern political interest from the socio-economic and technical objectives of project, such the case of ILP. In this sense, it is more likely that a political-opinion free population will judge the presented alternatives and deliberate based on the information given. Whether this will support of not the implementation of an ILP will depend on the current socio-economic circumstances but in any case not suppose an opaque immutable barrier but rather an effective quality control.

All in all, and given the combination of cost-effective solutions with enhanced socio-environmental scenarios that ILP can bring, it is of special interest to inform about the advantages with clear and trustworthy information to population. It is expected that public opinion will support the competitiveness enhancement, modernisation and energy-reduction of supply chain systems rather than impede its development if the direct benefits to it are clearly presented.

4.9 Sustainability Assessment on ILP

In this section, the case study developed towards the assessment of sustainability in the transportation practices is explained. Through the description of procedures used and assumptions made, the relevant aspects towards sustainable transportation are identified and discussed.

During the survey of the ILP projects within the scope of the present thesis, a great incidence on environmental concerns indicators has been identified. Most of ILP project related documents claim to suppose an environmental advantage respect of traditional logistics solutions in place before the implementation. This sustainability based

[19] Often public opinion results divided, confronted or segregated.

[20] It is understood that this society counts with reliable information to base its opinions on.

“marketing” is a common practice, as previously discussed during the LCA methodology description, but it is not always clear what is the real environmental advantage or even what the impact is caused regardless of the nature of the project (traditional LP or ILP). Of special importance given the previously seen interest from authorities into achieving more sustainable modes of transport, the arguments used to claim more environmentally friendly practices pursue have been highlighted:

- Increased efficiency thanks to alternative high capacity modes of transport reduce the amount of negative related effects (BATCo).
- Reduction of energy use (C-LIEGE).
- Modal shift towards sustainable mobility (CIVITAS).
- “Green” alternatives: biodiesel, biogas, hybrid and electrical vehicles (CIVITAS).
- Intermodal transport for a more sustainable logistics experience (FLAVIA).
- Fuel dependency reduction through traffic management (FREILOT).
- Develop a “green” and innovative corridor (SCANDRIA).
- Reduce road congestion, CO2 production and noise (STRAIGHTSOL).

These claims have in common that the environmental targets are rather primary goals or desirable related effects of the implementation of the projects and without background information is it difficult to relate to the real environmental advantage related. For example, in the case of UFT implementation of “green” energy sources new means of transport, the adjective “green” is commonly misplaced without taking into consideration the origin of the new energy source. In this sense, as many LCA related studies show, some alternative energy have no “end of pipe” emissions but have an energy intensive production process before reaching the tank of the vehicle and they result in no environmental advantage respect to the use of a traditional fossil fuelled vehicle. Some examples are first generation biofuels or hydrogen-cell vehicles (Dincer, 2000) (Cherubini, 2009). Nevertheless, this affirmation must not be regarded as a direct criticise to these alternatives energies but to the automatized application of the adjective “green”.

4.9.1 Case study description

Some the most addressed nuisances from traditional LP are the intensive use of road transport that result in increased GHG emissions (as seen previously in Figure 4) and other related issues such as congestion and road accidents. The ILP type co-modality deals directly with this issue by identifying alternative uses of existing technologies and supporting the creation of infrastructure towards a more even distribution of transport modes. One of the most often suggested alternative means of transport is the railway. Freight rail is presented in many of the revised ILP projects as a sustainable alternative to traditional truck based transport due to the use of electricity, the higher capacity of the vehicles or the penetration that renewable energies have in the European electrical generation.

This case study aims to illustrate on how sustainability assessment reaches beyond mode of transport or type of energy carrier used (diesel for the trucks, electricity for the trains) and the factors behind real environmental impact reduction towards a holistic view of the strong relations between technology, energy and the environment. Co-modality and specifically substitution of road transport by railway transport has been selected by among other factors being a recent priority in most of the surveyed ILP Co-modality projects and having an special interest in regards to energy use and renewable energies (in relation to electricity production in the EU).

The bases of the study are the analysis of the different energy/material flows into the logistics systems and the evaluation of the impact of these thanks to LCA characterisation. Following, Figure 45 illustrates on how independently of the energy source, any of the transportation systems that are analysed in the case study have the "positive" outcome of having the goods delivered to wherever necessary and the "negative" related outcome of emissions.

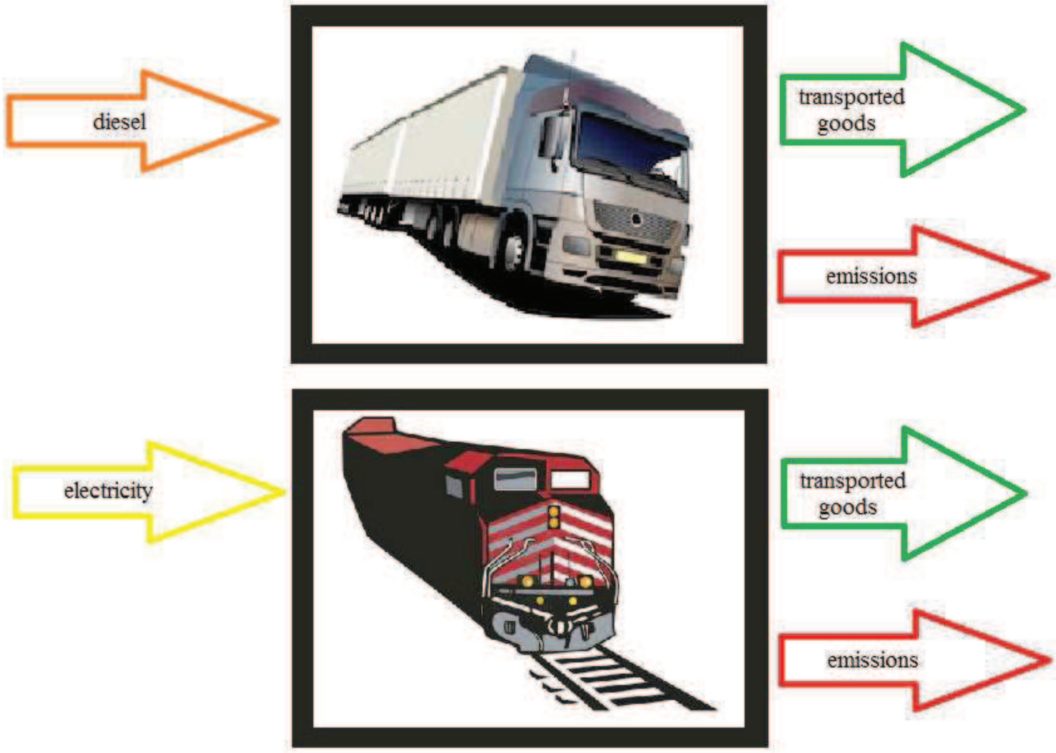

Figure 45 – "Black box" schema comparing transportation systems.

In the case of traditional truck transport, emissions take place directly at the mean of transport, coming out from the system as exhaust gases. This enables the direct relation between environmental impact and exhaust gas coming out of a pipe. But in the case of train transportation in Europe, emissions take place away from where the energy is used. The "end-pipe" in this case can be pictured as the exhaust of the corresponding power plant but this simplification can lead into a large error when LCA is involved. Instead, the entire electrical production of a territory is addressed in order to give room to the influence of renewable or "carbon free" energy sources. It has been excluded from calculation the influence of import-export of electrical activities in order to simplify the results given the "free" market that electricity entails in Europe.

Following, Figure 46, contains a graphical representation of the selected co-modality "from truck to rail" selected corridors. These have been selected given the extensive variety of territories they encompass and the fact that they connect important basins or emerging European economies with the rest of the EU.

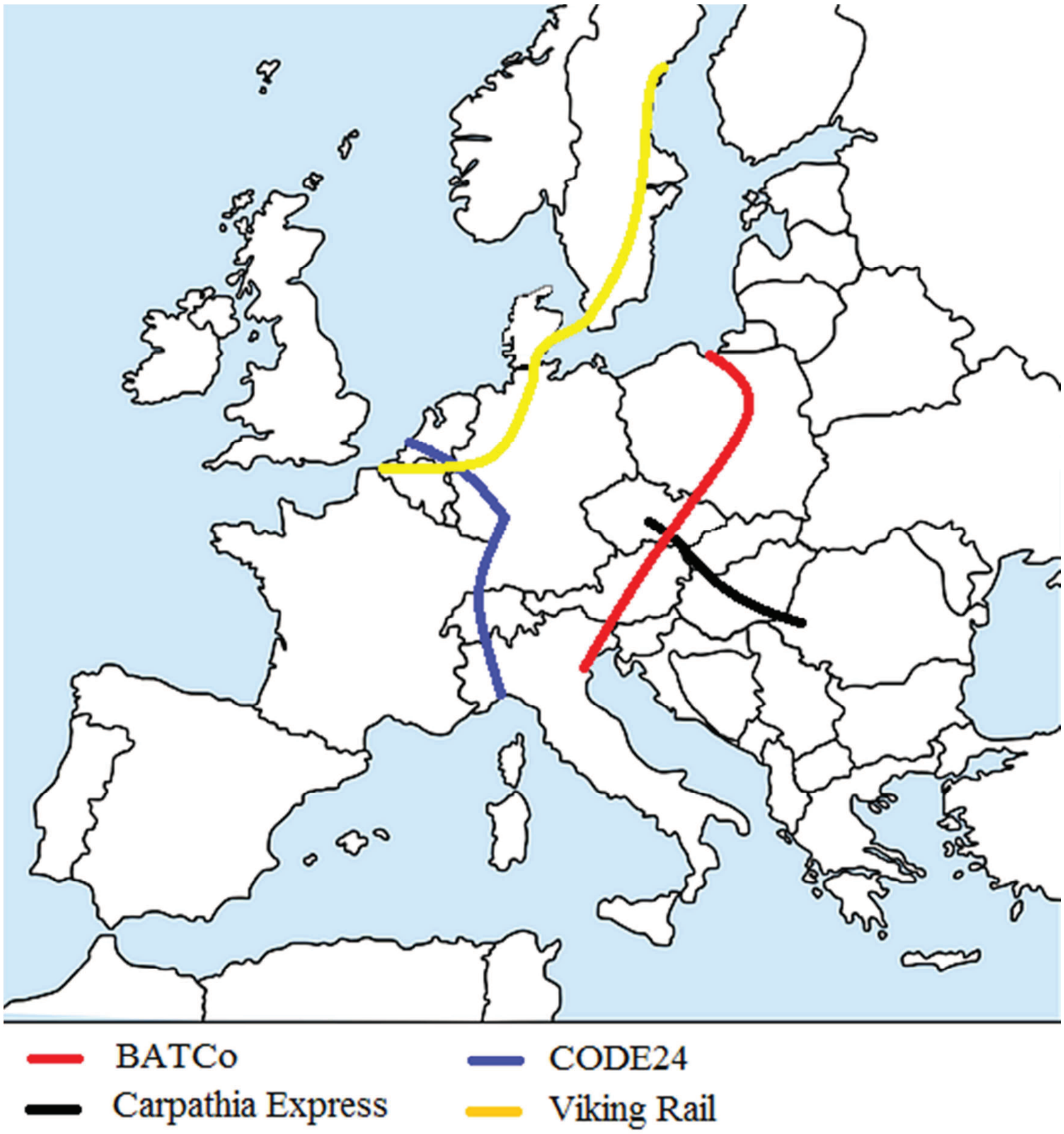

Figure 46 – European co-modality project corridors in the scope of the case study.

In Table 6 , the main features of these projects are highlighted. The average distances have been calculated trough map approximate routing of the main cities involved in the different steps of the projects.

Table 6 – Co-modality projects featured and their characteristics.

Project name	Countries involved	Distance	Approximate time[21]
BATCo	Austria, Czech Republic, Italy and Poland.	1649 km	18 hours
Carpathia Express	Czech Republic, Hungary, Romania and Slovakian Republic.	704 km	7 hours
CODE24	Germany, Italy, Netherlands and Switzerland.	1203 km	12 hours
Viking Rail	Belgium, Denmark, Germany and Sweden.	2424 km	25 hours

Further data on these corridors can be found in Appendix B, together with more detailed maps of the corridors' routes.

4.9.2 Assumptions and data collection

As previously explained in Methodology, in order to develop a case study on general terms, certain aspects of the technical media of the projects need to be assumed given the lack of information of specific data. Some other relevant assumptions made due to simplification or feasibility of the interpretation of the results can be seen in this present chapter.

4.9.2.1 Calculation strategy

The followings steps have been followed by recommendation of NTM guidelines:

1. Selection of vehicles and characteristics
2. Estimation of energy consumption
3. Calculation of emissions and primary demand
4. Allocation of cargo
5. Estimation of impacts from transportation

4.9.2.2 Transport system

One of the main assumptions that are made in order to simplify and make the environmental assessment comparable consists in assuming an integrated system. As Figure 47 shows, pre- and post-transport operations take place in main hubs that are connected to each other by high capacity transport service between terminals.

[21] Time estimation based on road traffic neglecting congestion effects.

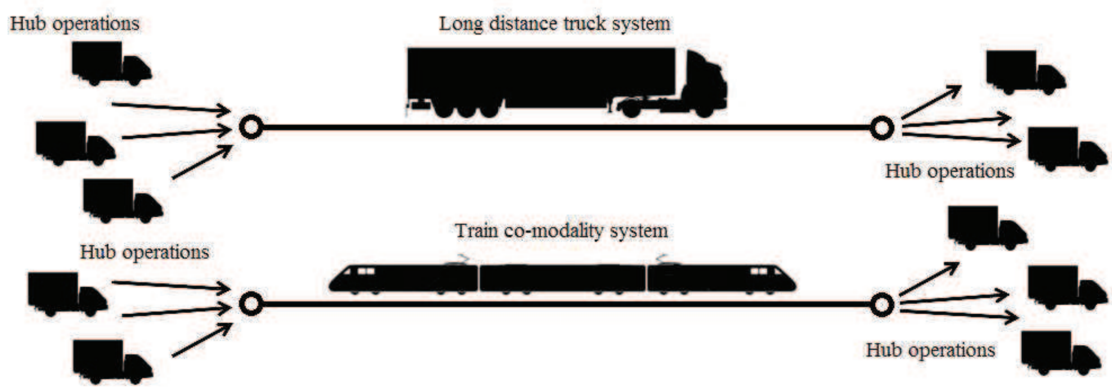

Figure 47 – Graphical description of the integrated system assumption.

This the integrated system assumption is reasonable from the point of view of co-modality implementation where large terminals are needed for the handling of the goods, not to mention storage or parking facilities, and the goods are "booked" into trips to maximize occupancy. Services towards and from the hub are neglected given the hub structure and the general characteristics of the case study. One of the immediate disadvantages that the truck system will suffer from is the economies of scale effect in pro of the train system. Nevertheless, this case study tries to quantify the environmental advantage of a modal shift instead of evaluating the impact of the entire system.

Another remarkable assumption inside of this study is the share of electrified railway in the different analysed co-modality corridors. Electricity is the most used energy source in railway transportation in Europe by both passenger and freight transport by number of electrified kilometres and importance of such (connecting capitals, main freight corridors, etc.) as can be seen in Figure 48. Here, the issue of having different voltages in the train transport becomes evident. Nevertheless, this technical question is neglected in the present case study due to the scope of the same.

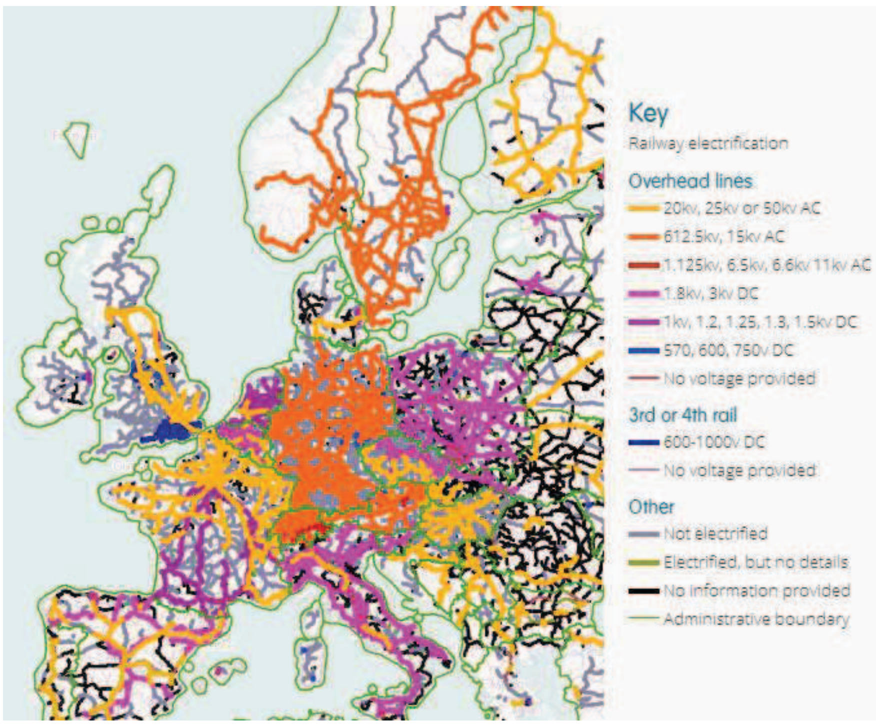

Figure 48 – Railway electrification in Europe (from ITO, www.itoworld.com/).

In regards to the electrical system, data from the IEA statistics on electricity production from 2009 is used instead of the 2004-2005 data available by NTM methodology given the increasing penetration of renewable energies in some territories of the EU in the recent years to reflect a more updated energy mix. For combustion related emissions, CPM LCA database is used for oil, coal, biofuels and natural gas. Renewable energy sources are considered emissions free given the large difference on emissions and their carbon-free nature. Biofuels are considered as well carbon-free but included in the accounting given the emissions of other substances due to combustions. Finally, waste fuelled generation of electricity is neglected due to the "surplus" nature of this electricity[22] respect of the primary purposes of these CHP power plants (CPM, 2013).

4.9.2.3 Vehicle selection

Vehicle selection is another important assumption given the performances and capacities of different vehicles. The previously mentioned systems are starred by high capacity vehicles with high occupancy of the available space as of the hub operation.

- Truck: diesel heavy duty vehicle tractor + semi-trailer, max weight 40 tonnes and maximum cargo capacity of 26 tonnes with load factor of 75%.
- Train: electrical driven long train, gross weight 1500 tonnes, working on bulk with an utilisation rate of 60% over the entire trip.

4.9.2.4 Performance data

Performance data is also supplied by NTM guidelines, from which recommended assumptions and average values have been extracted as follows.

4.9.2.4.1 Truck performance

Following, Table 7 shows the recommended share of road type and the consumption in litres per kilometre of diesel for the truck vehicle. The weighted consumption is calculated based on the share of each type of road and afterwards applied to the weighted emissions in Table 8. These emissions correspond to the certified emissions from high duty vehicles (28 to 40t) in the different types of road for Euro5 classification[23].

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[22] CPM database sheet for waste combustion (SPINE LCI dataset: Combustion of waste to generate heat and electricity) establishes heat and electricity production shares as 93,4% and 6,62% respectively.

[23] Euro5 is the most restrictive level of emissions in Europe, in prediction of future trends and in order to ensure the stability of the results this level has been selected due to the fact that new vehicles will need to be manufactured minimum to this level of requirements.

Table 7 – Truck consumption per type of road (NTM, 2008).

	Motorway	Rural	Urban	Weighted
Consumption (l/km)	0,293	0,313	0,396	0,31476
Share[24]	41%	47%	12%	-

Table 8 – Emission factors of substances per average type of road performance (NTM, 2008).

Emissions (g/l)	Highway	Rural	Urban	Weighted emissions
VOC	0,0500	0,0522	0,0693	0,0534
CO	0,3530	0,3740	0,4520	0,3748
NOx	8,3500	8,7400	8,7600	8,5825
Particles PM	0,0785	0,0831	0,1075	0,0841
CO2	2621	2621	2621	2621
Methane CH4	0,0010	0,0010	0,0014	0,0011
SOx	0,0033	0,0033	0,0033	0,0033

It must be highlighted the distinction made in the used sources between the impact of Methane and the rest of Volatile Organic Compounds, VOC. During the calculations of this case study, the fraction of Methane in the total VOC has been kept constant (assuming constant composition of the exhaust gas from diesel) and therefore calculated NMVOC as total VOC minus Methane content.

4.9.2.4.2 Train performance

Electrical consumption from the engines of the gross freight train, engines not included, is measured in average numbers depending on the nature of the territory as Table 9 illustrates following.

[24] This is a recommendation share distribution by NTM guidelines based on European statistics. It has been neglected the influence of fuel consumption variations due to capacity utilisation and speed variation.

Table 9 – Electrical consumption depending on topography (NTM, 2008).

Topography	Gross weight (t)	Electricity consumption (Wh/gross t km)
Flat terrain	Wgr = 1500	$540*Wgr^{-0.5}$
Hilly terrain	Wgr = 1500	$675*Wgr^{-0.5}$
Mountainous terrain	Wgr = 1500	$810*Wgr^{-0.5}$

Due to the different configurations of the European territories, the formula is combined and weighted with the total distance. The total weighted consumption is calculated as Equation 1 shows.

$$Electricity\ Consumption \left(\frac{Wh}{gross\ t}\right) = \\ = \frac{D1 * 540Wgr^{-0.5} + D2 * 675Wgr^{-0.5} + D3 * 810Wgr^{-0.5}}{Total\ distance}$$

Equation 1 – Electricity consumption weighted with D1, D2, D3 (flat, hilly and mountainous terrain).

Table 10 contains the distances for the different types of terrain topography that have been used in the calculation steps for train transport. Although approximate, the possible differences between the real train distance and the road one used for both calculations results negligible compared to average performance or emissions estimations and are therefore disregarded. Flat countries are Netherlands, Denmark and Sweden. Mountainous territories are Austria and Switzerland. The rest of the European countries are catalogued as hilly (NTM, 2008).

Table 10 – Topography distribution of the surveyed projects.

Topography	BATCo	Carpathia Express	CODE24	Viking rail
Flat (D1)	0 km	0 km	167 km	1592 km
Hilly (D2)	1169 km	704 km	751 km	832 km
Mountainous (D3)	480 km	0 km	285 km	0 km
Total	1649 km	704 km	1203 km	2424 km

4.9.3 Calculation procedure

This section compiles the equations on which the emissions and impact calculations have been based.

4.9.3.1 Truck calculation procedure

The following formulas are used to calculate the different impacts from the selected co-modality projects.

$$Total\ weighted\ consumption\ (l) =$$
$$= Consumption\ \left(\frac{l}{km}\right) \cdot \sum_{i=1}^{n=i} Distance_i \cdot Correction\ factor_i$$

Equation 2 – Total weight consumption equation.

The different correction factors, at Equation 2, are recommended by the NTM methodology in order to compensate for the topography of the different territories. A surplus of 5% is added to hilly countries' transit and a 10% is added to the mountainous ones, leaving flat territories' unchanged. Distances have been estimated by assessing distances between borderline cities. These data can be seen in Appendix B.

$$Total\ emissions\ (g) =$$
$$= Total\ weighted\ consumption\ (l) \cdot Emissions\ factor\ \left(\frac{g}{l}\right)$$

Equation 3 – Total emissions equation.

Emissions factors in Equation 3, are explained above in Table 8. Total emissions correspond to the total amount of emissions due to the transport and need to be translated into specific per service in order to be comparable to the train systems and among corridors.

$$Specific\ emisions\ \left(\frac{g}{t\ km}\right) =$$
$$= \frac{Total\ emissions\ (g)}{Total\ distance\ (km) \cdot Capacity(t) \cdot Load\ factor\ (\%)}$$

Equation 4 – Specific emissions equation.

In this equation, Equation 4, capacity corresponds to the total capacity of the type of truck vehicle selected at the NTM guidelines, in this case 26 gross tons. Load factor will determine greatly of the total performance of the system and therefore is submitted to a sensitivity analyses further in this document. For the base case, an estimation of 75% has been selected based on NTM guidelines and the transport system selected previously.

4.9.3.2 Train calculation procedure

The calculation procedure for the train consumption is based on the consumption obtained at Equation 1 combined with the total distance and load factor. This load factor has been established as 60% as of recommendation of NTM guidelines in Equation 5.

$$Electrcical\ Specific\ Consumption =$$
$$= \frac{Electricity\ consumption\left(\frac{Wh}{gross\ t}\right)}{Total\ distance\ (km) \cdot 1000\left(\frac{Wh}{kWh}\right) \cdot Loadfactor\ (\%)}$$

Equation 5 – Electrical specific consumption equation.

In the following equation, Equation 6, transmission losses account for 10% as recommended by NTM. This demand is divided into territorial demands based on distances belonging to each country that the corridor crosses.

$$Electrical\ Demand\ at\ power\ plant\left(\frac{MJ}{t\ km}\right) = \frac{Electrical\ Specific\ Consumption\left(\frac{kWh}{t\ km}\right)\cdot 3{,}6\left(\frac{MJ}{kWh}\right)}{1 - Transmission\ Losses}$$

Equation 6 – Electrical demand at power plant equation.

This assumption does not take into account the possible import/export of electricity between neighbour countries and therefore could be source of numerical disparity. It has been neglected as well the effects of peak production[25] versus average production of electricity. These assumptions are not expected to modify the competitiveness of the train technology based on the principle that this demands accounts for less than 1% of total production at any of the territories involved.

4.9.3.3 Impact calculation procedure

As previously mentioned during Methodology, NTM is an application of LCA into the transportation sector. In this sector, emissions are regarded as a direct external cost coming out of a "black box". The values inside of this "black box" include the weighted prices per tonne of emission depending on the territories where these emissions will take place. It is worthy to mention that PM_{10} result more expensive for the truck transport systems due to its proximity to urban areas, factor that increases the damage and therefore the cost per tonne of emission.

At the same time, emissions caused by the electricity production have been weighted by territory given the distance share of each section of the corridor. In this procedure, the different average type of electricity generation of each country is reflected in the total emissions associated to the train system.

The pollutants priced by the authorities are CO_2, CH_4, NOx, PM, SOx and NMVOC, for this reason, Equation 7 is applied.

$$NMVOC\ emissions\ (g) = VOC\ emissions\ (g) - CH_4\ emissions(g)$$

Equation 7 – Methane correction to VOC emissions.

Following, Table 11 contains the prices for the base case study for 2 relevant substances that are regulated at EU level. The rest of pollutants have different values in different territories. It must be highlighted that this prices for carbon dioxide and methane are variable and expected to increase as environmental policies in the EU take place. For this reason, these direct costs are submitted to a sensitivity analysis after the base case study in order to assess the possible role that an environmental regulation at EU level could have to the competitiveness of the different technologies.

[25] It is known that peak production technologies tend to be emissions intensive in many EU countries as well as the differences between seasonal peak production occurrences.

Table 11 – Cost of EU priced substances (NTM, 2008).

Substance	Cost of externalities (€/tonne)
Carbon Dioxide, CO_2	25
Methane, CH_4	23 times[26] CO_2 impact = 575

Finally, the cost of the emissions associated to each system, train or truck are calculated separately with the specific cost indexes (specific for each substance and system) to each technology following Equation 8.

$$Emissions\ Costs\left(\frac{€}{t\ km}\right) = Emissions\left(\frac{g}{t\ km}\right) \cdot Specific\ system\ cost\left(\frac{€}{g}\right)$$

Equation 8 – Emissions Costs equation.

For more information on the results of each step, please see Appendix C and consult Appendix D for further details on Electricity production per territory.

4.9.4 Results and sensitivity analysis

Hereby the results are shown in tables and graphs and compared to reflect on relevant aspects. All these charts have been created out of data available in the Appendix C. Discussion highlights are carried out based on the differences observed and the assumptions' influences.

4.9.4.1 Electricity generation aspects

The characteristics of the electrical grids across Europe vary greatly, mostly due to national resources political alliances or simple technology strategies. Depending on the territories where the electrical demand takes place, the emissions associated will have a certain composition and cost, as equivalent calculated for the case of the truck transport. The real advantage of the electrical system does not lie on the electricity, as there is generation loss from raw material to power or electric grid losses up to 10%, but in the economies of scale effect that substituting the main transport distance from hubs could result in. It is interesting to quantify the environmental advantage of the train system, which gets advertised often in ILP projects without giving much background information or transparency on how to estimate the impacts. As it is based on LCA and assumptions made mostly by the NTM, it is understandable that the numbers contained in this section are orientative. For the exact data calculations, please see Appendix C.

Figure 49, following, contain the emissions of CO_2 per territory. CO_2 is often targeted as the main source of concern from the administration and it is used as the main index given the order of magnitude of difference between CO_2 emissions and other sorts of emissions. CO_2 intensive countries can be regarded as those partially or totally dependent from fossil fuels, mainly coal. It is worthy to mention that the average electrical consumption in Poland will have a greater impact than any other electrical

[26] This value is based upon the equivalent impact of methane compared to CO_2 and its residence time in the atmosphere (IPCC, 1996).

service from other territories. This country entails therefore an indicator that is followed during the study.

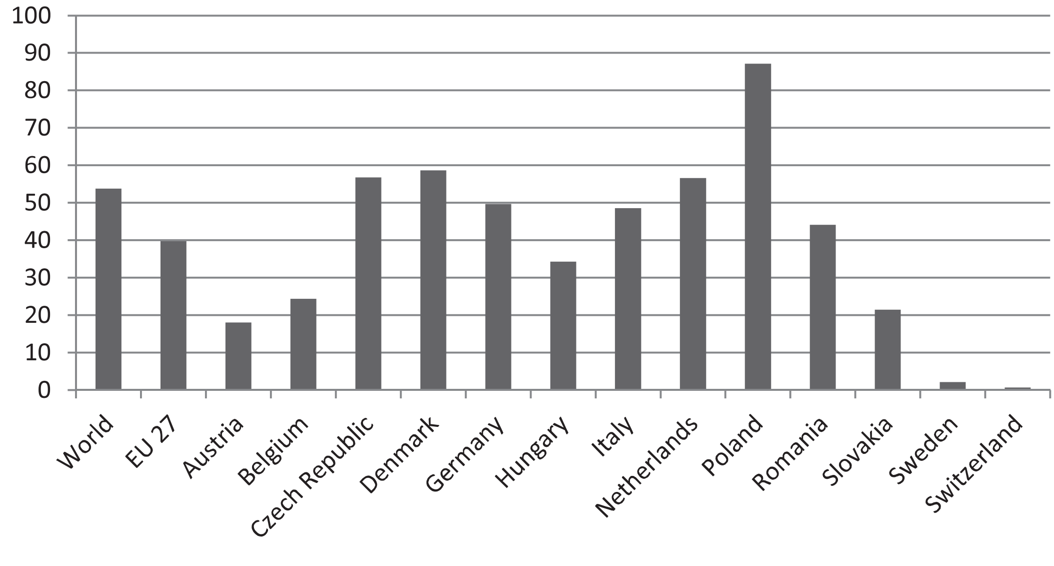

Figure 49 – CO_2 emission in g/MJ per territory by the average energy mix.

Following, Figure 50 contains the emission levels of other substances. Often disregarded, Particulate Matter (PM) and SO_2 are dangerous substances present in the air pollution, mainly caused by coal combustion plants. These two substances will determine the main cost of the impact of electricity as despite their lower emission levels they have serious effects on human health.

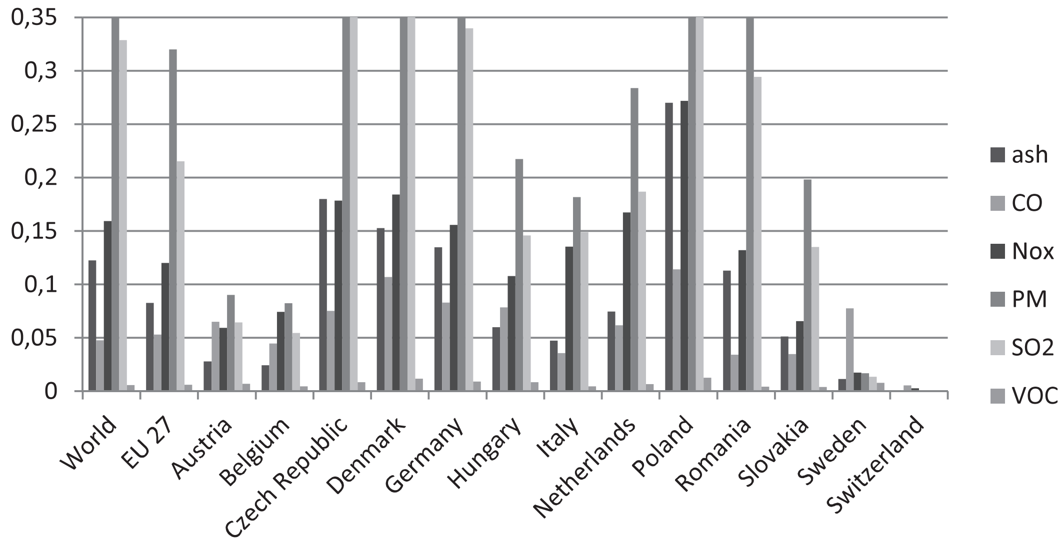

Figure 50 – Other emissions in g/MJ per territory by the average energy mix.

4.9.4.2 BATCo

The corridor BATCo joins the Baltic Sea basin with the Mediterranean Sea basin across the countries of Poland, Czech Republic, Austria and Italy. These countries, with the exception of Austria, feature a great amount of fossil fuels dependency and therefore high levels of sulphur and particulate emissions.

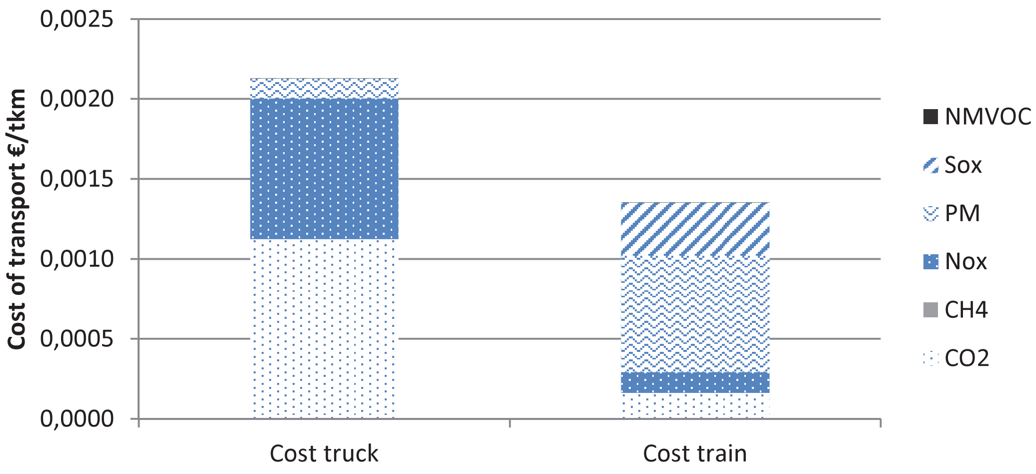

Figure 51 – BATCo project cost comparison of co-modality between hubs in €/tkm.

Despite it entails an environmental advantage of more than 35%, as in Figure 51, with this price reduction it might be difficult to support the decision based only on environmental concerns as the already monopoly of the sector, truck transport, doesn't require further investments.

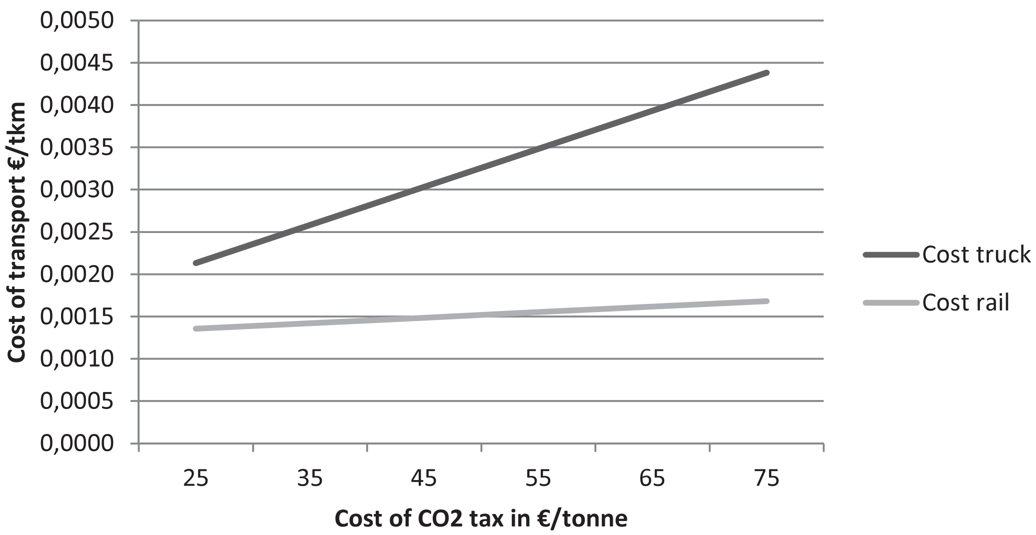

Figure 52 – Sensitivity analyses of the modes with CO_2-CH_4 tax change for BATCo project.

The fossil fuel dependency of the electrical power supply does reflect on the sensitivity analyses on future prices of CO_2 and CH_4, despite the fact that for the truck system this is more prejudicial. Figure 52 illustrates on this tax dependency from current approximate Swedish levels to long term scenario predictions by the European Authorities (NTM, 2008).

A Load factor is as well carried out for the corridor projects with relevant aspects for the case of BATCo. It can be seen how the impact of truck transport gets close to the train level from approximately a 75% load factor in the vehicle. This is relevant point of study given the other proposed ILP solutions for freight. In this case, increasing the load factor could result in a lower investment on, for example, an e-Freight solution instead of the great investments associated to co-modality implementation.

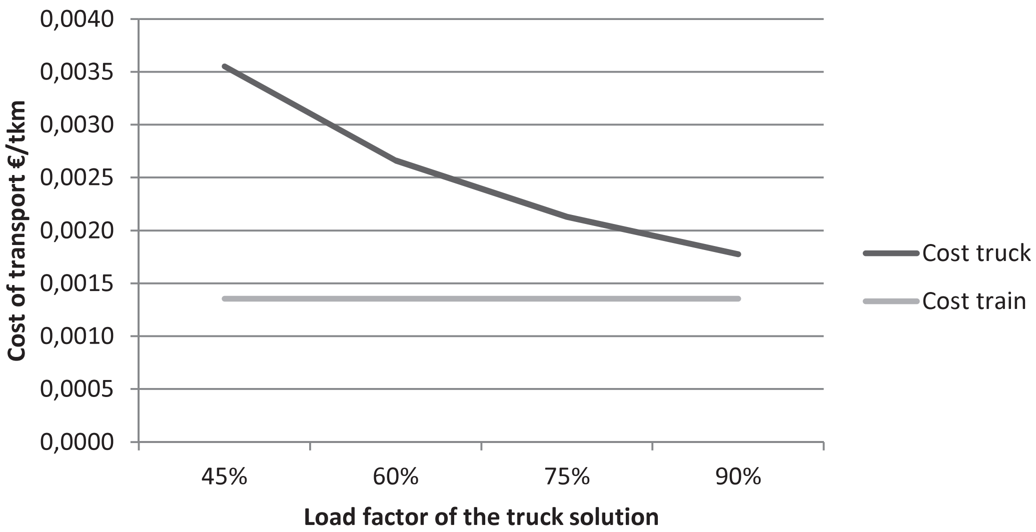

Figure 53 – Load factor sensitivity analysis for transport modes in BATCo project.

It is worthy to mention that despite the economic achievable competitiveness of the truck system (if properly managed) with the train system; the truck intensive use in EU does still come associated with high levels of congestion and other externalities.

4.9.4.3 Carpathia Express

The Carpathia Express is a joint venture towards the new economies attached to the EU, as Romania, and the latest members: Hungary, Slovakian Republic and Czech Republic. These territories are partially based on fossil fuels but count with a greater interest from the point of view of congestion and road safety (Socio-environmental drivers) as these intensively used routes of access to Europe count with difficult topography despite the territory is hilly as the average European region.

As Figure 54 demonstrates, there is a reasonable environmental advantage with up to 68% environmental externalities reductions, excluding the mentioned socio-drivers of interest. Therefore, in this region, the development of such project could be regarded as economic- environmentally supported given the cost advantage that will suppose per tonne and km ran.

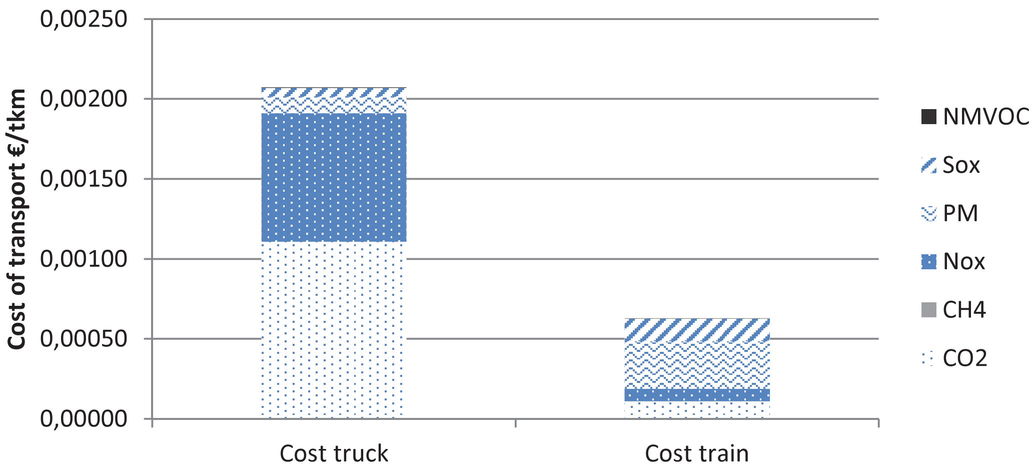

Figure 54 – Carpathia Express project cost comparison of co-modality between hubs in €/tkm.

As in the previous corridor, the substances distribution can show clear dominant substances, or more specifically their costs, for the two alternatives. In the case of the truck system, CO_2 is dominant and the cost of this substance is expected to grow based on the latest European policies that start including transport systems to the emissions trading schemes (European Commission, 2013). Another relevant substances share corresponds to the NOx, mainly NO_2. These substances have reduced their share in diesel combustion during the recent years given the development of post combustion capturing technologies, up to 90% in the case of Euro5 type of trucks, the one used in this report (NTM, 2008). It is not expected to achieve further reductions of the same magnitude given the high costs that these capturing technologies already have. Therefore the price of the socio-environmental impacts of the truck systems is expected to grow in time and technical development may be faded out by climate related taxation plans.

As of the emissions of the train system, particulates and sulphur oxides dominate unlike the common belief that CO_2 is the main concern in energy generation. On the one hand, it is true that the levels of emissions of CO_2 from power generation are the main source of climate change (IPCC, 1996), it must be highlighted the strong dependency of society in electricity. On the other hand, there is a continuous development of fossil free alternatives, energy mix enhancements and policies working in pro of the future CO_2 capture, "carbon sequestration", that is only economic and technically feasible in large scale power plants. Therefore, here we will highlight the negative effects of SOx and particulates, from the train system. The cost of these substances is lower given the fact that they are generally emitted out of urban areas and get "diffused" in the air causing rather a general impact. But this "diffused" impact must not be neglected given the toxicity and high cancer risk that this two substances have and the mechanisms of interaction in both the atmosphere and the ecosphere where the different compounds formed in air reactions deposit and cause secondary environmental effects more acute than for the case of CO_2 such as acidification or eutrophication among others. As a result, and despite the train system recommendation is the main finding of this case study, in this report it is wanted to highlight that power generation is far from having "zero" socio-environmental impact and must be developed further in order to minimise these effects.

Following, Figure 55 reflects on the effects that CO_2-CH_4 taxation would have on the two systems. High CO_2 emitting fossil dependent power generation suffers from the taxation but this effect is fairly low compared to the effect on the truck that can double its price in the upcoming years if all transport systems are included in the emissions schemes.

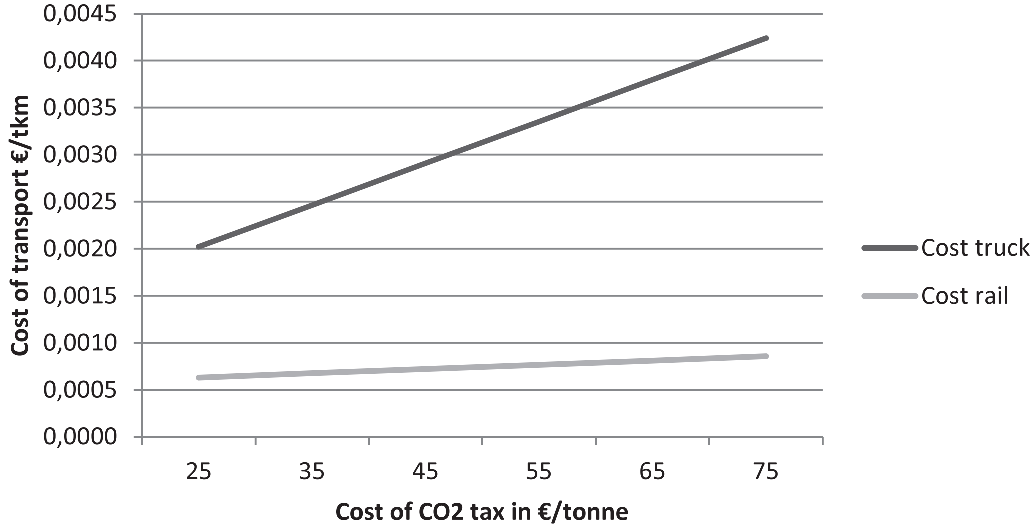

Figure 55 – Sensitivity analyses of the modes with CO_2-CH_4 tax change for Carpathia Express project.

This sensitivity has yet one more dimension as in the previous corridor when dealing with the load factor of the systems. Truck loading factor is very variable depending on the length of the trip or the strategy of the freight forwarder. It is important to highlight the efforts necessary in this matter for the truck system given its price relevance as in Figure 56.

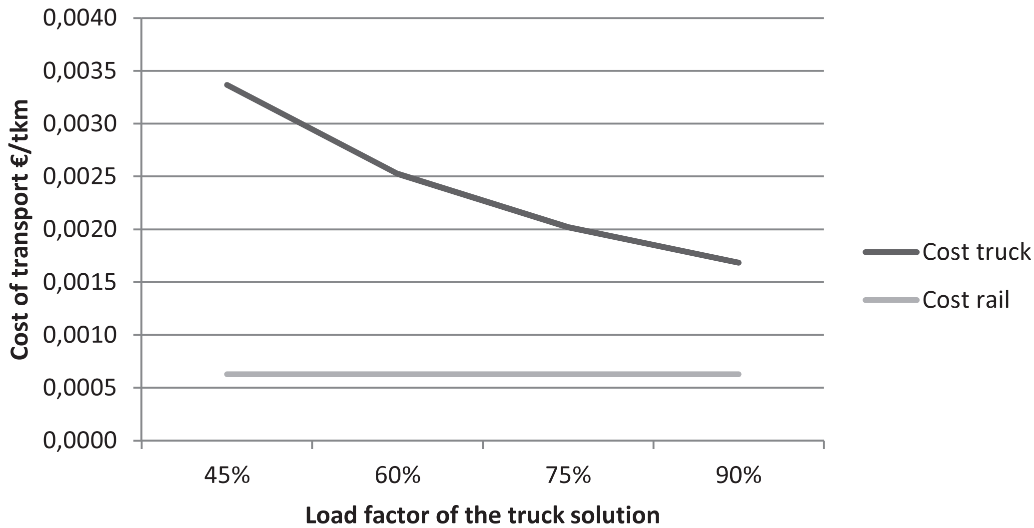

Figure 56 – Load factor sensitivity analysis for transport modes in Carpathia Express project.

The future competitiveness of the truck system will depend highly on the increase of load factor, especially with the environmental targets expected in the following years.

4.9.4.4 CODE24

CODE24 is the venture in the field of co-modality for a corridor North-South in the mid-West part of Europe. The countries featured in the study are an even mix of flat territories with mountainous passes. The areas, especially the passes across Switzerland, are typically congested areas. Several efforts are being put in the areas to transfer part of the traffic to the freight train infrastructures. This interest is supported by the socio-environmental cost analyses. As in Figure 57, the train system has an environmental cost reduction of more than 60% respect from the truck system. This fact entails a potential competitive advantage and justification of investment in the case of a co-modality project.

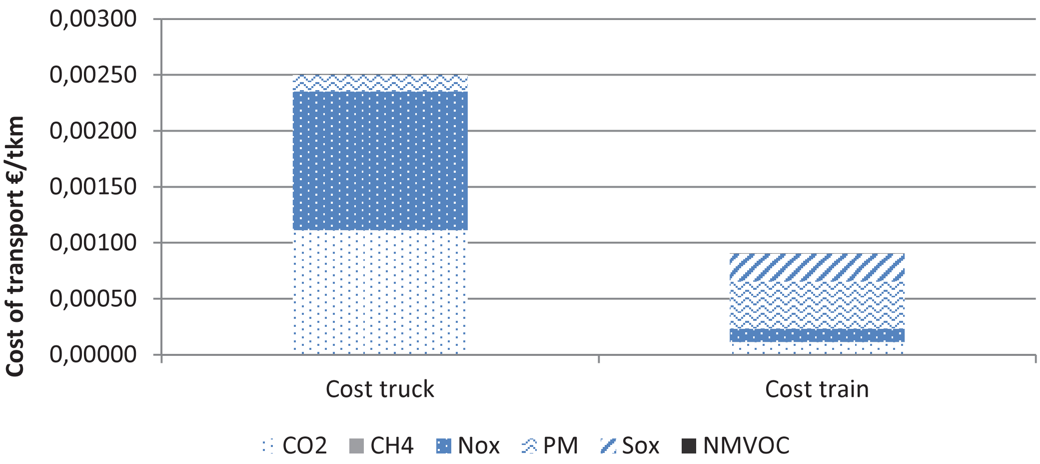

Figure 57 – CODE24 project cost comparison of co-modality between hubs in €/tkm.

The attractiveness of this case is even further highlighted in Figure 58. Here, the cost dependency of taxation on CO_2-CH_4 emissions is much more acute for the truck system than for the co-modality option. The competitiveness of using the train transport from hubs, as in the transportation system of this project, gets enhanced with the predictions of taxation in the transport sector.

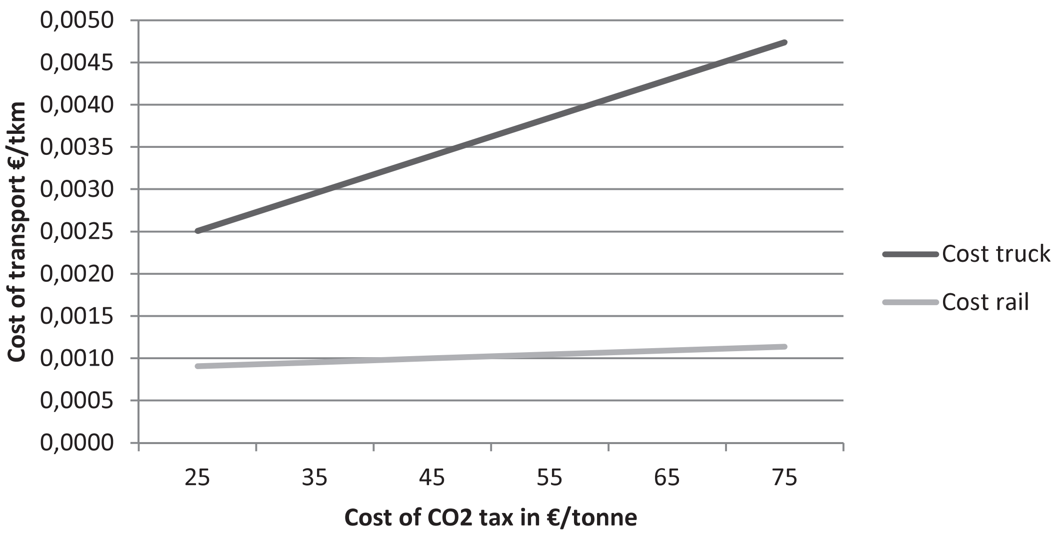

Figure 58 – Sensitivity analyses of the modes with CO_2-CH_4 tax change for CODE24 project.

Figure 59, following, show the results of increased effectiveness of the truck system through increase of load factor. Despite the evident cost-effective measure that increasing this factor entails, reducing the cost by almost a half, there is a favourable cost advantage for the train system given the economies of scale.

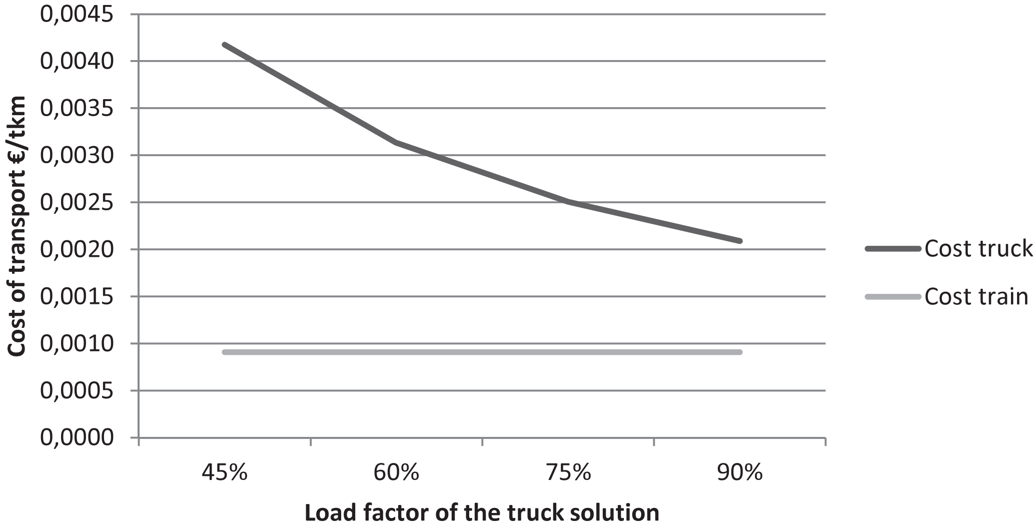

Figure 59 – Load factor sensitivity analysis for transport modes in CODE24 project.

Therefore, especially in this case and given the local congestion problems, it is recommended to adopt ILP solutions such as the co-modality option.

4.9.4.5 Viking Rail

Last but not least, Viking Rail from BestLog portfolio has been analysed in one of the main train options for the deliveries of components and vehicles shipped from a Swedish vehicle manufacturer. Freight content is forwarded from North Sweden to South Belgium across a large distance of more than 2000km through mostly flat territories without difficult topography.

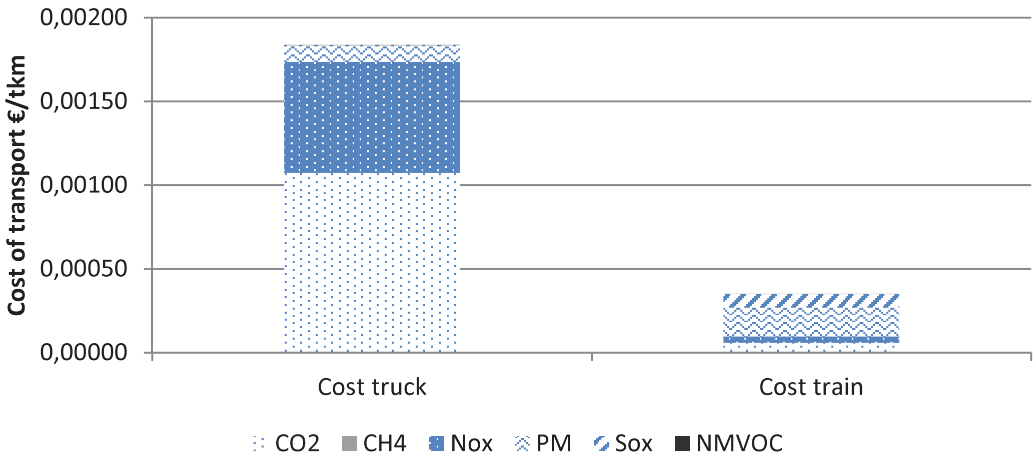

Figure 60 – Viking Rail project cost comparison of co-modality between hubs in €/tkm.

As in Figure 60, these factors are combined with the power generation mix of the territories, specially Sweden with almost carbon free electricity; resulting in a very low socio-environmental cost of the train system that entails savings up to 80% reduction from the truck system. Especially damaging substances such as local emitted NOx are avoided. Instead, a fairly small amount of particulates and SOx is allocated to the power generation of the combination of the countries.

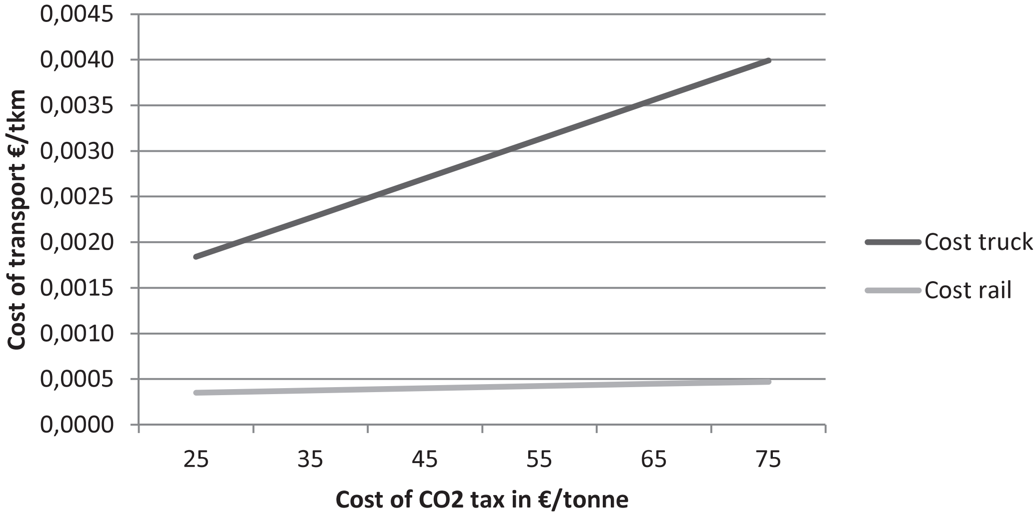

Figure 61 – Sensitivity analyses of the modes with CO_2-CH_4 tax change for Viking Rail project.

Figure 61 reflects on how sensitive this system is to CO_2-CH_4 emissions taxes, predicted for the upcoming decades due to climate change policies (European Commission, 2013). The train system is fairly stable to a great change in the tax levels while the truck system in this case is very sensitive to it. This reflects the tendency of this corridor to entail even a larger socio-environmental advantage. This fact can also be understood as the stability of the train transport system unlike more CO_2 sensitive means, and the suitability of this option to the North European freight distribution.

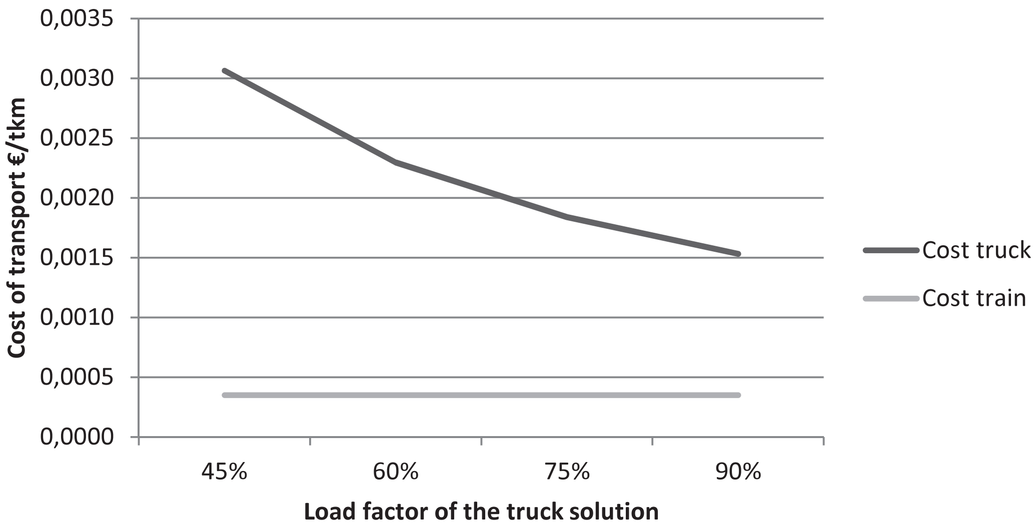

Figure 62 – Load factor sensitivity analysis for transport modes in Viking Rail project.

As in Figure 62, despite a great effort in increasing load factors in the train system, the gap in the cost of transport graph reflects values greater than 70% for the highest load factor analysed.

Furthermore, Viking Rail is a long distance freight line that uses existing infrastructure between nodes and counts with flexible routes in order to combine trains and access further locations. This use of existing infrastructure results of especially interest from the point of view of freight forwarders and other relevant stakeholders given the small investment necessity. In the case of Viking Rail equivalent projects, the key for success lies in the combination of coordinated efforts to achieve profitable transport management more than in the implementation of a new infrastructure or new technologies. It is worthy to highlight the small exploitation that freight transport has currently compared to truck systems and the fact that there is a large existing infrastructure available to fulfil experiences such as Viking Rail in the present and increase the penetration of this mean in the freight sector.

4.9.4.6 Case study results summary and EU27/World energy mixes

In order to summarize the case study conclusions, following Figure 63 contains the cost comparison of the projects depending on the modes. Here, it can be appreciated not only the cost advantage of the train system in all cases but the differences existing among costs of corridors.

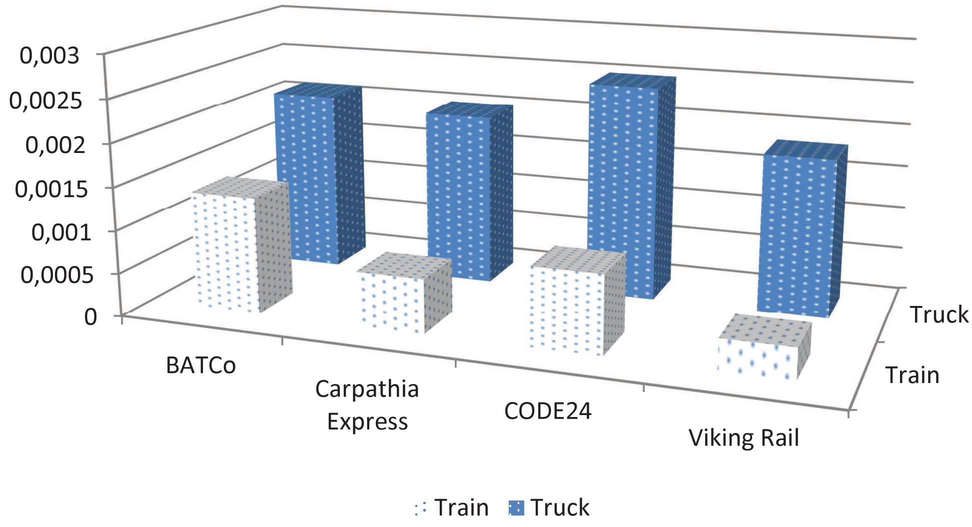

Figure 63 – Cost comparison of projects and modes for the selected corridors.

These differences are caused by three major factors:

1) Energy consumption given the topography of the project.
2) Fossil fuel dependency of the electrical generation mix of the territories.
3) Cost of emissions, especially NOx, Particulates, SOx and NMVOCs, depending on territory and local/non-local occurrence of the emissions.

These factors can be exemplified by for example the case of BATCo, where the high dependency of the power generation plants to fossil fuels (especially coal) reduces the potential cost advantage of the train system. Another remarkable highlight is the low impact of Viking Rail, which crosses a long distance over the Swedish territory, carbon free. Also remarkable the higher cost of CODE24 truck system, highest of all truck systems, which is associated to the nature of the countries that it crosses where local NOx and particulate emissions have a high cost compared to other European countries (Austria, Germany, Netherlands and Switzerland).

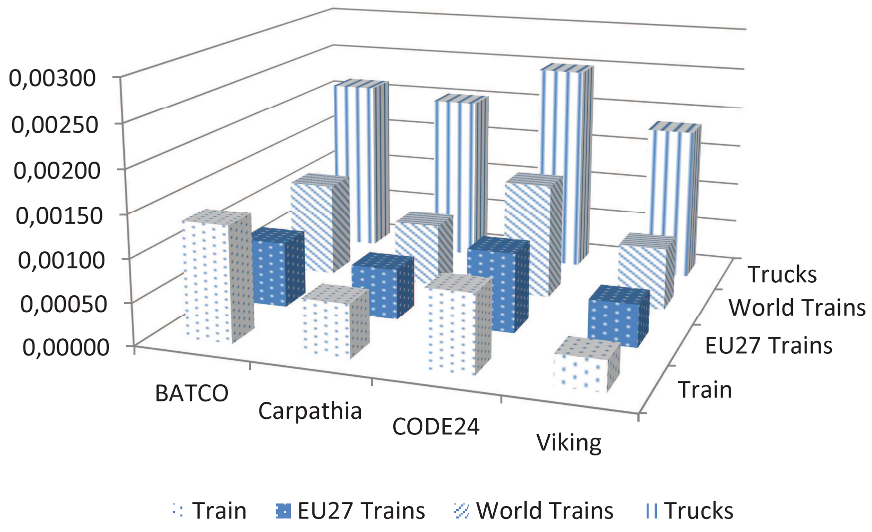

Figure 64 – Cost comparison of corridors with EU27/World energy mix.

In Figure 64, the systems are compared finally with EU27 and World mix averages. EU27 average is fairly higher in CO_2 than fossil semi-free countries such as Netherlands, Switzerland, Austria or Sweden. Therefore, where in these countries instead of weighted territorial energy mix data, the EU27 is applied, there is a risk for over calculation given the higher CO_2 levels or the efficiency and filtering technologies that in these countries allows Coal generation power to have lower particle and sulphur emissions than the average European.

There is also a highlight able general opinion among energy modelling experts that suggests that an increase in electricity demand could place the power needs into fossil energy sources given the supply security increased needs and the lack of reliability[27] that high shares of renewable energies have in the generation grid. Despite this facts, it is considered that a good security policy and the current energy balance auctions that take in place among several European countries (among the several regulatory systems in place in the EU) could act in favour of the energy system and even out the negative results in pro of the train system. World energy mix is high dependent on coal as well, and has higher use of the rest of the fossil fuels and biomass (timber) than European countries. In a case where comparing technology implementation across the world, given the differences between EU27 and World energy mix, these two could be used instead of the local levels but at any case in the scenarios of each corridor as it can be seen from train and EU27 columns, differences go in both positive/negative changes depending on the corridor.

Last but not least, comparing truck systems and train with the World energy mix it can be seen that train system is a convenient and sustainable socio-environmental advantage in all cases. Despite more information is needed for accurate data, as a general trend, train systems can be regarded as more suitable option for further transport development of freight transport including socio-environmental, economic and future competiveness considerations.

[27] Renewable energies depend on climate conditions such as precipitation, wind availability or amount of sun isolation. For this reason, peak demands and variability of supply are cushioned with fossil fuels, in special gas turbines.

5 Overcoming barriers

The problem of diffusing innovations and best practices is not new. For over 50 years, organisations have been aware of the paradoxes of innovation that despite the success in one location fail to spread in other environments and remain as “islands of innovation” (Zell, 2001). As a result, efforts are duplicated, cost reduction in large scale predictions does not take place and knowledge is put in risk given the perceived market failure. The challenge for management lies here, in simultaneously coordinate what already is in place (staff, processes, infrastructure, customers) while implementing something “unknown” and place the right amount of resources in it (Yorton, 2006). This section will shed some light to practitioners and managers in what can be done in common towards overcoming the barriers for innovation in general and ILP implementation in regards to this project.

Innovation is also associated negatively with declining productivity (Lindsay, Perkins, & Karanjikar, 2010). This is suspected to be caused by the lack of results in forehand when advocating for the implementation of an ILP and the multidisciplinary projects difficulties that arise during these procedures that tend to be associated to innovation when they do in fact belong to the entire functioning of the sector. Innovation should be understood as an asset for behavioural change (Lindsay, Perkins, & Karanjikar, 2010). This change given the multidimensionality of the sectors involved (population, organisations, technology or methodology) is expected not to happen instantly, fact that must be act in detriment of ILP. These factors are compiled in Figure 65.

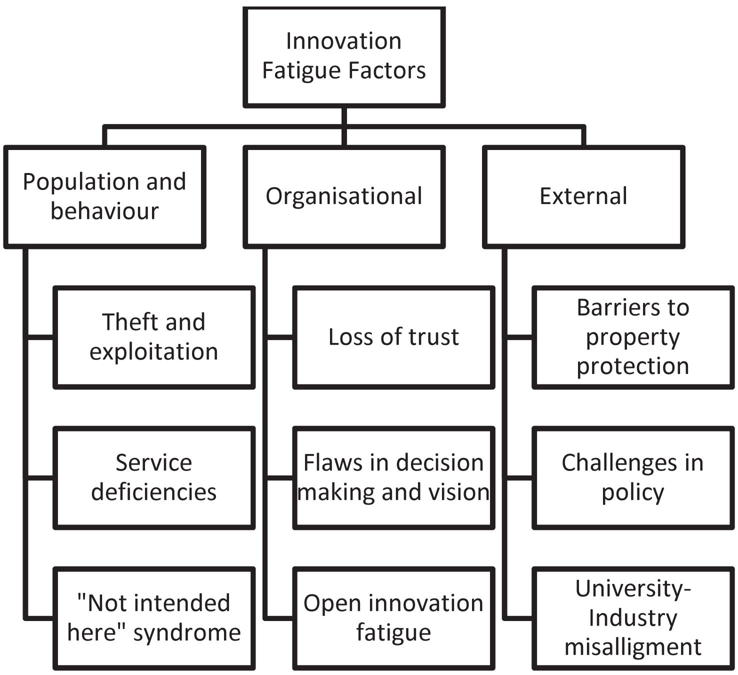

Figure 65 – Innovation fatigue factors (Lindsay, Perkins, & Karanjikar, 2010).

A good strategy towards conquering the behaviour of population starts by enabling information and making a great effort of auto-critic and transparency. Once population trust a technology and in the power of decision making of their representatives, it is more likely to obtain external support, especially in policy makers, industry and university. Once the framework is established, it is time to maintain the level of trust and take action with optimized timeframes and projects that will not wear off the effects of the support achieved so far.

- Peer-to-peer learning based on open scenario networks, at which the users must contribute equally sharing their past mistakes and performance indicators as well as the methods by which they have achieved a successful monitoring of the same (Zell, 2001). The practice of sharing mistakes is proved value adding practice that must take place in these networks as base of this learning procedure (Rivera-Vazquez, Ortiz-Fournier, & Flores, 2009). It is more valuable to know which management or technology strategies have turned out bad results in which situations to analyse the entire matrix of locations-strategies in order to identify most suitable target increasing the odds of ILP implementations.
- Safe environment for this consulting is value added and enables cooperation schemes as has been analysed in this report. It is crucial to supply the secure channels for information and data sharing in order for the partners to create trust (Lindsay, Perkins, & Karanjikar, 2010). This trust has shown to allocate positive feedbacks when the secure frameworks are in place and partners are familiar with each other. This long term scenario corresponds with the timelines necessary for sustainable development, which is a long-term target rather than an immediate effect of ILP performance.
- There is a need for top-level support, as it has been proved that technical and supply chain management solutions do exists and are scattered in a broad band of available products with more or less successful experiences. Anticipating the policy measures in high spheres and demanding engagement from the member countries could entail a powerful driver towards ILP diffusion. This is especially remarkable for the development of emerging European economies given the great economic growth and the investments that take place continuously. Is in these economies where all factors are currently aligned and only need political and public involvement in order to achieve sustainable best practices. This has a great positioning opportunity for the future that could set the bases for emerging economies all over the world.
- Last but not least, international culture difference related barriers monitored during this project have been already targeted by the experts. It is recommended to prioritise a healthy organisational environment focusing on emotional intelligence and targeting the differences between sectors, groups or individuals as tools towards overall organisational strengthening rather than obstacles (Rivera-Vazquez, Ortiz-Fournier, & Flores, 2009). Local/regional specific knowledge transfer teams are highly recommended to achieve the best results out of the integration policies.

All in all, Innovation is a hot topic today as the experts highlight and it is important that it maintains this position as it solves paradoxes existing in its nature that impede and delay in most cases the diffusion of the same. As brief summary about recommendations from this project it must be mentioned the inclusiveness and trustworthy strategies as well as the organisational and administrative support to technology, and the long-term timeframes that all of these factors need to become compatible with.

6 Conclusions

During the survey that this project has been based on, it has been seen that there is a relevant amount of successful ILP projects across Europe. They combine a series of characteristics, specific of each type of ILP, which are especially attractive to reflect on to the stakeholders. This is shown in Table 12.

Table 12 - Summary of drivers towards ILPs.

Type of ILPs	Economic perspective	Social perspective	Environmental perspective
E-freight	Modernisation of fleets and increase flexibility of business	Enhanced service/relations to customers/suppliers	Optimisation of resources (paperless)
Co-modality	Economies of scale and reach emerging markets	Enhanced international connectivity	Decreased environmental impacts
UFT	Increased reliability, minimise operation cost, niche markets	Safety and health advantages in urban context	Optimisation of spatial resources and environmental improvements
Intralogistics	High productivity and increase quality control/monitoring	Enhanced safety and control of production	Optimisation of in-house resources

With current rates of technology and supply chain techniques development, it must be highlighted that solutions are abundant and in place for practitioners to implement.

As of the drivers that may help the development of the projects, it has been found that there is a wide spectrum of funding support (private sector, EU programs, and regional developing programs) and research is carried out continuously by academia.

The EU is a relevant stakeholder in the field of ILP, as it represents the main public funding scheme (with several programmes in place) as well as a source of academic support and a great ally in term of information and networking support. Despite this great interest by the lead authorities of the Union, it has been observed that there is a gap of commitment at high national levels. This is expected to occur given the nature of EU policies regarding the socio-environmental advantages of ILP. When the documentation in place is only recommending taking action, while there is a lack of involvement from the economic sector (decreased implementation of ILP since 2009 with the start of the economical EU "crisis") the effect that results is a delay in the projects or in their continuity.

In regards to private funding, there is a clear behaviour of interested parties that invest in projects related to their own missions, but a lack of involvement in initiatives that pursue a more generic implementation across broader markets. It is important to highlight that the entire competitiveness of the sector is on the spot as fuel prices rise and congestion of the main routes increases; and that this segmented selective involvement is not productive in terms of continuity of ILP projects on time.

In regards to the political context of EU, it has been highlighted that there is a need for long term policy measures of the administrations in regards to socio-economic prospects. It is fundamental to regard the long term perspectives and uncertainties as a constructive foundation for the competitive advantages of ILP already nowadays and in the long run. The featured narrow perspectives, associated with political residence time, are not compatible with the great involvement and investments necessary for the spread of ILP across the European territory. Despite efforts are put in place nowadays in the shape of socio-economic framework policies, the pace at which they happen is slow for a complete sync. This policy-making period should be speed up and count with an increased compromise from the union members in order to start this long-term venture. Effects will not be immediately foreseen in many cases and in others implementation occurs without accurate predictions, reasons why long term perspectives must be in place and become public strategies for the entire society and industry to benefit from it.

Developing a sharing the benefit of sustainable supply chain practices and understanding that the reliability of the system is out of question is necessary. Public opinion often plays an important role in supporting technology and industry's vision towards implementation. Population needs to be well informed during the design of ILP in order to engage their support rather than discomfort at the same time that transparency is reinforced in all levels of society and administration. The power of good press references must not be underestimated.

On another line of observations is the transferability issue in ILP. Knowledge transfer and mentoring is a proven partially systematic approach in small-medium scale projects. Not all practices can be implemented exactly the same although the methods, frameworks, transferability and technical/consultant suppliers of ILPs are available. Systematically approach is not yet feasible given the complexity of the different scenarios but it has been proven that similar territories learn from each other with a greater outcome that the expected one. It is necessary to look at each situation separately: geography, technical, economic factors determine the feasibility of each type of solution. It is highly recommendable to keep this great engagement at city/regional level and explore further partnering and the influence and support that EU could give in order to adapt these practices to a more aggregated level including higher level data and information standards that could overcome technical and organisational barriers. It has been surveyed that there is a gap in high aggregated level of administration associated to the increased number of stakeholders and the competing levels of supply chain members.

This competition reflects on the most important conclusion, in regards to implementation, support and knowledge transfer: cooperation. It has been highlighted that a high level of trust is crucial to enable knowledge sharing and that cooperative partnerships result in more successful and faster implementations. Frameworks need to be put in place with dynamic and multidisciplinary strategies for the common benefit of the entire scope of actors. It is necessary to coordinate efforts beyond private interest and enable trustworthy environments via secure and confident relationships and long term commitment and alignment in order to achieve the level of system development that practitioners aim to supply.

Innovative Logistics Practices are the vivid combination of smart supply chain practices with socio-economic benefits and modernisation towards economic and environmental goals of the EU and therefore, it is necessary to highlight their importance and the need for society to keep implementing these procedures towards the benefit of the entire society.

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Appendix A: ILP projects

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General Information	
Project acronym	BATCo
Project title	The Baltic-Adriatic Transport Cooperation
Funding programme	European Regional Development Funds (ERDF)
Duration	36 months (from March 2010)
Official webpage	http://batco.datenkraft.info/
Project type	Co-modality
Abstract	

Description
- Intermodal railway that links the Baltic and the Adriatic Sea basins with primary hinterland cities between Poland and Italy.
- Countries involved: Austria, Czech Republic, Italy, Poland, and Slovakia.

Objectives
1. Enhance sustainable development of the Baltic-Adriatic Axis and its competitiveness with a holistic view.
2. Up-grade intermodal transport by the implementation of high capacity railway connections.
3. Reduce the impact on the environment via the limitation of negative transport related effects.
4. Secure employment via the strengthening of the economy.

Activities
- Develope and implement technical planning tools regarding transport system.
- Identify transport related effects on the environment.
- Stimulate economic activities by supporting end users such as logistics centres, SMEs etc.
- Strengthen intermodal logistics solutions and business models to support their use.
- Create international business cooperation nodes across the corridor's geographical area.

Drivers
- EU policy trends: technical improvements, cushioning environmental damage, economic development.
- Stakeholders' economic interests concerns.
- Interoperability and international cooperation.

Barriers
- Lack of standardisation.
- Cooperation between governing agencies.
- Large financing need.
- Technical difficulties in construction.
- Local neighbour opposition.

General Information	
Project acronym	BestLog
Project title	Logistics Best Practice
Funding programme	European Commission (EC)
Duration	50 months (from February 2006)
Official webpage	http://www.bestlog.org
Project type	e-freight, co-modality, UFT, intralogistics
Abstract	

Description
- Collection and dissemination of logistics best practices experiences.
- Platform to improve overall supply chain performance in Europe through international cooperation.
- Counts with important involvement from educational institutions, private stakeholders and EU agencies.
- Countries involved: EU, Russia, and Turkey.

Objectives
1. Improve logistics knowledge and establish best practices examples.
2. Raise standards of practice across Europe.
3. Create economic growth and job opportunities.
4. Align the European Commission policy makers and private business decisions.

Activity
- Platform for exchange logistics best practices.
- Online toolsets, directory of European logistics, and databases.
- Benchmarking on line for European companies.
- Conferences and workshops on logistics best practice for stakeholders.

Drivers
- Economic and environmental influences.
- Social awareness that requires industry to improve the performance of logistics practices.
- Effective communication and information.

Barriers
- Financial impediments.
- Institutional barriers related with regional/local corruption.
- Lack of quality and transparency.
- Bureaucratic arbitrariness.
- Infrastructure and safety lacks.

General Information	
Project acronym	C-LIEGE
Project title	Clean Last mile transport and logistics management for smart and efficient Local Governments in Europe
Funding programme	European Commission (EC) - Intelligent Energy European (IEE)
Duration	30 months (from June 2011)
Official webpage	http://www.c-liege.eu/
Project type	UFT
Abstract	

Description
- Integrated urban freight transport planning for clean and energy efficient European cities.
- Platform sharing knowledge about UFT management including best practices, tools, and roadmaps.
- Countries involved: Bulgaria, Germany, Italy, Malta, Poland, and United Kingdom.

Objectives
1. Define shared policies and measures for an energy-efficient UFT.
2. Demand management and planning through a cooperative approach between public and private stakeholders.
3. Reduction of energy use and environmental impact in EU.

Activities
- Investigating and analysing local initiatives.
- Test and share sets of integrated solutions and "push-and-pull" demand-oriented measures in roadmaps for the implementation in European cities.
- Use C-LIEGE toolbox for supporting local administrations.
- Apply transferability plan for European local administrations.
- Implement action plans on measures and policies.

Drivers
- Economic incentives and policy measurements supporting efforts.
- Societal trends and on-going efforts to improve efficiency, sustainability and safety.

Barriers
- Lack of data.
- Involvement of local stakeholders from public and private sector.
- Keep the participating stakeholders together.
- Financial scopes of different localities and other financial requirements.

General Information	
Project acronym	CASSANDRA
Project title	Common Assessment and analysis of risk in global supply chains
Funding programme	European Commission (EC) – 7FP
Duration	36 months (from June 2011)
Official webpage	http://www.cassandra-project.eu/
Project type	E-freight
Abstract	

Description

- Project that addresses the visibility needs of business and governments in the flow of containerized cargo by developing a data-sharing concept.
- Countries involved: Austria, Belgium, Germany, Luxembourg, Netherlands, Portugal, Spain, Switzerland, and United Kingdom.

Objectives

1. Improve supply chain visibility, efficiency of trade compliance and effectiveness of border control and supervision by combining e-Freight and e-Customs.

Activities

- Applying risk based approach in the supply chain on the basis of integral monitoring data on cargo flows and container integrity.
- Building interfaces between existing solutions and tools in an open architecture.
- Demonstrate the benefits from integration in supply chains of three major trading routes to and from Europe.
- Evaluate the quality of data in business and government.
- Facilitate a dialogue between business and government to gain consensus on the criteria for data sharing.

Drivers

- Business efficiency, interoperability and visibility increase interests.
- Corporate responsibility.
- Green lane benefits.

Barriers

- Lack of trust between companies and the customs administrations.
- Lack of data standards and IT budgets.
- Integration of new systems and technologies with existing ones.

General Information	
Project acronym	CityLog
Project title	Sustainability and efficiency of city logistics
Funding programme	European Commission (EC) – 7FP
Duration	36 months (from January 2010)
Official webpage	http://www.city-log.eu/
Project type	UFT

Abstract

Description
- Solutions for sustainability and the efficiency improvements in urban delivery through an adaptive and integrated mission management and innovative vehicle solutions.
- Logistic oriented telematics services for optimised routing and mission management, vehicle technologies to enable operational flexibility and safety of trucks and innovative load units.
- Countries involved: Belgium, France, Germany, Italy, Netherlands, Sweden

Objectives
1. Limit the number of vehicles entering the city centre offering alternative systems.
2. Reduce the number of unsuccessful deliveries.
3. Make acceptable cost and time transhipment operation processes.
4. Develop and exploit the CITYLOG telematics services and offer logistics-targeted services.
5. Design and prototype specific configurations for the freight delivery vehicles focusing on flexibility, safety and traffic efficiency

Activities
Implement and provide:
- An optimised pre-trip planning system.
- Commercial vehicle-targeted enhanced maps and navigation services.
- Last mile parcel tracking systems.
- Freight bus (medium-dimension truck able to carry several load units and to quickly unload them) from peripheral hubs to city centre.
- Delivery vans (vehicles with ad hoc body configuration) in urban contexts.
- Interoperable load units, including re-configurable secure containers (Bento Box), to serve several types of customers.

Drivers
- Increase safety and efficiency policies in the EU.
- Interest by companies to reduce unsuccessful deliveries.
- Involvement of local authorities and other interested parties.

Barriers
- Lack of cooperation for implementing cooperative systems.
- Funding necessary, technical constrains and conflicts with other road users.

General Information	
Project acronym	CityMove
Project title	City multi-Role Optimized Vehicle
Funding programme	European Commission (EC) – 7FP
Duration	36 months (from January 2010)
Official webpage	http://www.citymoveproject.eu
Project type	UFT
Abstract	

Description
- New vehicle architecture specifically designed for the optimisation of the freight transport in urban areas.
- Countries involved: Belgium, France, Germany, Italy, Netherlands, and Sweden.

Objectives
1. To develop an innovative integrated vehicle solution for secure, flexible, reliable, clean, energy efficient and safe road transportation.
2. Act as a bridge between the freight vehicle industry, the transport research community, city planning authorities and local business communities.
3. To contribute to match EU urban needs by integrating new technologies.

Activities
- Capture the transport usage in urban geographical areas, focusing on vehicle characteristics, safety requirements and new transport modes.
- Design new vehicle architecture appropriate to freights operating in urban context.
- Analyse innovative Body solutions integrated with OEMs new vehicle concepts.
- Develop the Predictive anti-rollover functionality for Urban Goods delivery Trucks and other safety novelties.
- Select a significant number of use cases according to user needs and requirements, perform test in real use cases all over Europe, and evaluate impacts.

Drivers
- EU policy trends: environmental, efficiency and safety improvements.
- Interests from stakeholders for regulations regarding UFT.

Barriers
- Finance required implementing state-of-the-art technology.
- Coordination efforts by all stakeholders.

General Information	
Project acronym	CIVITAS
Project title	City-Vitality-Sustainability, or Cleaner and Better Transport in Cities
Funding programme	European Commission (EC)
Duration	CIVITAS I 48 months (From 2002), CIVITAS 48 months (From 2005), CIVITAS Plus 48 months (From 2008)
Official webpage	http://www.civitas.eu/
Project type	UFT
Abstract	

Description

- Project promoting energy-efficient freight logistics and new methods for goods distribution that contribute to better overall urban transport in cities all over Europe.
- Project consists of 3 financing periods, programs: CIVITAS I, CIVITAS II, CIVITAS plus and CIVITAS plus II.
- Countries involved: Albania, Croatia, the EU, Macedonia, and Serbia.

Objectives

1. Support cities in transport measures and policies towards sustainable urban mobility.
2. Achieve a significant shift in the modal split towards sustainable transport through encouraging both innovative technology and policy-based strategies.
3. Enhance sustainability and safety in the cities.
4. Creation of the platform for exchange & innovation – CIVITAS Forum Network.

Activities

- Cities to test biodiesel, biogas, compressed natural gas and hybrid and e-vehicles.
- Enable collective passenger transport.
- Demand management strategies, such as access restrictions, road pricing, parking policies and marketing campaigns, corporate mobility plans, reducing traffic and pollution.
- Mobility management awareness to create a new mobility culture.
- Urban freight logistics are managed to minimize the negative impacts on people's lives.
- Enable transport telematics systems offer opportunities to help passengers make informed choices and make urban transport faster and more efficient.

Drivers

- Political commitment from EU – Relevant stakeholder's attention.
- Funding from EU.
- Environmental awareness.
- Need for safer and smarter mobility.

Barriers

- Insufficient policy formulation – Competitiveness is compromised.
- Implementation stages and technology are far to reach.
- Complexity of integration.
- Lack of cooperation from some actors.

General Information	
Project acronym	CODE24
Project title	Corridor 24 Development Rotterdam-Genoa
Funding programme	INTERREG IVB NWE (http://www.nweurope.eu/)
Duration	60 months (from January 2010)
Official webpage	http://www.code-24.eu
Project type	E-freight, Co-modality
Abstract	

Description

- The interconnection of economic development, spatial, transport and ecological planning along the trans-European railway axis (TEN-T) no. 24: from Rotterdam to Genoa.
- Coordinated international strategy to support the improvement and the development of the corridor.
- Countries involved: France, Germany, Italy, Netherlands, and Switzerland.

Objectives

1. Accelerate and develop the transport capacity of the entire corridor.
2. Ensure optimal economic benefits and spatial integration.
3. Reduce negative impacts on the environment.

Activities

- Provide web based corridor information system for the regions with the overview about the state of the corridor.
- Identify the main bottlenecks in transport and provide the effective solutions.
- Promote pilot projects using innovative spatial development methods and ad hoc instruments (test planning).
- Consider inland waterways and high speed rail integration.
- Use of ecological compensation measures and innovative noise protection.
- Link the terminal ports to the hinterland.
- Endure interregional cooperation by having general project communication, events, conferences, workshops and seminars.

Drivers

- Economic incentives between corridors.
- Environmental policies.
- Corporate responsibility and involvement between stakeholders and regional actors.

Barriers

- Lack of information and results sharing.
- Limits in economic and spatial development.

General Information	
Project acronym	COFRET
Project title	Carbon footprint of freight transport
Funding programme	European Commission (EC) – 7FP
Duration	30 months (from June 2011)
Official webpage	http://www.cofret-project.eu
Project type	e-Freight, UFT
Abstract	

Description

- A collaborative research and demonstration project, which will deliver a methodology for the calculation of the carbon footprint along the full supply chain.
- Countries involved: Finland, France, Germany, Greece, Lithuania, Netherlands, Norway, Poland, Switzerland, and United Kingdom.

Objectives

1. Establish a complete GHG emission calculation methodology and framework in the context of complex supply chains based on available calculation tools for CO2 emissions.
2. Cover all types of transport relations at all logistics levels.
3. Provide a methodology applicable for supply chains across the EU.

Activities

- Conduct comparative analysis and evaluation of available methodologies and tools.
- Include user needs and requirements of supply chain management and all stakeholders in the supply chain.
- Apply appropriate methodologies supply chain management systems, leading to the development of a prototype-software for testing purposes.
- Implement test cases to validate the overall methodological approach and to derive recommendations for further practical exploitation.

Drivers

- Environmental concerns.
- International economic incentives
- Willingness to collaborate towards standardisation in EU and worldwide

Barriers

- Limitation in applicability beyond national context.
- Issues in accessibility and availability due to language barriers.
- Lack of transparency of involved parties.

General Information	
Project acronym	COMCIS
Project title	Collaborative Information Services for Container Management
Funding programme	European Commission (EC) – 7FP
Duration	24 months (from September 2011)
Official webpage	http://www.comcis.eu/
Project type	E-freight

Abstract

Description
- A collaborative project between multiple transport and logistics actors for awareness along global supply chains in support of enhanced logistics services and interoperability between existing e-freight systems.
- Countries involved: Belgium, Canada, Germany, Italy, Netherlands, Norway, Poland, Switzerland, and United Kingdom.

Objectives
1. Deliver awareness throughout global supply chains to solve problems of data fragmentation, delay and inconsistency.
2. Create a holistic view of supply chain beyond the boundaries of a single actor's operational responsibilities.
3. Offer information services that can benefit logistics service providers, terminal operators, ocean carriers, and port authorities and customs administrations in their respective activities.

Activities
- Offer Shippers, beneficial cargo owners, logistics service providers, customs authorities' information with shorten lead times and increase reliability.
- Unlock valuable information as: data from container security devices, port communities, logistics network, terminal operators, etc.
- Focus on better integration of customs processes.
- Conduct common framework, which supports interoperability between ICT systems in logistics.
- Aggregate and standardize data.
- Consolidate the data to create on-time, qualified and derived information.

Drivers
- Global trend to change new models for business and operations.
- Economic incentives, financial benefits, reliability.
- Access, standardisation.

Barriers
- Lack of communication.
- Difficult cooperation involving different actors.

General Information	
Project acronym	DELIVER
Project title	Design of Electric Light Vans for Environment-impact Reduction
Funding programme	European Commission (EC) – 7FP
Duration	36 months (From November 2011)
Official webpage	http://www.deliver-project.org
Project type	UFT
Abstract	

Description
- Part of the European Green Cars Initiative.
- Project aiming to develop a new urban electric light commercial vehicle concept intended for future larger scale production.
- Countries involved: Belgium, France, Germany, Italy, Sweden, Turkey, United Kingdom

Objectives
1. Design an innovative electric urban commercial vehicle with improved efficiency.
2. Optimise ergonomics and loading space at affordable costs.

Activities
- Execute a broad scope conceptual design study.
- Establish initial design specifications and continue to a detailed prototype-based, virtual performance assessment, and a running concept demonstrator vehicle.
- Focus on the rules of the design of electrical vehicles to be launched by 2020.

Drivers
- Environmental regulations and standards.
- Incentives like tax reduction, filling station network availability, individual transport strategy and deployment of vehicles.

Barriers
- High operational costs.
- Insufficient infrastructure and high investment costs.

General Information	
Project acronym	E-Freight
Project title	European e-Freight capabilities for Co-modal transport
Funding programme	European Commission (EC) – 7FP
Duration	48 months (from January 2010)
Official webpage	http://www.efreightproject.eu/
Project type	E-freight, Co-modality
Abstract	

Description

- International project that aims to facilitate the use of different transport modes on their own and in combination to obtain an optimal and sustainable utilisation of European freight transport resources.
- Countries involved: Austria, Cyprus, Finland, Germany, Greece, Hungary, Ireland, Latvia, Netherlands, Norway, Portugal, Spain, Sweden, and United Kingdom.

Objectives

1. Enable transport users to identify and use suitable direct or combined transport services.
2. Achieve efficient use of the different transport modes on their own and in combination.
3. Improve means to strategically manage networks and to plan and control shipments.
4. Development of a European network of integrated transport chains.

Activities

- Develop a suitable registry of e-Freight services and means for their secure interconnection supporting an evolutionary approach to the development of e-Freight market places.
- Provide transport chain management solutions assisting transport stakeholders to establish common end-to-end transportation processes.
- Investigate solutions for the Single Transport Document that can be generated in the transport planning process and communicated to all involved parties regardless of mode.
- Develop Next Generation Single Windows for cargo and integration with Safe Sea Net and e-Customs to support cooperation between administrations in security, safety and environmental risk management.

Drivers

- Cooperation between different interested actors.
- Standardisation action and access.
- Improved sustainability and efficiency of the use of the different transport modes as time and economic saver.
- EU support.

Barriers

- Interoperability problems.
- Need of infrastructure.
- Lack of standards.

General Information	
Project acronym	ECOSTARS
Project title	ECOSTARS Fleet Recognition Scheme
Funding programme	European Commission (EC) - Intelligent Energy Europe (IEE)
Duration	36 months (from June 2011)
Official webpage	http://www.ecostars-europe.eu/en/
Project type	UFT

Abstract

Description

- A project establishing a number of fleet recognition schemes in European cities and regions to support energy efficient, cleaner goods and passenger vehicle movements.
- Countries involved: Belgium, Czech Republic, Italy, Netherlands, Spain, Sweden, and United Kingdom.

Objectives

1. Increase the energy efficiency of freight distribution.
2. Encourage the introduction of vehicles using clean fuel technologies.
3. Development of energy efficient driving schemes and operational management practices.
4. Promote the auditing and certification of freight operators using a Europe-wide approach to sustainable practices in freight operations.

Activities

- Advertise more efficient and cleaner freight and passenger transport vehicle movements by providing recognition, guidance and advice to operators of vehicle fleets.
- Rate vehicles and operating practices using simple star rating criteria, to recognize levels of environmental and energy savings performance.
- Ensure the fleet is running as efficiently and economically as possible by receiving tailor-made support.
- Design common scheme standards across Europe by producing a guide for Local Authorities into setting up ECOSTARS schemes.

Drivers

- EU regulations and incentives.
- Environmental concern regarding energy efficiency.
- Involved parties' cooperation and willingness.

Barriers

- Difficulty in involving small actors.
- Establishing new relationships between the local authority and the private freight sector.
- Unwillingness to provide data from private stakeholders.
- Funding.

General Information	
Project acronym	eMar
Project title	e-Maritime Strategic Framework and Simulation based Validation
Funding programme	European Commission (EC) – 7FP
Duration	36 months (from January 2012)
Official webpage	http://www.emarproject.eu/
Project type	E-freight, co-modality

Abstract

Description

- Project for the development of sustainable maritime transport in Europe through the development of a framework based on the latest information, communication, and surveillance technologies.
- Countries involved: Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Netherlands, Norway, Spain, and United Kingdom.

Objectives

1. Improve safety and security of maritime transport services and assets and promoting enhanced environmental performance.
2. Increase the competitiveness of the EU maritime transport.
3. Increase the attractiveness of the seafaring profession and improving working conditions.

Activities

- Conduct market surveys to identify business drivers and requirement priorities of different stakeholder groups.
- Identify implications for standardisation and suitable strategies.
- Conduct measures to address legal and organisational inconsistencies at national and regional levels.
- Interfaces with Safe Sea Net, e-Freight and e-Customs, National Single Windows, Galileo and e-Navigation development.
- Conduct cost-benefit analysis for new business models relying on e-Maritime services.

Drivers

- Economic incentives
- Environmental concerns regarding safety and security maritime transport.
- Collaboration between authorities.
- Transport stakeholders' involvement.

Barriers

- Complex and time-consuming administrative procedures.
- Limited linkage between Safe Sea Net and the port networks.
- Standardisation requirement.
- Need for security and interoperability of information exchanges.

General Information	
Project acronym	EUROSCOPE
Project title	Efficient urban transport operation services co-operation of port cities in Europe: Traveller information, logistical information and communication, traffic management
Funding programme	European Commission (EC)
Duration	24 months (from January 1996)
Official webpage	http://www.eranet.gr/euroscope
Project type	e-Freight, Co-modality, UFT
Abstract	

Description
- Project based on the necessity for better integration and information of transport users. It involves 3 different categories: information for traveller, logistic information and communication systems and network management.
- Countries involved: France, Germany, Ireland, Italy, Netherlands, and United Kingdom.

Objectives
1. Demonstrate advanced transport systems across Europe for the benefit of transport users.
2. Inform and reflect information to all sorts of users.
3. Promote freight information interchange and modernise freight terminals.
4. Optimise network for on-time management and strategies.

Activities
- Deploy and validate transport telematics services.
- Provide Informed Traveller application: includes multi-modal planning terminals, real-time information on board, and guidance information among others.
- Provide logistics information at freight terminals for the better integration between modes and coordination of distribution centres and freight interchanges.
- Provide network management that includes monitoring, incident management strategies, priority measures for public transport, links between control and information centres and real-time trip planning.

Drivers

- Stakeholders interest in improving management of the road network and EU funding.
- Global trends in term of reducing the levels of pollution through management of transport.
- Co-operation scheme (a management enabling the value added service to be implemented).

Barriers

- Involvement of different authorities at the urban and inter-urban interface.
- Standardisation/regulations/laws of each city.

General Information	
Project acronym	FLAVIA
Project title	EU CE: Freight and Logistics Advancement in Central Europe – Validation of processes, Improvements, Application of co-operation
Funding programme	European Regional Development Funds (ERDF)
Duration	35 months (from March 2010)
Official webpage	http://www.flavia-online.eu
Project type	Co-modality

Abstract

Description

- Logistic process project with the aim to improve intermodal cargo flows as an alternative to the construction of new infrastructure and therefore existing resources management.
- Counties involved: Austria, Czech Republic, Germany, Hungary, Poland, Romania, and Slovak Republic.

Objectives

1. Establish intermodal cooperation and development of the logistic corridor.
2. Enhance the competitiveness of the involved regions by supporting the harbour development at the Black Sea as an alternative to the Adriatic harbours for Central European overseas trade.
3. Foster the intermodal transport infrastructure for a more sustainable logistics experience.

Activities

- Analyse logistic flows and chains, network and organisational barriers, security aspects and visualize bottlenecks in an IT tool in order to eliminate them and optimise logistics techniques.
- Transfer best practice in rail and inland waterways transport.
- Elaborate concepts for intermodal security and efficiency and establish institutional pro-rail and intermodal terminal alliances and establish cooperation structures.
- Support multi-modal goods transport by improving the accessibility of the involved regions.
- Unburden the congested roads and contribute to the sustainability goals.

Drivers

- Economic support and integration of markets in the enlarged European Union as a way of strengthening the economies of new member and candidate countries to EU.
- Enhance competitiveness and focus on sustainability improvements.

Barriers

- Lack of infrastructure quality, inevitable infrastructure investments for further development.
- Need for legislation.
- High prices for rolling stock and equipment for combined transport.
- Insufficient awareness and knowledge of market players.
- Low transmission rate of the goods for shippers.

General Information	
Project acronym	FREIGHTWISE
Project title	Management Framework for Intelligent Intermodal Transport
Funding programme	European Commission (EC) – 6FP
Duration	42 months (from November 2006)
Official webpage	http://www.freightwise.info
Project type	Co-modality

Abstract

Description

- A multimodal framework for exchange information and enhance co-operation between different sectors, to develop and demonstrate suitable intermodal transport solutions. Parties involved are:
  - Transport Management (Shippers, Forwarders. Operators and Agents)
  - Traffic and Infrastructure Management (Rail, Road, Sea, Inland waterways)
  - Administration (Customs, Border Crossing, Hazardous Cargo, Safety and Security)
- Countries involved: Belgium, Czech Republic, Estonia, Finland, France, Germany, Greece, Italy, Netherlands, Norway, Poland, Spain, Sweden, and United Kingdom.

Objectives

1. Support the modal shift of cargo flows from road to intermodal transport using road in combination with short sea shipping, inland waterways and rail.
2. Contribute to EU formulation of future legislation.
3. Developing initiatives that can provide a platform on which the industry can develop management solutions.
4. Increase the competitiveness of intermodal transport solutions.

Activities

- Develop a framework to achieve interoperability between all stakeholders.
- Improve transport management through traffic information and authority networks.
- Support to European policies.
- Enable practical solutions for a user community of intermodal operations, including the architecture and the business models.

Drivers

- Environmental targets and financial support and interest from EU.
- Reach cost effective multi-modal transport and
- Improve interoperability along the intermodal transport chain.

Barriers

- Lack of true interoperability between transport management ICT systems.
- Lack of standardisation.
- Difficult to transform framework into policy comprehensible terms.
- Lack of involvement of actors.

General Information	
Project acronym	FREILOT
Project title	Urban Freight Energy Efficiency Pilot
Funding programme	European Commission (EC)
Duration	30 months (from April 2009)
Official webpage	http://www.freilot.eu/
Project type	UFT
Abstract	

Description

- An innovative solution for urban freight energy efficiency by developing a holistic and integrated approach for urban freight combining various measures and services.
- Countries involved: France, Netherlands, Poland, and Spain.

Objectives

1. Increase overall energy efficiency in road goods transport in urban areas through a holistic treatment of traffic management, fleet management and driving.
2. Demonstrate in four linked pilot projects that up to 25% reduction of fuel consumption in urban areas is feasible.
3. Disseminate and share the pilot results with all relevant stakeholders so that the FREILOT service can become a truly EU for transport in urban areas.
4. Increase the involvement of fleet operators, cities and other stakeholders in the scheme.

Activities

- Energy efficiency optimized intersection control management.
- Adaptive acceleration and speed limiters for drivers as part of consumption management techniques.
- Enhanced “green driving” support as part of awareness and educative programs to relevant actors.
- Real-time loading/delivery space booking for enhanced transport efficiency.

Drivers

- Economic interest in transport efficiency.
- Fuel reduction and fuel dependency.
- Decrease cost of urban transport.
- Reduce congestion and environmental related nuisance.

Barriers

- High price of invest in equipment and operation.
- Negative perception of effects on traffic safety and efficiency – Lack of information and non-available previous experiences.
- Technical complexity (technical problems create abruption in the operational phase).

General Information	
Project acronym	Hinterport
Project title	Promotion of hinterland transport cooperative solutions for integrated operations of sea-inland ports
Funding programme	European Commission (EC) - Marco Polo
Duration	24 months (from January 2010)
Official webpage	http://www.hinterport.eu
Project type	E-freight, Co-modality
Abstract	

Description

- Project with the aim to establish an interactive network of inter-modality related stakeholders in order to capture available success stories from Europe transport business cases, validate their applicability and viability and promote them through training/dissemination activities using innovative methods and ICT tools.
- Counties involved: Belgium, Estonia, France, Germany, Greece, Italy, Lithuania, Slovenia, and Spain.

Objectives

1. Expansion of the relevant actors' network and establishment of the HINTERPORT Forum.
2. Development of various thematic Blueprints.
3. Introduction of user friendly ICT means for distance awareness and learning.
4. Execution of detailed and innovative training and dissemination programs.

Activities

- Present good practices of sea–inland ports integration considering the driving forces and the prerequisites imposed by the transport operators.
- Provide a practical guideline for extrapolation of the practices in form of Blueprint.
- Use advanced ICT means for the implementation and communication of the gathered practices to provide a user friendly demonstration of applicability.
- Establish training and dissemination plans to guide an extensive awareness and knowledge transfer program targeting the wider possible audience and putting emphasis on remote and developing business cases and related actors.
- Develop a HINTERPORT forum for scalability and viability of the developed networking platform.

Drivers

- Future joint and cooperative business initiatives.
- Interest in improving logistics chain by stakeholders.
- Demand for non-road transport.

Barriers

- Variety of stakeholders involved and different needs.
- Financing.

General Information	
Project acronym	iCargo
Project title	Intelligent Cargo in Efficient and Sustainable Global Logistics Operations
Funding programme	European Commission (EC) – 7FP
Duration	42 months (from November 2011)
Official webpage	http://i-cargo.eu/
Project type	E-freight
Abstract	

Description

- A decentralized ICT infrastructure that allows new planning services including CO2 calculation and existing systems to co-exist and efficiently co-operate at an affordable cost for logistics stakeholders.
- Countries involved: Austria, Belgium, Finland, France Germany, Italy, Netherlands, Norway, Poland, Spain Sweden, and United Kingdom.

Objectives

1. Synchronize vehicle movements and logistics operations across various modes and actors to lower CO2 emissions.
2. Adapt to changing conditions through dynamic planning methods involving intelligent cargo, vehicle and infrastructure systems.
3. Combine services, resources and information from different stakeholders, taking part in an open freight management ecosystem.
4. Provide information for shippers and carriers to communicate their requirements, service availability, door-to-door service planning, and performance monitoring and reporting.
5. Create a platform for planning and managing end-to-end logistic chains involving multiple companies.

Activities

- Create mechanisms to support collaborative planning.
- Provide logistic chains with a portfolio composed of the available transport services.
- Enable ways for client to re-plan and change the logistic chain as goals and change.
- Allow logistic service to optimize the use of transport resources.
- Gather data relevant to environmental footprint from logistic chain and share with their customers for reporting purposes.

Drivers

- Improved supply chain efficiency – economic incentives.
- Reduction of congestion and sustainability goals.

Barriers

- Interoperability challenges.
- Underutilised transport capacity at aggregate level.
- Limited shift from road to alternative transport modes and limited infrastructure.

General Information	
Project acronym	L4life
Project title	Logistics Industry Coalition for Long-term, ICT-based Freight Transport Efficiency
Funding programme	European Commission (EC) – 7FP
Duration	30 months (from January 2010)
Official webpage	http://www.logistics4life.eu/
Project type	E-freight
Abstract	

Description

- A Coordination Action that brings together leading logistics companies, technology providers and research organisations working on Innovative ICT solutions to ensure the long-term sustainability of the logistics industry by increasing its operational efficiency: making logistic operations more efficient, more environmentally friendly, and financially and socially suitable.
- Countries involved: Austria, China, Finland, Germany, Greece, Ireland, Italy, Norway, and Sweden.

Objectives

1. Create a network of logistic companies, technology providers and researchers.
2. Establish a reference framework where logistic efficiency requirements from different stakeholders are related to sustainability strategic objectives.
3. Develop a strategic roadmap including concrete actions and strategies.
4. Establish a common working platform for the community of users and researchers working on logistic long-term efficiency.

Activities

- Capture the different stakeholders' perspective, in terms of efficiency and related ICT requirements, and relate them to long-term sustainability strategic goals.
- Map the existing ICT for transport solutions landscape.
- Provide a basis for discussion inside and outside the project, by pointing out duplications, gaps, critical unaddressed requirements…
- Develop a strategic roadmap for energy efficiency in Logistics.
- Establish Logistics for LIFE Forum.

Drivers

- Close cooperation in supply networks and logistics operations.
- Supply chain efficiency increase interest – economic positioning.

Barriers

- Unstructured information and cooperation in information sharing needed.
- Not enough projects and initiatives for cost effective green freight transport.

General Information	
Project acronym	SAFEPOST
Project title	Reuse and development of Security Knowledge assets for International Postal supply chains
Funding programme	European Commission (EC) – 7FP
Duration	48 months (from April 2012)
Official webpage	http://www.safepostproject.eu/
Project type	E-freight
Abstract	

Description
- An innovative solution for postal security that aims towards an international customs standards and controls exchanging information framework between all relevant stakeholders, particularly the authorities, to enable them to employ responsible co-operative strategies.
- Countries involved: Belgium, Greece, Iceland, Italy, Netherlands, Norway, Spain, Sweden, Switzerland, and United Kingdom.

Objectives
1. Assist stakeholders involved in postal services to achieve enhanced security without cost penalties.
2. Facilitate the sustainable development of increasing level of postal security across EU.
3. Increase awareness of the necessity of common policies from authorities.

Activities
- Identify common gaps in representative postal operations, where the security control measures do not match the threat probabilities and consequences.
- Gap analysis with stakeholder requirements analysis and clarifying of the KPIs.
- Produce a postal generic model for future secure and efficient postal operations.
- Develop a platform utilizing existing technologies and open standards to provide the physical integration of the above and to support interoperability between the different postal security stakeholder groups, and increase the visibility of these.

Drivers
- Threatens are difficult to identify – Security concern arisen.
- Increased drug trafficking – Social concerns.
- Need for increased efficiency for economic results improvement.

Barriers
- Detection and threat handling solutions are difficult to combine with large flows.
- Information sharing and interoperability between postal security stakeholders.
- Organisational and regulatory changes affecting the entire sector.

General Information	
Project acronym	SCANDRIA
Project title	Scandinavian – Adriatic Corridor for Growth and Innovation
Funding programme	Baltic Sea Region Programme (BSRP) of the European Union
Duration	36 months (from September 2009)
Official webpage	http://www.scandriaproject.eu
Project type	Co-modality

Abstract

Description
- Developing a green and innovative transport corridor between the Baltic and the Adriatic Sea that will reduce traffic congestion and speed up the transportation times in the corridor at the same time as providing a more sustainable solution for the supply chain of involved stakeholders.
- Countries involved: Denmark, Finland, Germany, Norway, and Sweden.

Objectives
1. Increase infrastructural accessibility and efficiency for passengers and freight and to improve regional economic potentials.
2. Promote co-modality practices as a mean to strengthen more environmental suitable transportation and de-congest roads.
3. Increase the attractiveness and competitiveness of rail traffic by means of high speed trains and increased capacity and transport efficiency.

Activities
- Enable green heavy goods transport by using intelligent transport systems and alternative fuels.
- Compose a common strategy of corridor functionality by joint action and stakeholders' involvement.
- Create a common strategy on logistics business management by development of logistic solutions and marketing campaign for logistics services.

Drivers
- Increased competitiveness of sector.
- Efficient means of transport – suitable with EU environmental targets.
- Global trend regarding sustainability.
- EU economic incentives.

Barriers
- Complexity of cross-border transport in EU because of several different railway electrification systems.
- Technical incompatibilities - Large investments required.
- Bureaucracy issues and delays in the progress of the project – need for improved cooperation.

General Information	
Project acronym	SMARTFUSION
Project title	Smart Urban Freight Solutions
Funding programme	European Commission (EC) – 7FP
Duration	36 months (from April 2012)
Official webpage	http://www.smartfusion.eu/
Project type	UFT
Abstract	

Description
- A joint venue towards the development and demonstration of novel transport innovations that will improve the efficiency, social and environmental sustainability of urban freight operations and the related urban- interurban shipment processes.
- Countries involved: Belgium, Germany, Italy, Netherlands, Sweden, Switzerland, and United Kingdom.

Objectives
1. Enhance the implementation of innovation processes at urban-interurban interfaces.
2. Demonstrate and evaluate the technical and logistical feasibility of introducing electric vehicles and the second generation of hybrid truck technology into the business environment.
3. Apply these vehicle technologies, in conjunction with information technology.
4. Determine the critical success factors in the market uptake of new vehicle technology and other innovations.
5. Develop a tool that allows other city-regions and company supply chains to analyse the likely success and benefits of applying these innovations in their domain.

Activities
- Design frameworks to demonstrate the innovations in a local context.
- Prove vehicle innovations and green planning and routing at urban-interurban contexts.
- Conduct impact assessments and develop the tool for systematic analyse of the urban areas.
- Demonstrate the simultaneous implementation and operation of urban consolidation centres, vehicle telematics systems and urban freight policy measures.
- Create standardised and objective methodology for data collection and analysis, impact assessment, across the demonstrations.
- Determine the critical success factors increasing the viability of the implementation of the innovations in other city-regions and supply chains.

Drivers
- Improving sustainability in urban areas and increase competitiveness: Interest from EU.
- Need for standardisation and support of all stakeholders.

Barriers
- Difficult aggregation of experienced results.

General Information	
Project acronym	SPECTRUM
Project title	Solution and Processes to Enhance the Competitiveness of Transport by Rail in Unexploited Markets
Funding programme	European Commission (EC) – 7FP
Duration	48 months (from May 2011)
Official webpage	http://www.spectrumrail.info/
Project type	Co-modality
Abstract	

Description
- Project designed to develop a detailed design concept for a high performance freight train that is efficiently lightweight, has driving performance characteristics that facilitate mixed running with passenger services and is capable of accommodating the required types of freight container units.
- Countries involved: Belgium France, Germany, Italy, Netherlands, Norway, Sweden, Switzerland, Turkey, and United Kingdom.

Objectives
1. Develop rail freight services to match seamlessly with customers' supply chains.
2. Improve technical difficulties related to co-modality implementation.
3. Analyse the logistics market as a whole, with a view to identifying the market for low density, high value goods specifically.

Activities
- Analyse technological, operational, and organisational requirements.
- Design and optimize: wagon structures, vehicle dynamic systems, electrical and coupling systems, container units and their handling and power conversions.
- Implement high speed operation along the corridors.
- Develop critical aspects of the lightweight vehicle structure and the freight handling systems to assist them.
- Replicate 'Real life' conditions in terms of scale, fabrication, installation maintainability and robustness.

Drivers
- Market opportunities of rail freight to growth.
- Environmental friendly transport of goods of interest to stakeholders.
- Pursue of increased reliability and availability.

Barriers
- Harmonisation and standardisation needs for implementation.
- R&D required for further improvements of rolling stock.
- IT incompatibility - Data exchanging needs.
- Need for data share and involvement from stakeholders.

General Information	
Project acronym	STRAIGHTSOL
Project title	Strategies and measures for smarter urban freight solutions
Funding programme	European Commission (EC) – 7FP
Duration	36 months (from September 2011)
Official webpage	http://www.straightsol.eu/index.htm
Project type	UFT

Abstract

Description
- Venture willing to demonstrate and evaluate urban freight transport and urban-interurban freight transport interfaces in involved partner cities with congestion and pollution derived issues in search of smarter UFT solutions.
- Countries involved: Belgium, Greece, Netherlands, Norway, Portugal, Slovenia, Spain, and United Kingdom.

Objectives
1. Develop a new impact assessment framework for measures applied to urban-interurban freight transport interfaces.
2. Support innovative field demonstrations.
3. Apply the impact assessment framework and develop specific recommendations for future freight policies.

Activities
- State-of-art review on past, existing and emerging freight measures and initiatives.
- Impact assessment and monitoring of urban and inter-urban freight transport.
- Reduce road congestion, CO2 production and noise pollution.
- Implement retail supply chain management and "last mile" distribution by use of standardized information and demonstrate night-time distribution.
- Develop a set of tailored recommendations to improve the logistics operations in selected areas.

Drivers
- Environmental and health concerns in urban areas.
- Interest in increasing logistic performance.
- Needs for a comprehensive approach to urban freight solutions – cooperation and standardisation required.

Barriers
- Lack of public funding in combination with private sector's unwillingness to afford the costs.
- Low public acceptance, lack of authorities' involvement.
- Socioeconomic and environmental burdening due to the prioritisation of freight activities over all the rest.

General Information	
Project acronym	SUGAR
Project title	Sustainable Urban Goods Logistics Achieved by Regional and Local Policies
Funding programme	European Regional Development Funds (ERDF) and INTERREG IVC NWE (http://www.nweurope.eu/)
Duration	40 months (from November 2008)
Official webpage	http://www.sugarlogistics.eu
Project type	UFT

Abstract

Description

- Project that promotes the exchange of knowledge through the field of urban freight management, between and among Good Practice and Transfer sites.
- The policy leverages covered include transport, environmental and spatial measures such:
  - Access control, regulation of pricing or intelligent communication technologies.
  - Incentives for clean vehicles and modes, environmental zoning.
  - Planning distribution and loading areas.
- Countries involved: Belgium, Bulgaria, Czech Republic, France, Greece, Italy, Poland, Slovenia, Spain, and United Kingdom.

Objectives

1. Address the problem of inefficient and ineffective management of urban freight distribution as a source of pollution and health concerns.
2. Pursue of policies promoting good practice sites and the support of administrations.
3. Transferability achievement towards the expansion of the project to other urban areas with similar issues.

Activities

- Refinement of urban freight policies of SUGAR Good Practice Sites through dialogue with other leading administration.
- Mapping of innovation areas.
- Development of urban freight policies in SUGAR Transfer Sites by the exporting good practice approach.
- Creation of interest, knowledge, tools and exchange for new administrations.
- Provide access to project results, participation in training events, and a high-level exchange programme for bilateral meetings between administrations.

Drivers

- Environmental concerns and strong political will.

Barriers

- Lack of staff and partnership involvement.
- High cost of infrastructure.
- Lack of supporting regulation and rules.

General Information	
Project acronym	SULOGTRA
Project title	Effects on Transport of Trends in Logistics and Supply Chain Management
Funding programme	European Community (EC)
Duration	24 months (from January 2000)
Official webpage	http://www.logistik.tu-berlin.de/sulogtra+protrans (closed)
Project type	Co-modality, Intralogistics
Abstract	

Description

- This project was created after arisen concerns with societal needs and improving methods for the efficiency of logistics operations and transport systems were identified by the stakeholders. The project supports efforts to raise the competitiveness of the European industry by examining ways to promote supply chain integration with innovative solutions.
- Countries involved: France, Germany, Greece, Netherlands, Portugal, and United Kingdom.

Objectives

1. Promoting supply chain integration of innovative solutions in EU interested actors.
2. Provide industry on supply chain trends information, performance measurement and supply chain optimisation tools.
3. Identify policy implications and necessary fields where new measures need to be put in place in pro of the modernisation of supply chain experiences.

Activities

- Identify logistics and supply chain trends.
- Develop supply chain management metrics, mapping tools and benchmarking procedures.
- Investigate the processes of value creation in supply chain and establish and disseminate of best practices related to them.
- Analyse benchmarking results and arise awareness.
- Promote information flows.

Drivers

- Economic growth potential.
- Technological implementation to improve the entire sector.
- Growth of an agreement culture, harmonisation and regulations of laws – Pursuing better international relations.
- Social and environmental concerns.

Barriers

- Reluctance to take action from stakeholders.
- Trust and competition issues towards co-ordination and project leadership.
- Funding required.
- Need for the availability of enabling technologies.

General Information	
Project acronym	SuperGreen
Project title	Supporting EU's Freight Transport Logistics Action Plan on Green Corridors Issues
Funding programme	European Commission (EC) - 7FP
Duration	36 months (from January 2010)
Official webpage	http://www.supergreenproject.eu/
Project type	E-freight, co-modality, intralogistics
Abstract	

Description
- A coordinated action that identifies solutions and evaluates a series of green corridors covering some representative regions and main transport route throughout Europe.
- Countries involved: Austria, Belgium, Finland, Germany, Greece, Italy, Norway, Portugal, Spain, Sweden, Turkey, Ukraine, and United Kingdom.

Objectives
1. To promote the development of European freight logistics in an environmentally friendly manner.
2. Conduct benchmarking of Green Corridors based on relevant parameters (KPIs) including identification of areas and candidates for improvement.

Activities
- Use green technologies and improved methods for the identified bottlenecks or novel concepts of any kind relevant for the multimodal Green Corridors.
- Use of ICT flows such as e-freight, supply chain management, navigation technologies or track & trace.
- Identify recommendations for R&D where the available sustainable alternatives and present knowledge about utilisation of ICT-flows are not sufficient to improve bottlenecks.
- Examine policy implications to provide assistance to the EC in the formulation and harmonisation of policies on Green Corridors.
- Development of a dissemination plan, promotional material, workshops and other events with stakeholder participation.

Drivers
- Environmental concerns.
- Close contact with the logistics sector.
- Increase competitiveness and modernisation.

Barriers
- Lack of harmonisation and co-operation - Interoperability problems due to different operational rules and requirements by the Member States.
- Difficulty in market integration both within and between transport modes.
- Insufficient intermodal infrastructure.
- Incompatible ICT systems.
- Significant investments in transport infrastructure needed.

General Information	
Project acronym	SuPorts
Project title	Sustainable management for European local ports
Funding programme	European Regional Development Fund (ERDF), INTERREG IVC NWE (http://www.nweurope.eu/)
Duration	36 months (from January 2010)
Official webpage	http://www.seinemaritime.net/suports
Project type	Co-modality, intralogistics
Abstract	

Description
- Initiative directed to assist local ports in the implementation of environmental strategies and to facilitate their access to suitable environmental management tools, enabling them to remain competitive by contributing to a more sustainable EU.
- Countries involved: France, Greece, Italy, Lithuania, Netherlands, Spain, United Kingdom

Objectives
1. Help local ports to design better environmental strategies and to contribute to a more sustainable EU.
2. Exchange of experience to identify and promote better practice in the fields of dredging, protecting the marine biodiversity and involving stakeholders.
3. Customize existing environmental management tools, such as self-diagnosis, indicators, and environmental management systems that have been developed for large ports or other fields, to produce easy and ready-to-use tools that are relevant for use by local ports.

Activities
- Identify better practice by larger and leading edge, small ports and tools developed for use by local ports and local authorities to encourage them to be pro-active environmental players:
- Design and implement innovative environmental and port policies.
- Share and identify better practice, test and formalize methodological tools
- Provide trainings, studies, workshops, fieldwork and the drafting of easy-to-read technical documentation
- Disseminate by Europe-wide conferences, local dissemination events in different languages and through a network of trainers.

Drivers
- Competitiveness increase need.
- Economic incentives by EU.
- Environmental concerns.

Barriers
- Lack the tools or prior indicators data.
- Need for sharing information.

General Information	
Project acronym	Support
Project title	Security Upgrade for Ports
Funding programme	European Commission (EC) – 7FP
Duration	48 months (from July 2010)
Official webpage	http://www.support-project.eu/
Project type	E-freight

Abstract

Description
- Initiative to help port stakeholders establish the security levels sufficient to meet evolving international regulations and standards, and which work in the complexity of the real port environment.
- Countries involved: Austria, Cyprus, Finland, France, Greece, Ireland, Latvia, Netherland, Norway, Spain, Sweden, United Kingdom

Objectives
1. To address total port security upgrade solutions encompassing legal, organisational, technological, training and human factors perspectives.
2. Facilitate secure and efficient operation of European ports in the context of sustainable transport.
3. Enable uninterrupted flows of cargo and passengers.
4. Suppression of attacks on high value port facilities, illegal immigration, trafficking of drugs, weapons and illicit substances.

Activities
- Conduct a risk model highlighting the relationship between threats, consequences and risk management options.
- Develop port security process framework.
- Conduct an advanced financial model allowing ports to conduct cost-benefit analyses.
- Provide an ICT platform to provide the necessary information exchange.
- Establish a set of capabilities that will enable port security stakeholders to collaborate efficiently in dealing with risks and threats.
- Engage in promoting improved levels of security in international supply chains and raise security standards across Europe.

Drivers
- Enabling competitive operational efficiency and safety and security of population.

Barriers
- Implementation of technological interfaces needed.
- Organisation of border control authorities and other intervention forces and transport and logistics operators – need for more interconnected actors.
- Complexity and cost related to port operation for European freight.

General Information	
Project acronym	SURF
Project title	Sustainable Urban Fringes
Funding programme	European Regional Development Fund (ERDF), INTERREG IVC NWE (http://www.nweurope.eu/)
Duration	36 months (From September 2009)
Official webpage	http://www.sustainablefringes.eu/
Project type	UFT
Abstract	

Description

- Urban Fringe is a zone of transition and interface between urban and country areas, where a broad variety of land uses and activities come together. Recognised as valuable assets, which can provide a high quality environment in an urban setting, creating vital areas for the health and wellbeing of local communities, these facilities are of the interest of this project.
- Countries involved: Belgium, Germany, Netherlands, Sweden, and United Kingdom.

Objectives

1. Unlock the potential of urban fringe in areas often neglected and under threat from growth and expansion and inconsistent spatial planning policy.
2. Create awareness of the necessity of Urban Fringes in policy makers.
3. Provide a common platform for experts and institutions to exchange information, strategies and policies on dealing with urban fringes.

Activities

- Review urban fringe policies and develop a set of policy guidelines to tackle issues of governance and spatial planning.
- Create a common platform for experts and institutions to exchange information and create strategies to present to relevant authorities.
- Engage policy analysis to tackle urban fringe challenges, which include complex issues of ownership and administration, biodiversity loss, water quality loss, lack of green spaces, and public accessibility.

Drivers

- Rise environmental awareness.
- Inform about the necessity of Urban Fringes.
- Competitive advantage for city regions – marketing green spaces as part of healthier cities.
- Bridge the gap between existing urban and rural policy.

Barrier

- Complex issues of ownership and administration.
- Fragmented spaces declining biodiversity – Environmental concerns in urban areas.
- Poor access to green infrastructures.
- Lack of engagement with local communities – Obsolete urban planning.

General Information	
Project acronym	SUSTRAIL
Project title	The sustainable freight railway
Funding programme	European Commission (EC) – 7FP
Duration	48 months (from June 2011)
Official webpage	http://www.sustrail.eu/
Project type	Co-modality

Abstract

Description
- The sustainable freight railway: Designing the freight vehicle – track system for higher delivered and tonnage with improved availability at reduced cost.
- Countries involved: Belgium, Bulgaria, France, Georgia, Germany, Italy, Norway, Romania, Russia, Spain, Sweden, Switzerland, United Kingdom

Objectives
1. Contribute to the rail freight system modernisation to allow it to regain position and market.
2. Reduce road transport share as targeted by the European Commission.
3. Provide the approach, structure, and technical content to improve the sustainability, competitiveness, and availability of European railway networks thanks to an integrated approach.

Activities
- Conduct a holistic approach that leverages the technical solutions including vehicles and their subcomponents for both freight and passenger operational procedures.
- Provide state of the art benchmarking, integration of on-going rail projects, timeframes and roadmaps.
- Focus on scheduling of actions for optimal implementation.
- Balance actions for short-term impact with room to be strikingly innovative for midterm impact and follow the KPIs.
- Demonstrate on real routes, selected based on their geographic dispersion, their type (freight vs. passenger) and their frequency of traffic.

Drivers
- Reinforce competitiveness of related economies.
- Development and improvement in vehicles and rail infrastructures – Enabling technical change.
- EU target in reduction of road transport.

Barriers
- Need for standardisation.
- IT procedures and systems applicable incompatibilities.
- Other technical incompatibilities.

General Information	
Project acronym	TAPAS
Project title	Robotics-enabled Logistics and Assistive Services for the Transformable Factory of the Future
Funding programme	European Commission (EC) – 7FP
Duration	42 months (from October 2010)
Official webpage	http://www.tapas-project.eu/
Project type	Intralogistics
Abstract	

Description
- A new generation of transformable solutions to automation and logistics for small and large series production economic viable and flexible, regardless of changes in volumes and product type.
- Countries involved: Austria, Denmark, and Germany.

Objectives
1. Create a new brand of robot-based automation and logistics as the backbone of a transformable factory of the future, enabling an economic production regardless of changes in volumes and product type.
2. Optimize European production and to prevent manufacturing jobs from migrating to low wage economies.

Activities
- Develop mobile robots with more flexibility that improve the tasks of collecting and transporting parts needed at any given time and delivering these to their relevant locations.
- Provide automation of assistive tasks, which naturally build on logistical tasks, such as preparatory and post-processing work such as pre-assembly or machine quality control.

Drivers
- Interest in cooperation between stakeholders: robot manufacturers, software technology provider and logistics procedures designers.
- Increase competitiveness in EU.

Barriers
- High cost of investment

General Information	
Project acronym	TRAILBLAZER
Project title	Transport and Innovation Logistics By Local Authorities with a Zest for Efficiency and Realisation
Funding programme	European Commission (EC) – Intelligent Energy European Programme (IEE)
Duration	36 months (from June 2013)
Official webpage	http://www.trailblazer.eu/content.php
Project type	UFT
Abstract	

Description
- Showcase existing good practices and promote public sector policy interventions which can bring about a reduction in energy used in urban freight transport by implementation of servicing plans and key strategies.
- Countries involved: Croatia, Germany, Greece, Italy, Portugal, Spain, Sweden, and United Kingdom.

Objectives
1. Promote co-ordination, management, information mechanisms and motivation to fleet operators, retailers and stakeholders in the freight sector about measures to increase the energy efficiency of their operations.
2. Support learning experiences and information exchanges between practitioners, employees of regulating and administrative bodies or experts in order to transfer knowledge and experience.

Activities
- Implement the actions contained in the portfolios.
- Evidence reduced energy use by freight transport in the cities by comparing baseline energy use with actual or projected energy use following production and implementation of the actions contained in the project.
- Transfer knowledge and exchange experience between experienced and less experienced municipalities, private sector organisations, freight transport operators and project stakeholders.
- Promote best practice in freight energy efficiency among local and regional authorities in Europe.

Drivers
- Environmental awareness and social responsibility.
- Increase cost efficiency and competitiveness.
- Security and noise reductions targets.

Barriers
- Time consuming negotiations – lack of involvement from actors.
- Hard to motivate private sector.

General Information	
Project acronym	TRANSITECTS
Project title	Transalpine Transport Architects Intermodal solutions for transalpine freight traffic
Funding programme	European Regional Development Funds (ERDF)
Duration	36 months (from July 2009)
Official webpage	http://www.transitects.org/
Project type	Co-modality
Abstract	

Description

- Venue aiming to create sustainable intermodal solutions to fit changing markets and focuses on optimizing the existing alpine railway system for freight transports.
- Countries involved: Austria, Germany, Italy, and Slovenia.

Objectives

1. Create sustainable intermodal solutions for transalpine freight traffic.
2. Improve the railway network's attractiveness and accessibility for the market.
3. Disburden alpine transport routes and generate positive ecologic and economic incentives.
4. Implement the shift from road to rail related traffic.
5. Activate synergies and leverage effects through international cooperation.

Activities

- Analysis and implementation of logistic solutions.
- Measures to promote new products as well as different workshops with potential investors accompany the implementation process.
- Evaluation of projects implemented using specific environmental models.
- Building a transnational partner network and developing a cross-project cooperation platform.

Drivers

- Needs for expansion of rail transport sector.
- EU political and economic interests in co-modality.
- Environmental concerns.

Barriers

- Cooperation between involved countries.
- Lack of modern infrastructure.
- Large investments for technical modernisation.

General Information	
Project acronym	TURBLOG
Project title	Transferability of Urban Logistics Concepts and Practices from A World Wide Perspective
Funding programme	European Commission (EC) - 7FP
Duration	24 months (from October 2009)
Official webpage	http://www.turblog.eu/
Project type	UFT
Abstract	

Description

- Project aiming to act as a coordination platform, gathering worldwide experiences to select best practices, develop case studies and recommend solutions on urban logistics and extend existing knowledge on urban logistics to other countries and thus effectively contribute to the transfer of knowledge between Europe and Latin America.
- Countries involved: Brazil, Netherlands, Peru, Portugal, and United Kingdom.

Objectives

1. Provide an international network of experts and a platform for the exchange of ideas, information and policies concerning the field of urban logistics.
2. Promote cooperation among relevant international networks on urban logistics and create a coordinated network.
3. Select case studies for an analysis of potential transferability.
4. To develop transferability guidelines targeting each type of stakeholder to facilitate the transferring of international case studies.

Activities

- Select case studies to establish a framework at international level.
- Provide different organisation schemes for sustainable city logistics.
- Compare and analyse Business concepts and business models to build logistic profile.
- Focus on transferability of processes and implementation strategies.
- Organize thematic workshops coupled with site visits.

Drivers

- Reinforcement of international cooperation.
- Enhance the competitiveness of EU industry.
- Research needs at a global level and international support of developing countries.

Barriers

- Partners from Latin America are not familiar with the EC research procedures.
- Language barrier – Lack of international experience.
- Long distance implementation.
- Technical change and investments required.

General Information	
Project acronym	UNDA Project
Project title	UNDA Project on CO_2 emissions and ForFITS (For Future Inland Transport Systems)
Funding programme	UN Development Account (UNDA)
Duration	36 months (from January 2011)
Official webpage	http://www.unece.org/?id=19273
Project type	UFT, E-freight
Abstract	

Description

- Venture developing an information and analysis-modelling tool based on a uniform methodology for the evaluation of the emissions of carbon dioxide in a modelling tool that is used for estimate of emissions of transport and the evaluation of transport policies for pollution mitigation with focus on the inland transport sector (road, rail and inland waterways).
- Excluded international aviation and maritime transport from its scope.
- Countries involved: Switzerland.

Objectives

1. Raise awareness for CO2 emissions from inland transport.
2. Develop a web-based tool for monitoring inland transport emissions, including a transport policy converter.
3. Define harmonized recommendations for data collection on inland transport CO2 emissions.
4. Organize capacity-building workshops among UN members.

Activities

- Use tools to provide a framework for analysing different scenario.
- Set up a global status report on CO2 emissions from inland transport.
- Develop the assessment tool comprising the policy converter.
- Offer capacity building workshops and training sessions to policy makers.

Drivers

- Emissions concerns in regards to sustainable transport development.
- Transport-policy strategies aligned with goals.
- New types technological solutions available.
- Revitalisation interest of railway and inland waterway transport.

Barriers

- Tools do not address transport externalities.
- Missed to evaluate the external costs due to congestion.
- Difficult to obtain policy measures – Slow legislative procedures.

General Information	
Project acronym	VIACOMBI
Project title	The gateway for transport co-modality
Funding programme	European Commission (EC)
Duration	2009
Official webpage	http://www.viacombi.eu/en/
Project type	Co-modality
Abstract	

Description

- The collection and dissemination of logistics best practice based on intermodal transport.
- Countries involved: Austria, Belgium, Croatia, Czech Republic, France, Germany, Hungary, Italy, Morocco, Poland, Romania, Serbia, Slovenia, Spain, Switzerland, and United Kingdom.

Objectives

1. Develop smart and profitable logistic solutions based on co-modality solutions and a more intensive use of railways.
2. Give a clear illustration of intermodal issues and raise awareness for bottlenecks and necessary involvement from administrations.
3. Expand the Best Practices and improve their transferability.

Activities

- Develop a user-friendly presentation of the intermodal services supply with unique intermodal routing system for door-to-door shipments.
- Present a tool to assess environmental performances of the different transport solutions.
- Transfer a selection of Best Practices and monitor progress and KPIs for future experiences.
- Entailing a relevant source of information: operators' contacts, grants and financial support schemes details available throughout Europe.

Drivers

- Competitiveness improving of different modes and multimodal integration.
- Needs for safe and reliable alternatives to traditional road intensive transport.
- Reduce travel time and door-door transport via efficient ports.
- Environmental concerns.

Barriers

- Congestion in the waterways.
- Weak competition among shipping lines.
- Low load efficiency.
- Need for cooperation and data sharing.

Appendix B: Data on co-modality corridors

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1 BATCo

BATCo project consist of an intermodal railway that aims to provide competitive advantages to Adriatic and Baltic Sea basins with enhanced connectivity and international improved relations.

Table 13 – BATCo general data.

BATCo General Data			
From	Gdansk	Poland	Hilly terrain
	Warszawa, Katowice	Poland	Hilly terrain
	Wien, Klagenfurt	Austria	Mountainous terrain
To	Venice	Italy	Hilly terrain
	Distance	1649 km	
	Approximate time	18 hours	

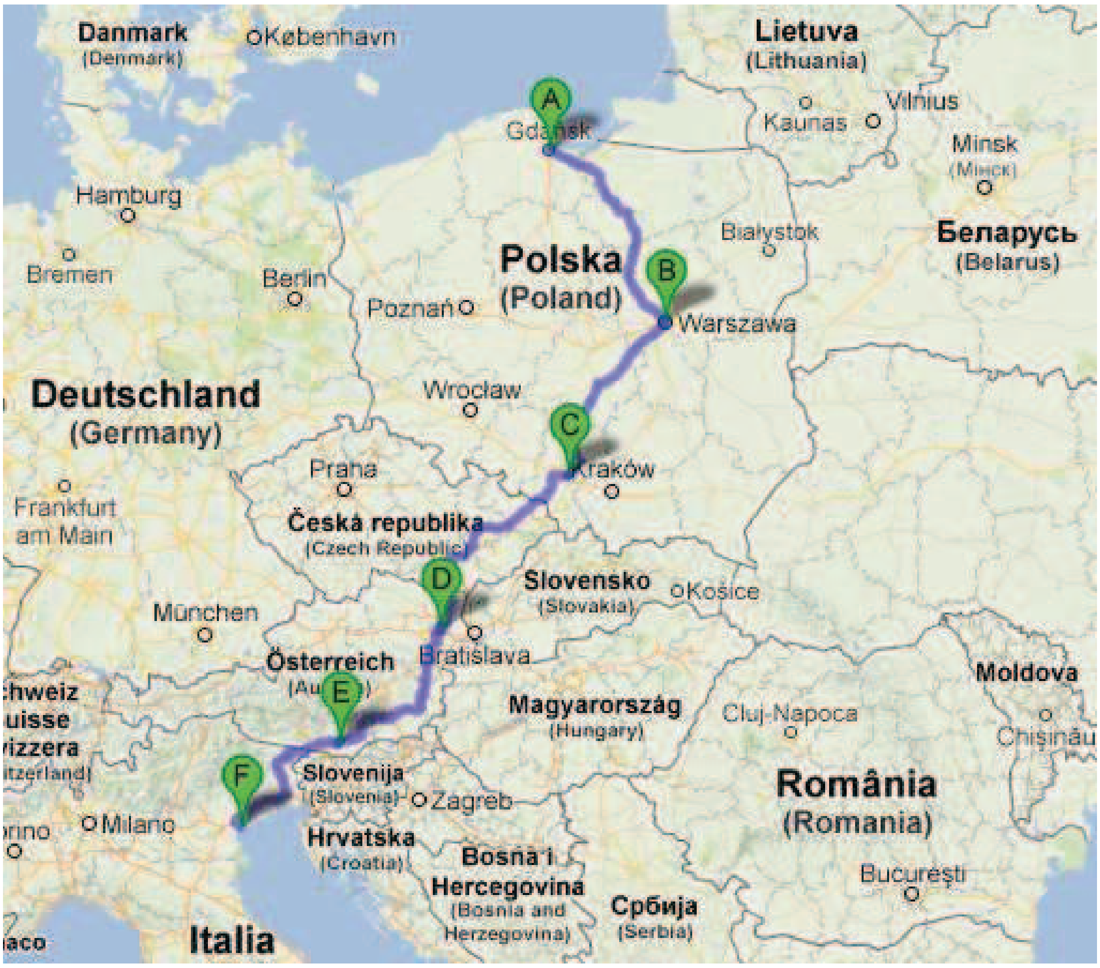

Figure 66 – BATCO road simulation for calculation purposes (Google maps).

2 Carpathia Express

The Carpathia Express corridor aims to enhance economic activity among the connected East European countries with improved environmental performance from the modal shift solution.

Table 14 – Carpathia Express general data.

Carpathia Express General Data			
From	Havlíčkův Brod	Czech Republic	Hilly terrain
	Brno, Břeclav	Czech Republic	Hilly terrain
	Bratislava	Slovakia	Hilly terrain
	Budapest	Hungary	Hilly terrain
To	Curtici	Romania	Hilly terrain
	Distance	704 km	
	Approximate time	7 hours	

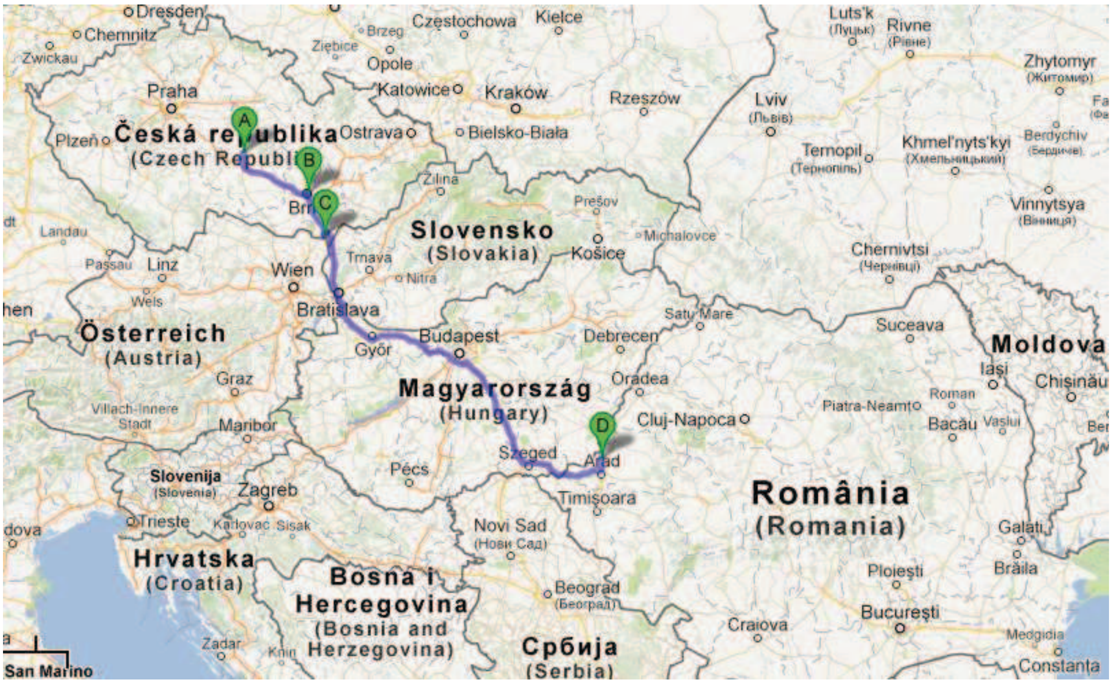

Figure 67 – Carpathia Express road simulation for calculation purposes (Google maps).

3 CODE24

CODE24 combines economic development targets with road safety and decongestion initiatives supported by the EC. It combines co-modality with e-Freight for an exceptional international transport strategy.

Table 15 – CODE24 Genera data.

CODE24 General Data			
From	Rotterdam	Netherlands	Flat terrain
	Mannheim	Germany	Hilly terrain
	Basel	Switzerland	Mountainous terrain
To	Genoa	Italy	Hilly terrain
	Distance	1203 km	
	Approximate time	12 hours	

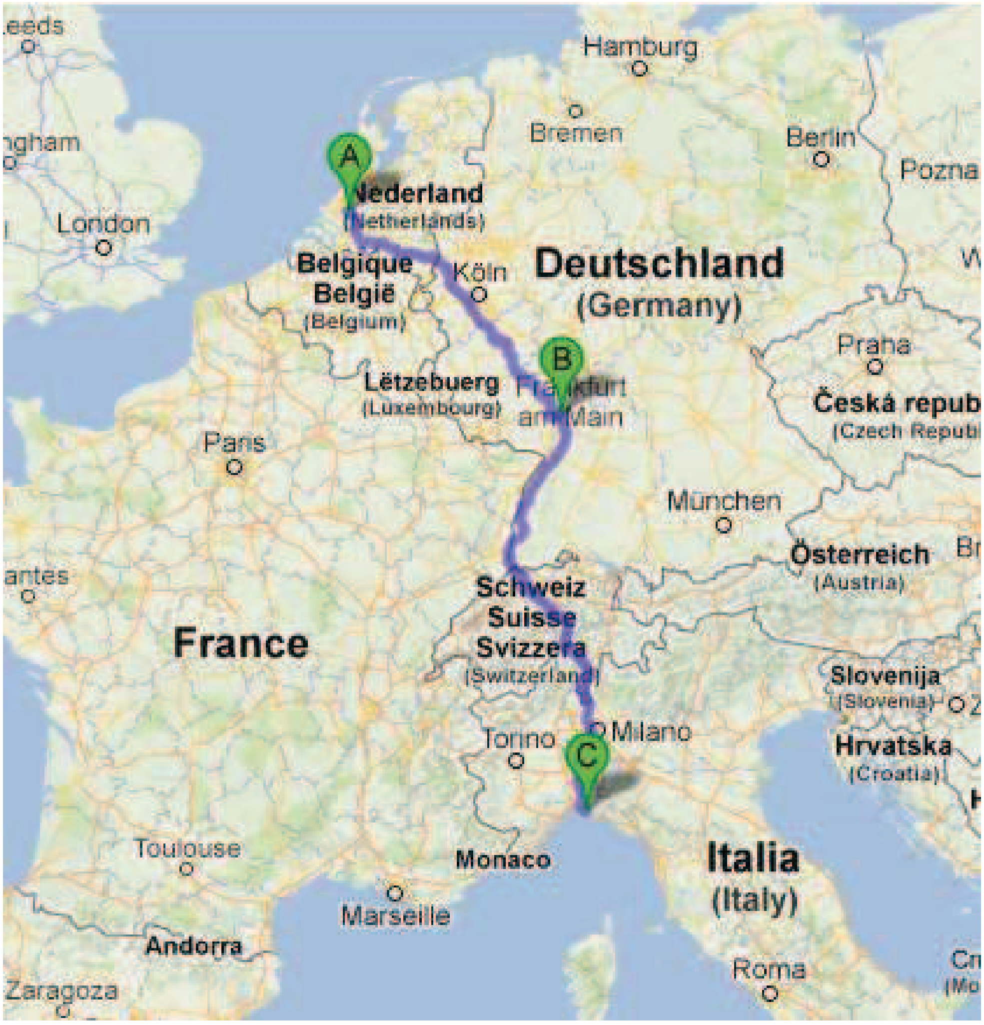

Figure 68 – CODE24 road simulation for calculation purposes (Google maps).

4 Viking Rail

Viking Rail initiative arises from Volvo's interest in improving on-time European deliveries and environmental footprint reduction through the exploitation of intermodal solutions for long distance large haul transport.

Table 16 – Viking Rail general data.

Viking Rail General Data			
From	Umeå	Sweden	Flat terrain
	Malmö	Sweden	Flat terrain
	Hamburg	Germany	Hilly terrain
To	Gent	Belgium	Hilly terrain
	Distance	2424 km	
	Approximate time	25 hours	

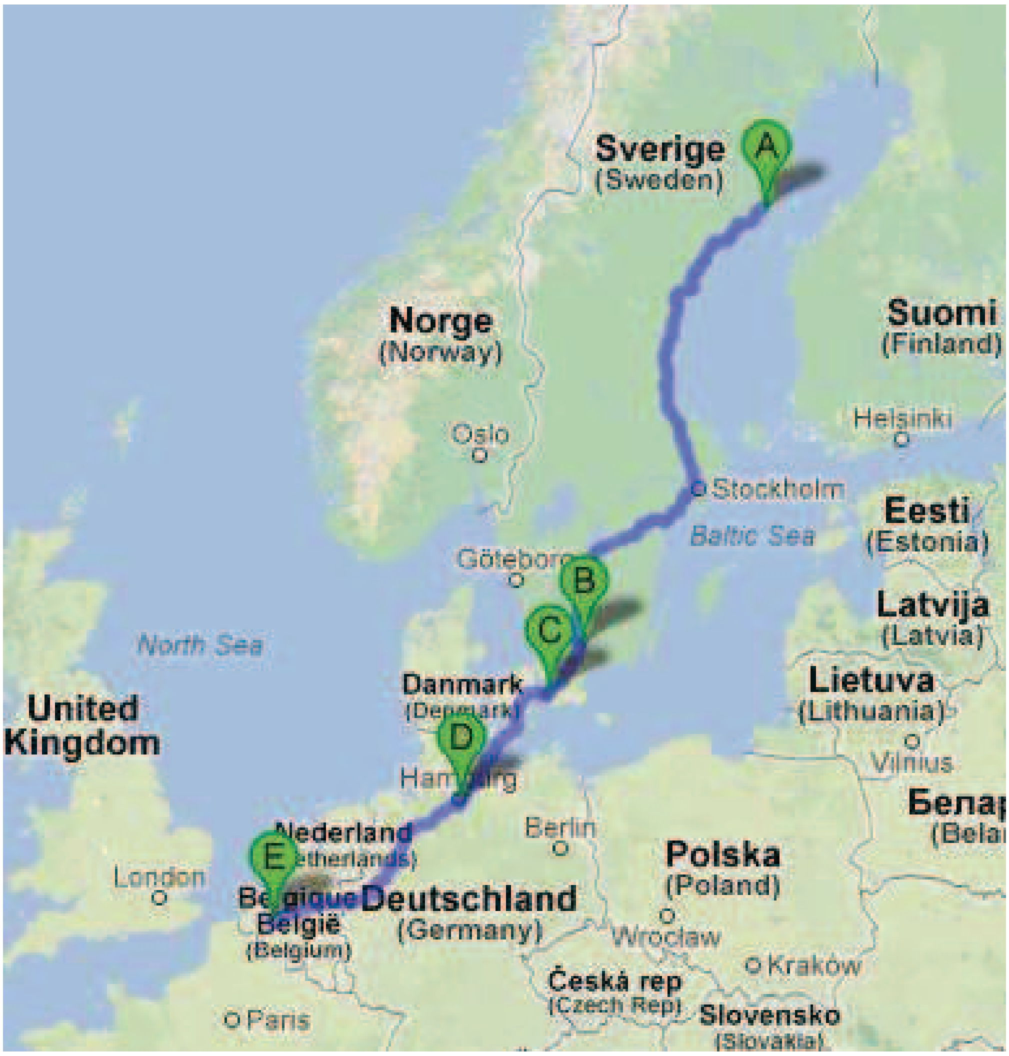

Figure 69 – Viking Rail road simulation for calculation purposes (Google maps).

Appendix C: Calculations

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Index of data tables

Fuel consumption

Hereby, fuel consumption and emissions related are calculates thanks to the NTM guidelines recommendations and specific data from the corridors project reports.

The general data compiled from each corridor project is shown as follows:

Table 17 – BATCo weighted consumption data.

Country	Distance (km)	Weighted total consumption (l)
Poland +5%	711	234,98
Czech Republic +5%	232	76,68
Austria +10%	453	156,84
Italy 5%	253	83,62
Total	1649	552,12

Table 18 – Carpathia Express weighted consumption data.

Country	Distance (km)	Weighted total consumption (l)
Czech Republic +5%	162	53,54
Slovakian Republic +5%	82,4	27,23
Hungary +5%	394	130,22
Romania +5%	65,6	21,68
Total	704	232,67

Table 19 – CODE24 weighted consumption data.

Country	Distance (km)	Weighted total consumption (l)
Netherlands +0%	167	52,56
Germany +5%	560	185,08
Switzerland +10%	285	98,68
Italy +5%	191	63,13
Total	1203	399,45

Table 20 – Viking Rail weighted data.

Country	Distance (km)	Weighted total consumption (l)
Sweden +0%	1249	393,14
Denmark +0%	343	107,96
Germany +5%	637	210,53
Belgium +5%	195	64,45
Total	2424	776,07

Specific emissions are the base for the calculation of the following categories, as in Table 21.

Table 21 – Specific emissions from diesel and weighted performance.

Substance	g/l
CO	0,3748
CO_2	2621
CH_4	0,0011
NOx	8,5825
PM	0,0841
SOx	0,0033
VOC	0,0534

Following, footprint is calculated as the total of the corridor and then as specific consumption from the distance, in Table 23, and from load factor in Table 24.

Table 22 – Total emissions footprint per corridor in g.

Substance	BATCO	Carpathia	CODE24	Viking rail
CO	207	87	150	291
CO_2	1.447.108	609.830	1.046.948	2.034.085
CH_4	0,5916	0,2493	0,4280	0,8316
NOx	4.739	1.997	3.428	6.661
PM	46	20	34	65
SOx	2	1	1	3
VOC	29	12	21	41

Table 23 – Emissions footprint per corridor in g/km.

Substance	BATCO	Carpathia	CODE24	Viking rail
CO	0,1255	0,1239	0,1244	0,1200
CO_2	878	866	870	839
CH_4	0,0004	0,0004	0,0004	0,0003
NOx	2,8736	2,8365	2,8497	2,7478
PM	0,0282	0,0278	0,0279	0,0269
SOx	0,0011	0,0011	0,0011	0,0011
VOC	0,0179	0,0176	0,0177	0,0171

Table 24 – Load factor translation into tonnes transported per truck.

Load factor	Tonnes from 26 tonnes total capacity
45%	11,7
60%	15,6
75%	19,5
90%	23,4

Of the load factor in Table 24 will depend largely the influence of the emissions of the truck given the limited capacity per vehicle and the economies of scale effect that runs in favour of the train transport.

Table 25 – Specific emissions per corridor in g/t km with 45% and 60% load factor.

45% load factor				60% load factor			
BATCo	**Carpathia**	**CODE24**	**Viking Rail**	**BATCo**	**Carpathia**	**CODE24**	**Viking Rail**
0,0107	0,0106	0,0106	0,0103	0,0080	0,0079	0,0080	0,0077
75,01	74,04	74,38	71,72	56,25	55,53	55,79	53,79
3,07E-05	3,03E-05	3,04E-05	2,93E-05	2,30E-05	2,27E-05	2,28E-05	2,20E-05
0,2456	0,2424	0,2436	0,2349	0,1842	0,1818	0,1827	0,1761
0,0024	0,0024	0,0024	0,0023	0,0018	0,0018	0,0018	0,0017
9,53E-05	9,41E-05	9,45E-05	9,11E-05	7,15E-05	7,05E-05	7,09E-05	6,83E-05
0,0015	0,0015	0,0015	0,0015	0,0011	0,0011	0,0011	0,0011

Table 26 - Specific emissions per corridor in g/t km with 75% and 90% load factor.

75% load factor				90% load factor			
BATCo	**Carpathia**	**CODE24**	**Viking Rail**	**BATCo**	**Carpathia**	**CODE24**	**Viking Rail**
0,0064	0,0064	0,0064	0,0062	0,0054	0,0053	0,0053	0,0051
45,00	44,42	44,63	43,03	37,50	37,02	37,19	35,86
1,84E-05	1,82E-05	1,82E-05	1,76E-05	1,53E-05	1,51E-05	1,52E-05	1,47E-05
0,1474	0,1455	0,1461	0,1409	0,1228	0,1212	0,1218	0,1174
0,0014	0,0014	0,0014	0,0014	0,0012	0,0012	0,0012	0,0012
5,72E-05	5,64E-05	5,67E-05	5,47E-05	4,76E-05	4,70E-05	4,73E-05	4,56E-05
0,0009	0,0009	0,0009	0,0009	0,0008	0,0008	0,0008	0,0007

The base case study will use 75% as load factor, recommendation by the NTM guideline (NTM, 2008).

Electrical consumption

Electrical consumption takes place locally at the railway infrastructure but can be directly related to the energy production of the territory as it is included in the total demand. Following, this consumption is calculated.

Taking into consideration the gross capacity of the train selected as 1500 tonnes and a load factor recommendation of 60%, the following electrical net consumption is calculated:

Table 27 – Electrical consumption per corridor.

	BATCo	Carpathia Express	CODE 24	Viking rail
Consumption per gross tonne kWh/gross tkm	30,41	12,27	21,38	36,70
Consumption per net tonne kWh/net tkm	0,0307	0,0290	0,0296	0,0252
Transmission losses 10% kWh/net tkm	0,0034	0,0032	0,0033	0,0028
Electrical demand at power plant kWh/net tkm	0,0342	0,0323	0,0329	0,0280
Final consumption (3,6 MJ/kWh) MJ/net tkm	0,1230	0,1162	0,1185	0,1009

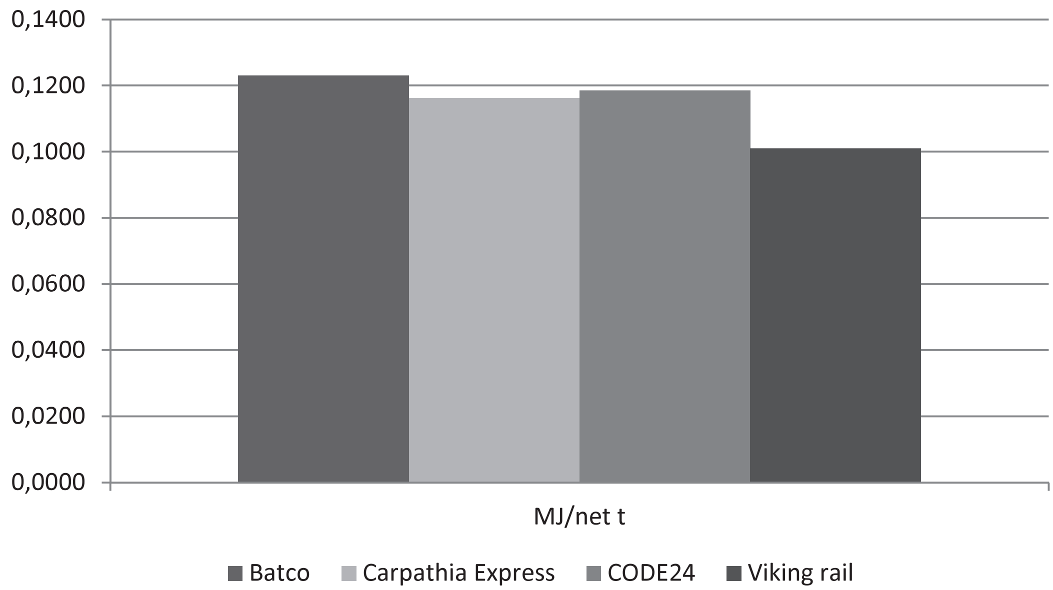

Figure 70 – Specific final consumption comparison per corridor.

The specific impact, Figure 70 of each corridor depends on the nature of the territories that it crosses. Following, Figure 71, illustrates on this fact giving the topography.

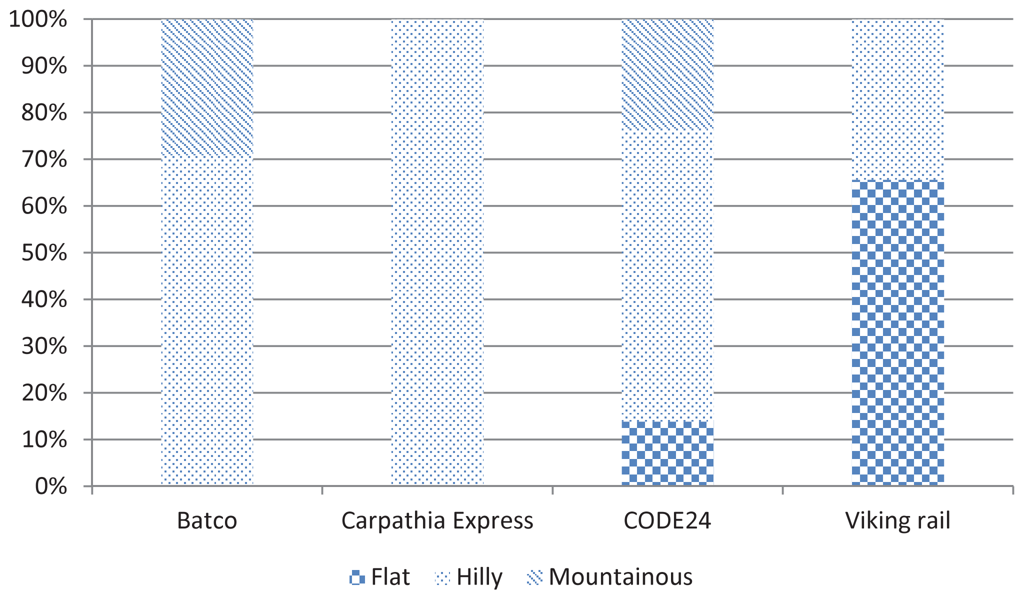

Figure 71 – Topography share per corridor.

The specific consumption of electricity is translated into country specific weighted consumption thanks to the distances routed.

Table 28 – Country shares and energy consumption distribution per corridor.

Project	Country	Distance km	Share %	Consumption MJ/net tkm
BATCo	Poland	711	0,4312	0,0530
	Czech Republic	232	0,1407	0,0173
	Austria	453	0,2747	0,0338
	Italy	253	0,1534	0,0189
	Total	1649	1	0,1230
Carpathia Express	Czech Republic	162	0,2301	0,0267
	Slovakian Republic	82,4	0,1170	0,0136
	Hungary	394	0,5597	0,0650
	Romania	65,6	0,0932	0,0108
	Total	704	1	0,1162
CODE24	Netherlands	167	0,1388	0,0164
	Germany	560	0,4655	0,0551
	Switzerland	285	0,2369	0,0281
	Italy	191	0,1588	0,0188
	Total	1203	1	0,1185
Viking rail	Sweden	1249	0,5153	0,0520
	Denmark	343	0,1415	0,0143
	Germany	637	0,2628	0,0265
	Belgium	195	0,0804	0,0081
	Total	2424	1	0,1009

Shares per country in the shape of consumption are the factors weighting specific emissions per country in the following tables:

Table 29 – BATCo specific emissions from electricity in g/tkm.

BATCo	MJ/net tkm	Ash	CO	CO_2	NOx	PM	SOx	VOC
Poland	0,0530	0,0143	0,0060	4,6168	0,0144	0,0567	0,0364	0,0007
Czech Republic	0,0173	0,0031	0,0013	0,4211	0,0031	0,0123	0,0079	0,0001
Austria	0,0338	0,0009	0,0022	0,6087	0,0020	0,0030	0,0022	0,0002
Italy	0,0189	0,0009	0,0007	0,9156	0,0026	0,0034	0,0028	0,0001
Total	0,1230	0,0192	0,0102	6,5622	0,0220	0,0755	0,0493	0,0011
World	0,1230	0,0151	0,0059	6,6162	0,0196	0,0599	0,0404	0,0007
EU27	0,1230	0,0101	0,0065	4,8913	0,0147	0,0394	0,0264	0,0007

Table 30 – Carpathia Express specific emissions from electricity in g/tkm.

Carpathia Express	MJ/net tkm	Ash	CO	CO_2	NOx	PM	SOx	VOC
Czech Republic	0,0267	0,0048	0,0020	1,5188	0,0048	0,0191	0,0121	0,0002
Slovakia	0,0136	0,0007	0,0005	0,2915	0,0009	0,0027	0,0018	0,0001
Hungary	0,0650	0,0039	0,0051	2,2277	0,0070	0,0141	0,0095	0,0005
Romania	0,0108	0,0012	0,0004	0,4776	0,0014	0,0049	0,0032	0,0000
Total	0,1162	0,0106	0,0079	4,5156	0,0141	0,0408	0,0266	0,0008
World	0,1162	0,0142	0,0055	6,2522	0,0185	0,0566	0,0382	0,0007
EU27	0,1162	0,0096	0,0061	4,6222	0,0139	0,0372	0,0250	0,0007

Table 31 – CODE24 specific emissions from electricity in g/tkm.

CODE24	MJ/net tkm	Ash	CO	CO_2	NOx	PM	SOx	VOC
Netherlands	0,0164	0,0012	0,0010	0,9305	0,0027	0,0047	0,0031	0,0001
Germany	0,0551	0,0074	0,0046	2,7376	0,0086	0,0289	0,0187	0,0005
Switzerland	0,0281	0,0000	0,0001	0,0186	0,0001	0,0000	0,0000	0,0000
Italy	0,0188	0,0009	0,0007	0,9129	0,0025	0,0034	0,0028	0,0001
Total	0,1185	0,0096	0,0064	4,5996	0,0139	0,0370	0,0246	0,0007
World	0,1185	0,0145	0,0056	6,3749	0,0188	0,0577	0,0389	0,0007
EU27	0,1185	0,0098	0,0063	4,7129	0,0142	0,0379	0,0255	0,0007

Table 32 – Viking rail specific emissions from electricity in g/tkm.

Viking rail	MJ/net tkm	Ash	CO	CO_2	NOx	PM	SOx	VOC
Sweden	0,0520	0,0006	0,0040	0,0345	0,0009	0,0009	0,0007	0,0004
Denmark	0,0143	0,0022	0,0015	0,8381	0,0026	0,0084	0,0055	0,0002
Germany	0,0265	0,0036	0,0022	1,3166	0,0041	0,0139	0,0090	0,0002
Belgium	0,0081	0,0002	0,0004	0,1976	0,0006	0,0007	0,0004	0,0000
Total	0,1009	0,0065	0,0081	2,3869	0,0083	0,0238	0,0157	0,0008
World	0,1009	0,0124	0,0048	5,4310	0,0161	0,0491	0,0332	0,0006
EU27	0,1009	0,0083	0,0053	4,0151	0,0121	0,0323	0,0217	0,0006

Impact cost assessment

This section compiles the costs of the different substances' impacts on the different territories and adapts them into the corridors of the case study. Data has been obtained from the Transport guidelines described in the main document of this report (NTM, 2008)*. Cost impact methodology has been selected by recommendation of NTM guidelines given the relevance when comparing cost-competitiveness of technologies.*

Electricity cost impact

Electrical impact for the selected substances accounts differently per territory as follows:

Table 33 - Cost of tonne of emission from electricity generation per territory.

	NOx	NMVOC	SOx	PM
Austria	8700	1700	8300	13311
Belgium	5200	2500	1000	15111
Czech Republic	7300	1000	8000	8990
Denmark	4400	700	5200	6511
Germany	9600	1700	11000	10352
Hungary	5400	900	4800	7262
Italy	5700	1100	6100	8352
Netherlands	6600	1900	13000	15111
Poland	3900	600	5600	7890
Romania	2200	400	2000	3013
Slovakia	5200	700	4900	7390
Sweden	2200	300	2800	4552
Switzerland	9200	1800	8800	13901

In order to simplify the final impact calculation, costs of tonne of emitted substance in Table 33 have been weighted with the shares of route per country in order to sum up these weighted prices and compile the following total equivalent cost as in Table 34.

Table 34 – Cost in €/t for electricity generation per corridor.

	NOx	NMVOC	SOx	PM
BATCO	5973,14	1035,17	6756,09	9604,86
Carpathia	5515,63	853,01	5287,16	7278,69
CODE24	8469,58	1656,19	9978,47	11535,89
Viking rail	4697,28	901,49	5149,67	7202,80

Fuel cost impact

Fuel impacts are also accounted in economic terms as suggested by the NTM guidelines, but can result in some aspects higher than the equivalent to the electricity production. This is due to the nature of the place where emissions occur, in the case of fuel, transport vehicles cross urban and semi-urban areas leaving particles that cause a higher effect on health than when they take place in, often, non-urban areas such as the ones where large power plants are situated.

Table 35 – Cost of tonne of emission from fuel per territory.

	NOx	NMVOC	SOx	PM
Austria	8700	1700	8300	97400
Belgium	5200	2500	1000	127600
Czech Republic	7300	1000	8000	87800
Denmark	4400	700	5200	63700
Germany	9600	1700	11000	105000
Hungary	5400	900	4800	73200
Italy	5700	1100	6100	94700
Netherlands	6600	1900	13000	115600
Poland	3900	600	5600	73300
Romania	2200	400	2000	10500
Slovakia	5200	700	4900	73400
Sweden	2200	300	2800	48000
Switzerland	9200	1800	8800	102900

In order to simplify the final impact calculation, costs of tonne of emitted substance in Table 35 have been weighted with the shares of route per country in order to sum up these weighted prices and compile the following total equivalent cost as in Table 36.

Table 36 – Cost in €/t for fuel emissions per corridor.

	NOx	NMVOC	SOx	PM
BATCO	5973,14	1035,17	6756,09	85243,91
Carpathia	5515,63	5515,63	5287,16	70740,57
CODE24	8469,58	1656,19	9978,47	104338,65
Viking rail	4697,28	901,49	5149,67	71604,00

BATCo

The following tables contain the data calculated and used for the case study of the BATCo project followed by the content of the sensitivity analysis of Load factor of the truck vehicle and CO2-CH4 emissions.

Emissions costs calculations

Table 37 – Cost of road trip for BATCo, in €/tkm.

Substance	Cost road €/g	Truck emissions g/tkm	Cost truck €/tkm
CO2	0,0000	45,0034	0,0011
CH4	0,0006	0,0000	0,0000
NOx	0,0060	0,1474	0,0009
PM	0,0852	0,0014	0,0001
SOx	0,0068	0,0001	0,0000
NMVOC	0,0010	0,0009	0,0000
Total €/tkm			0,0021

Table 38 – Cost of train trip for BATCo, in €/tkm

Substance	Cost elect €/g	Train emissions g/tkm	Cost train
CO2	0,0000	6,5622	0,0002
CH4	0,0006	0,0000	0,0000
NOx	0,0060	0,0220	0,0001
PM	0,0096	0,0755	0,0007
SOx	0,0068	0,0493	0,0003
NMVOC	0,0010	0,0011	0,0000
Total €/tkm			0,0014

Load factor sensitivity analysis

Table 39 – Costs in €/tkm depending on load factor for BATCo.

Substance	Cost LF 45%	Cost LF 60%	Cost LF 75%	Cost LF 90%
CO2	0,0019	0,0014	0,0011	0,0009
CH4	0,0000	0,0000	0,0000	0,0000
NOx	0,0015	0,0011	0,0009	0,0007
PM	0,0002	0,0002	0,0001	0,0001
SOx	0,0000	0,0000	0,0000	0,0000
NMVOC	0,0000	0,0000	0,0000	0,0000
Total cost €/tkm	0,0035	0,0027	0,0021	0,0018

Environmental taxes sensitivity analysis

Table 40 – Cost variations of environmental tax for BATCo.

CO2 cost (€/tonne)	CH4 cost (€/tonne)	Cost truck €/tkm	Cost rail €/tkm
25	575	0,00213	0,00135
35	805	0,00258	0,00142
45	1035	0,00303	0,00149
55	1265	0,00348	0,00155
65	1495	0,00393	0,00162
75	1725	0,00438	0,00168

Carpathia Express

The following tables contain the data calculated and used for the case study of the Carpathia Express project followed by the content of the sensitivity analysis of Load factor of the truck vehicle and CO2-CH4 emissions.

Emissions costs calculations

Table 41 – Cost of road trip for Carpathia Express, in €/tkm.

Substance	Cost road €/g	Truck emissions g/tkm	Cost truck
CO2	0,0000	44,42232	0,00111
CH4	0,0006	0,00002	0,00000
NOx	0,0055	0,14546	0,00080
PM	0,0707	0,00143	0,00010
SOx	0,0053	0,00006	0,00000
NMVOC	0,0055	0,00089	0,00000
Total cost €/tkm			0,0020

Table 42 – Cost of train trip for Carpathia Express, in €/tkm.

Substance	Cost elect €/g	Train emissions g/tkm	Cost train
CO2	0,0000	4,51559	0,0001
CH4	0,0006	0,00002	0,0000
NOx	0,0055	0,01409	0,0001
PM	0,0073	0,04078	0,0003
SOx	0,0053	0,02665	0,0001
NMVOC	0,0009	0,00083	0,0000
Total €/tkm			0,0006

Load factor sensitivity analysis

Table 43 – Costs in €/tkm depending on load factor for Carpathia Express.

Substance	Cost LF 45%	Cost LF 60%	Cost LF 75%	Cost LF 90%
CO2	0,0019	0,0014	0,0011	0,0009
CH4	0,0000	0,0000	0,0000	0,0000
NOx	0,0013	0,0010	0,0008	0,0007
PM	0,0002	0,0001	0,0001	0,0001
SOx	0,0000	0,0000	0,0000	0,0000
NMVOC	0,0000	0,0000	0,0000	0,0000
Total €/tkm	0,0034	0,0025	0,0020	0,0017

Environmental taxes sensitivity analysis

Table 44 – Cost variations of environmental tax for Carpathia Express.

CO2 (€/tonne)	CH4 (€/tonne)	Cost truck €/tkm	Cost rail €/tkm
25	575	0,002019	0,000629
35	805	0,002463	0,000674
45	1035	0,002907	0,000719
55	1265	0,003352	0,000764
65	1495	0,003796	0,00081
75	1725	0,00424	0,000855

CODE24

The following tables contain the data calculated and used for the case study of the CODE24 project followed by the content of the sensitivity analysis of Load factor of the truck vehicle and CO2-CH4 emissions.

Emissions costs calculations

Table 45 – Cost of road trip for CODE24, in €/tkm.

Substance	Cost road €/g	Truck emissions g/tkm	Cost truck
CO2	0,0000	44,62981	0,00112
CH4	0,0006	0,00002	0,00000
NOx	0,0085	0,14614	0,00124
PM	0,1043	0,00143	0,00015
SOx	0,0100	0,00006	0,00000
NMVOC	0,0017	0,00089	0,00000
Total €/tkm			0,0025

Table 46 – Cost of train trip for CODE24, in €/tkm.

Substance	Cost elect €/g	Train emissions g/tkm	Cost train
CO2	0,0000	4,59958	0,0001
CH4	0,0006	0,00001	0,0000
NOx	0,0085	0,01395	0,0001
PM	0,0115	0,03698	0,0004
SOx	0,0100	0,02463	0,0002
NMVOC	0,0017	0,00068	0,0000
Total €/tkm			0,0009

Load factor sensitivity analysis

Table 47 – Costs in €/tkm depending on load factor for CODE24.

Substance	Cost LF 45%	Cost LF 60%	Cost LF 75%	Cost LF 90%
CO2	0,0019	0,0014	0,0011	0,0009
CH4	0,0000	0,0000	0,0000	0,0000
NOx	0,0021	0,0015	0,0012	0,0010
PM	0,0002	0,0002	0,0001	0,0001
SOx	0,0000	0,0000	0,0000	0,0000
NMVOC	0,0000	0,0000	0,0000	0,0000
Total cost €/tkm	0,0042	0,0031	0,0025	0,0021

Environmental taxes sensitivity analysis

Table 48 – Cost variations of environmental tax for CODE24.

CO2 (€/tonne)	CH4 (€/tonne)	Cost truck €/tkm	Cost rail €/tkm
25	575	0,00251	0,00091
35	805	0,00295	0,00095
45	1035	0,00340	0,00100
55	1265	0,00384	0,00104
65	1495	0,00429	0,00109
75	1725	0,00474	0,00114

Viking Rail

The following tables contain the data calculated and used for the case study of the Viking Rail project followed by the content of the sensitivity analysis of Load factor of the truck vehicle and CO2-CH4 emissions.

Emissions costs calculations

Table 49 – Cost of road trip for Viking Rail, in €/tkm.

Substance	Cost road €/g	Truck emissions g/tkm	Cost truck
CO2	0,0000	43,03303	0,00108
CH4	0,0006	0,00002	0,00000
NOx	0,0047	0,14091	0,00066
PM	0,0716	0,00138	0,00010
SOx	0,0051	0,00005	0,00000
NMVOC	0,0009	0,00086	0,00000
Total €/tkm			0,0018

Table 50 – Cost of train trip for Viking Rail, in €/tkm.

Substance	Cost elect €/g	Train emissions g/tkm	Cost train
CO2	0,0000	2,38686	0,0001
CH4	0,0006	0,00002	0,0000
NOx	0,0047	0,00826	0,0000
PM	0,0072	0,02382	0,0002
SOx	0,0051	0,01567	0,0001
NMVOC	0,0009	0,00082	0,0000
Total €/tkm			0,0004

Load factor sensitivity analysis

Table 51 – Costs in €/tkm depending on load factor for Viking Rail.

Substance	Cost LF 45%	Cost LF 60%	Cost LF 75%	Cost LF 90%
CO2	0,0018	0,0013	0,0011	0,0009
CH4	0,0000	0,0000	0,0000	0,0000
NOx	0,0011	0,0008	0,0007	0,0006
PM	0,0002	0,0001	0,0001	0,0001
SOx	0,0000	0,0000	0,0000	0,0000
NMVOC	0,0000	0,0000	0,0000	0,0000
Total cost €/tkm	0,0031	0,0023	0,0018	0,0015

Environmental taxes sensitivity analysis

Table 52 – Cost variations of environmental tax for Viking Rail.

CO2 (€/tonne)	CH4 (€/tonne)	Cost truck €/tkm	Cost rail €/tkm
25	575	0,00184	0,00035
35	805	0,00227	0,00038
45	1035	0,00270	0,00040
55	1265	0,00313	0,00042
65	1495	0,00356	0,00045
75	1725	0,00399	0,00047

Summary of costs and socio-environmental savings

The following table contains the costs for the different options of each project and the total socio-environmental savings of the train option.

Table 53 – Cost comparison and socio-environmental savings summary.

Project	Truck cost €/tkm	Train cost €/tkm	Savings
BATCo	0,002130	0,001355	36,38%
Carpathia Express	0,002019	0,000629	68,84%
CODE24	0,002505	0,000907	63,81%
Viking Rail	0,001838	0,000351	80,87%

Table 54 – Cost comparison of EU27 and World energy mixes equivalents, part 1.

Substance	EU27 BATCO	World BATCO	EU27 Carpathia E.	World Carpathia E.
CO2	0,00012	0,00017	0,00012	0,00072
CH4	0,00000	0,00000	0,00000	0,00000
NOx	0,00009	0,00012	0,00008	0,00000
PM	0,00038	0,00058	0,00027	0,00002
SOx	0,00018	0,00027	0,00013	0,00001
NMVOC	0,00000	0,00000	0,00000	0,00000
Total €/tkm	0,00077	0,00113	0,00060	0,00074

Table 55 - Cost comparison of EU27 and World energy mixes equivalents, part 2.

Substance	EU27 CODE24	World CODE24	EU27 Viking Rail	World Viking Rail
CO2	0,00012	0,00016	0,00010	0,00014
CH4	0,00000	0,00000	0,00000	0,00000
NOx	0,00012	0,00016	0,00006	0,00008
PM	0,00044	0,00067	0,00023	0,00035
SOx	0,00025	0,00039	0,00011	0,00017
NMVOC	0,00000	0,00000	0,00000	0,00000
Total €/tkm	0,00093	0,00137	0,00050	0,00074

Appendix D: Electricity database

Contents

Index of data tables

Introduction

This appendix entails de database used for energy related calculations. All energy mix data corresponds to the International Energy Agency public statistics from 2009 for electricity production **Invalid source specified.**.

In the sections of this appendix, production figures for each country and their production charts are presented for the better understanding of the reader.

Last part of the appendix contains the references by which emissions are calculated. Combustion data has been collected from CPD Database, from Chalmers University LCA practitioners with exception of the coal combustion[28] that has been weighted with European Statistic studies based on a large number of current operative power plants.

Directions for data interpretation

In the territories' tables (excluding World production), the rows import, export and balance can be found. Import corresponds to the amount of purchased electricity from neighbours countries. Export on the other hand, represents the energy exported with commercial or regulative purposes. Balance, calculated as the total of production, imports and exports; can be assessed as the total energy consumption of the territory.

As a general trend, import and export energy transfers occur as part of economic regulations, management of energy exceeds from renewable energies and political strategies. It is out of the scope the source of energy imports/exports of each country and the different impacts that each transaction will have in the correspondent country's emissions. This decision has been taken in order to facilitate the development of the case study and present a clear simplified perspective of energy production across EU.

Following the balance figure, the percentage unbalance is presented. This figure is calculated as follows:

$$\%\ of\ Unbalance = \frac{Balance - Total\ production}{Balance} \cdot 100$$

A positive value of this calculation means that the country is an overall importer of energy and its dependency. A negative value, on the other hand, will entail that the country is a net exporter of electricity.

A certain error is expected in the development of the calculations given the previously explained assumption regarding import/export electrical operations. The greater % of Unbalance figure represents the possibility that the uncertainty in the calculation of emissions of such country could result.

[28] Coal power plants have a very large lifetime and are extensively used in Europe with lower efficiencies than the Swedish equivalent, which makes the average coal power plant of a substantial lower performance than the data from CPM.

Worldwide energy mix

Table 56 – Worldwide average energy mix table.

Source of energy	World Production in GWh
Coal and peat	8118552
Gas	4301367
Hydro	3328627
Nuclear	2696765
Oil	1027328
Wind	273153
Biofuels	217301
Waste	70850
Geothermal	66672
Solar PV	20155
Other sources	10070
Solar Thermal	842
Tide	530
Total production	20132212

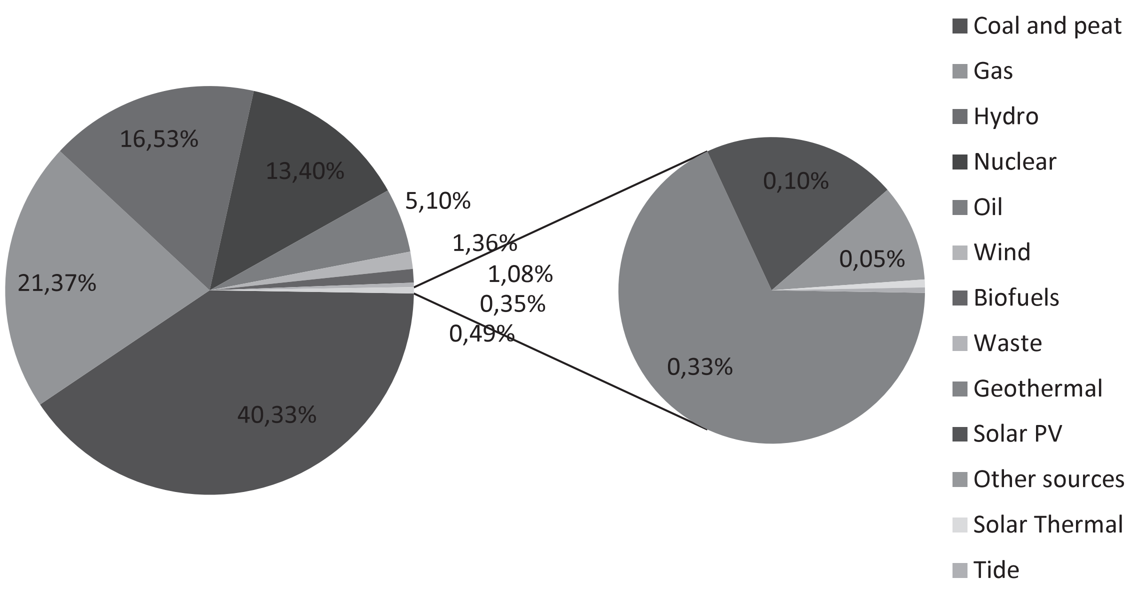

Figure 72 – World energy mix pie chart.

EU27 energy mix

Table 57 – Europe of the 27 members' average production table.

Source of energy	EU 27 production in GWh
Coal and peat	849327
Gas	725961
Hydro	359106
Nuclear	893991
Oil	95972
Wind	132666
Biofuels	91742
Waste	32696
Geothermal	5547
Solar PV	14058
Other sources	8281
Solar Thermal	22
Tide	497
Total production	3209866
Import	285369
Export	-270235
Balance*	3225000

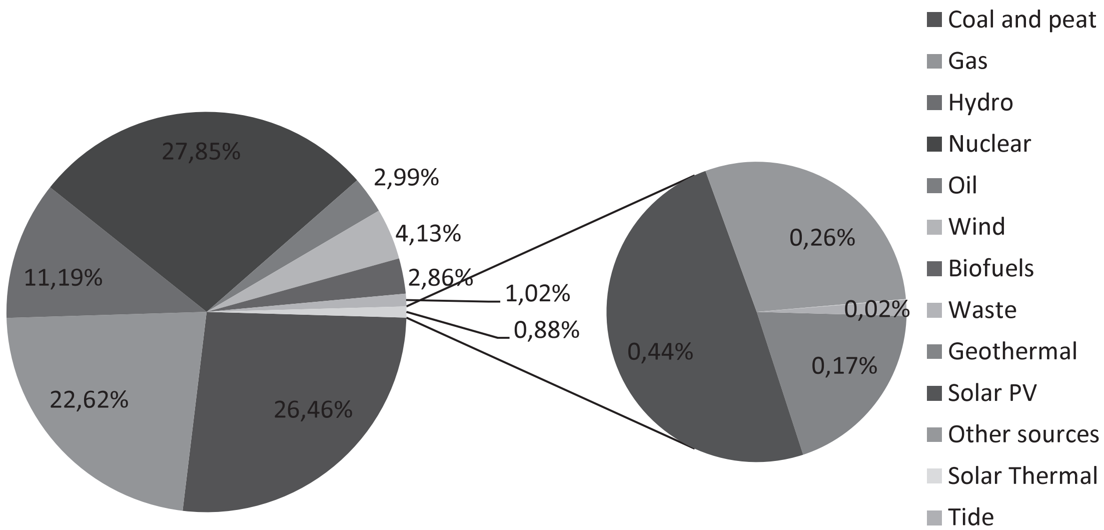

Figure 73 – EU27 energy mix pie chart.

Austria

Table 58 – Austrian energy mix table.

Source of energy	Austrian production in GWh
Coal and peat	5032
Gas	12338
Hydro	43662
Nuclear	0
Oil	1137
Wind	1967
Biofuels	4003
Waste	796
Geothermal	2
Solar PV	35
Other sources	17
Solar Thermal	0
Tide	0
Total production	68989
Import	19542
Export	-18762
Balance	69769

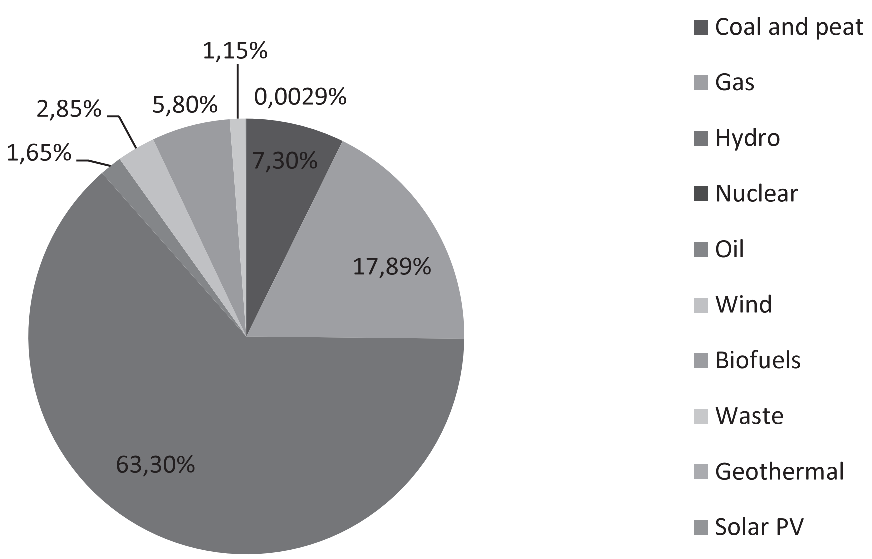

Figure 74 - Austrian energy mix pie chart.

Belgium

Table 59 - Belgian energy mix table.

Source of energy	Belgian production in GWh
Coal and peat	6147
Gas	29310
Hydro	1757
Nuclear	47222
Oil	280
Wind	996
Biofuels	3486
Waste	1776
Geothermal	0
Solar PV	166
Other sources	85
Solar Thermal	0
Tide	0
Total production	91225
Import	9486
Export	-11321
Balance	89390

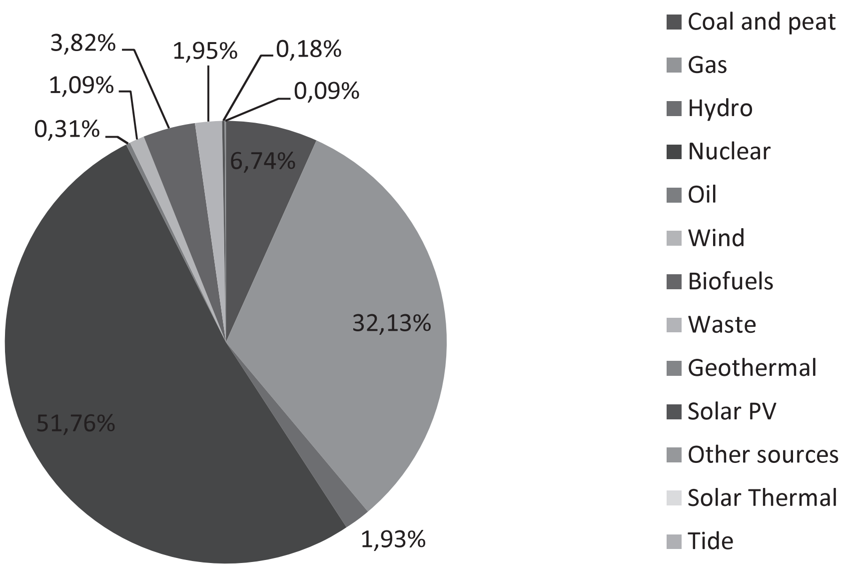

Figure 75 - Belgian energy mix pie chart.

Czech Republic

Table 60 - Czech energy mix table.

Source of energy	Czech production in GWh
Coal and peat	48695
Gas	975
Hydro	2982
Nuclear	27208
Oil	156
Wind	288
Biofuels	1837
Waste	20
Geothermal	0
Solar PV	89
Other sources	0
Solar Thermal	0
Tide	0
Total production	82250
Import	8586
Export	-22230
Balance	68606

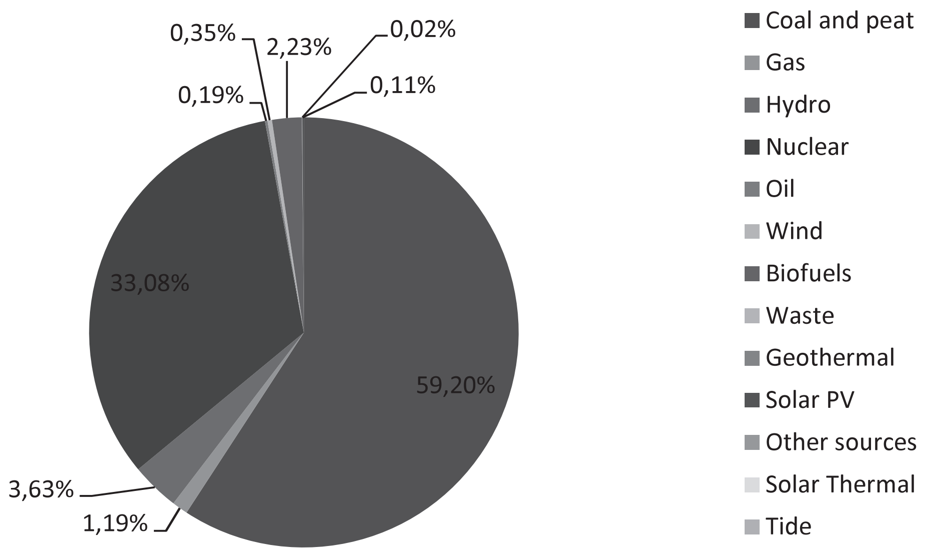

Figure 76 – Czech energy mix pie chart.

Denmark

Table 61 - Danish energy mix table.

Source of energy	Danish production in GWh
Coal and peat	17688
Gas	6733
Hydro	19
Nuclear	0
Oil	1176
Wind	6721
Biofuels	2288
Waste	1735
Geothermal	0
Solar PV	4
Other sources	0
Solar Thermal	0
Tide	0
Total production	36364
Import	11208
Export	-10874
Balance	36698

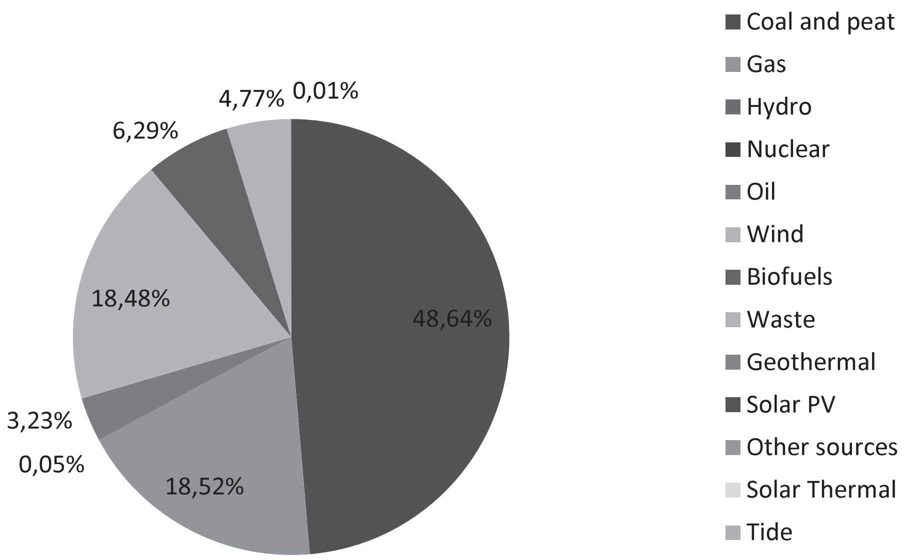

Figure 77 - Danish energy mix pie chart.

Germany

Table 62 - German energy mix table.

Source of energy	German production in GWh
Coal and peat	257137
Gas	78884
Hydro	24710
Nuclear	134932
Oil	9639
Wind	38639
Biofuels	25928
Waste	9634
Geothermal	19
Solar PV	6579
Other sources	6363
Solar Thermal	0
Tide	0
Total production	592464
Import	41859
Export	-54132
Balance	580191

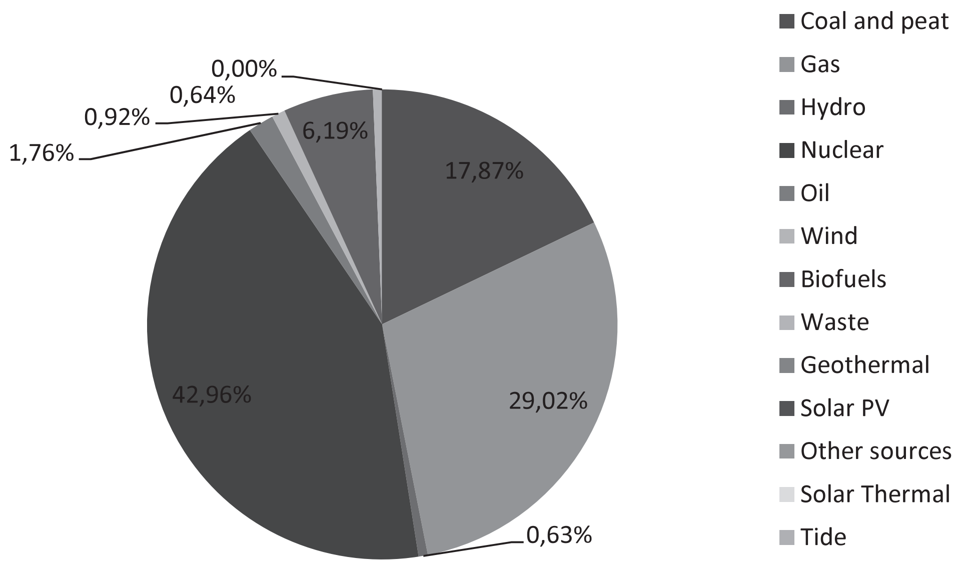

Figure 78 - German energy mix pie chart.

Hungary

Table 63 - Hungarian energy mix table.

Source of energy	Hungarian production in GWh
Coal and peat	6415
Gas	10422
Hydro	228
Nuclear	15426
Oil	633
Wind	331
Biofuels	2222
Waste	230
Geothermal	0
Solar PV	1
Other sources	0
Solar Thermal	0
Tide	0
Total production	35908
Import	10972
Export	-5459
Balance	41421

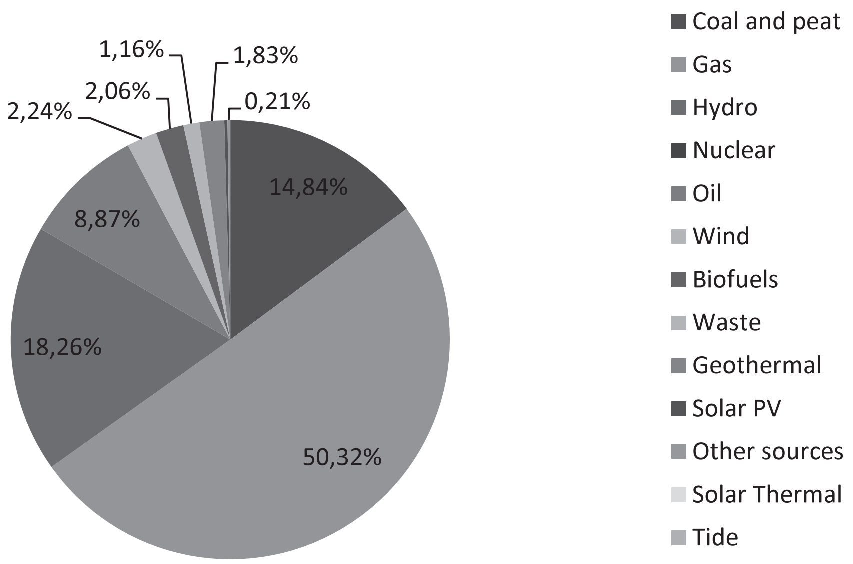

Figure 79 – Hungarian energy mix pie chart.

Italy

Table 64 - Italian energy mix table.

Source of energy	Italian production in GWh
Coal and peat	43416
Gas	147269
Hydro	53443
Nuclear	0
Oil	25946
Wind	6543
Biofuels	6015
Waste	3388
Geothermal	5342
Solar PV	676
Other sources	603
Solar Thermal	0
Tide	0
Total production	292641
Import	47070
Export	-2111
Balance	337600

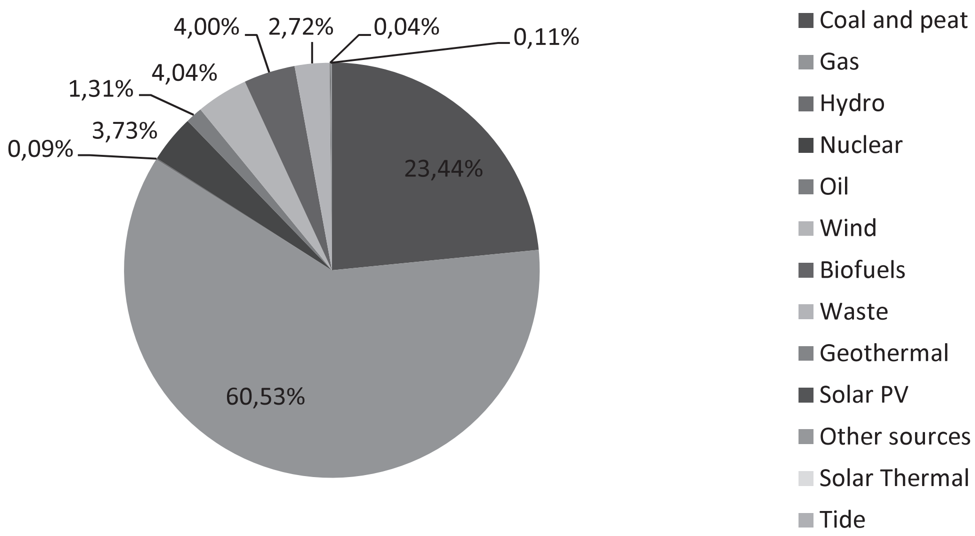

Figure 80 – Italian energy mix pie chart.

Netherlands

Table 65 - Dutch energy mix table.

Source of energy	Dutch production in GWh
Coal and peat	26605
Gas	68705
Hydro	98
Nuclear	4228
Oil	1487
Wind	4581
Biofuels	4538
Waste	3084
Geothermal	0
Solar PV	46
Other sources	130
Solar Thermal	0
Tide	0
Total production	113502
Import	15452
Export	-10561
Balance	118393

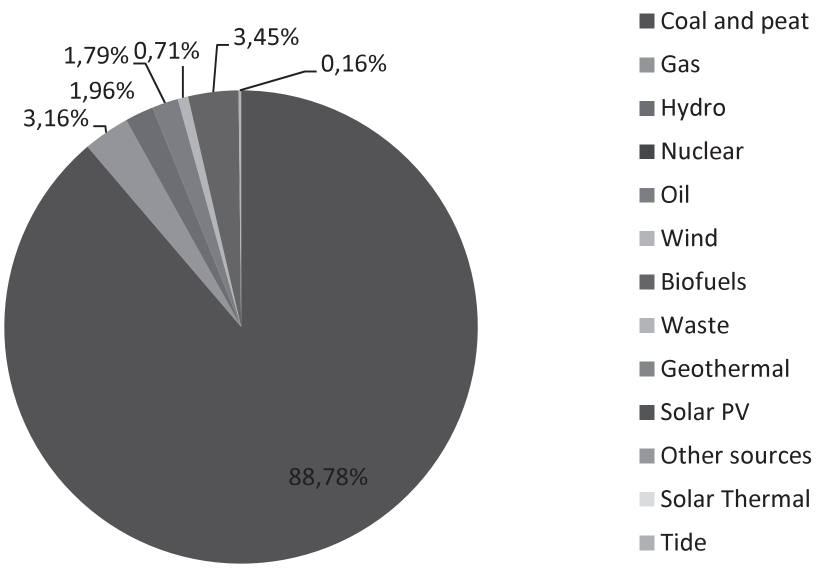

Figure 81 – Dutch energy mix pie chart.

Poland

Table 66 - Polish energy mix table.

Source of energy	Polish production in GWh
Coal and peat	134696
Gas	4787
Hydro	2974
Nuclear	0
Oil	2723
Wind	1077
Biofuels	5227
Waste	236
Geothermal	0
Solar PV	0
Other sources	0
Solar Thermal	0
Tide	0
Total production	151720
Import	7403
Export	-9594
Balance	149529

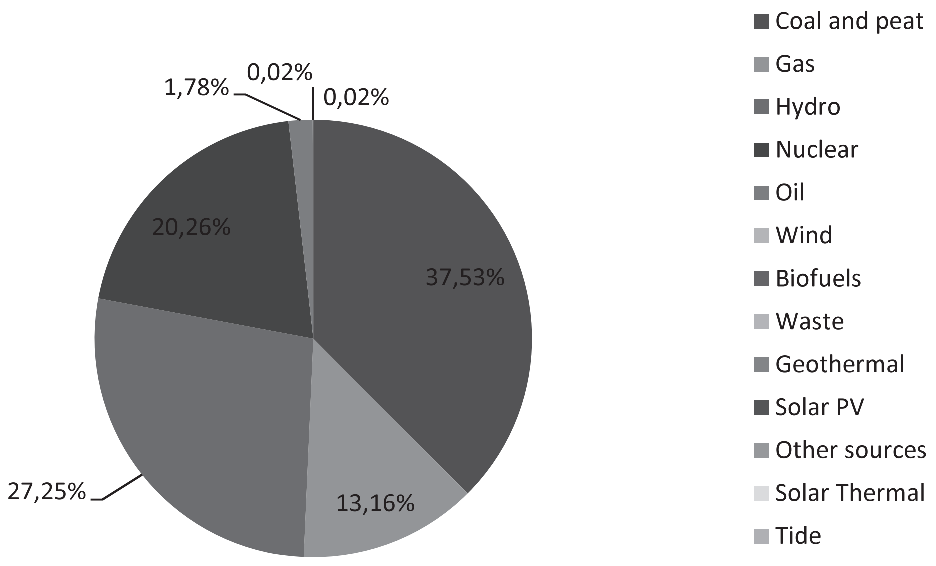

Figure 82 – Polish energy mix pie chart.

Romania[29]

Table 67 - Romanian energy mix table.

Source of energy	Romanian production in GWh
Coal and peat	21773
Gas	7632
Hydro	15807
Nuclear	11752
Oil	1031
Wind	9
Biofuels	10
Waste	0
Geothermal	0
Solar PV	0
Other sources	0
Solar Thermal	0
Tide	0
Total production	58014
Import	651
Export	-2946
Balance	55719

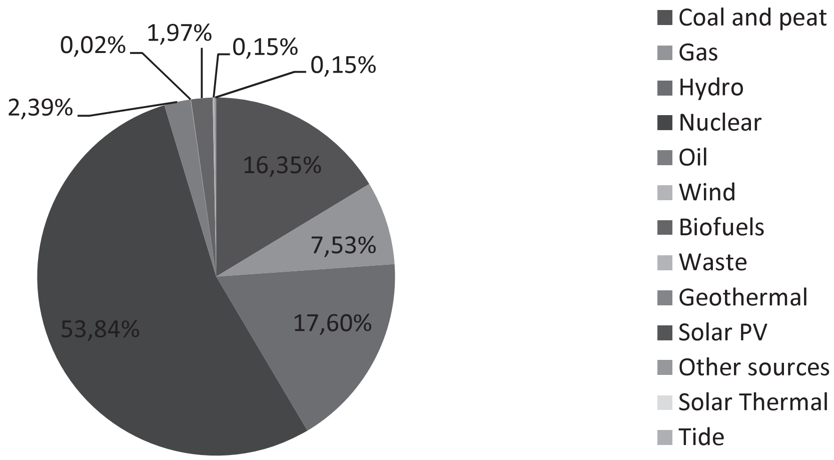

Figure 83 – Romanian energy mix pie chart.

[29] Romania became member of the EU in 2007 but it is not a member of Schengen (Free circulation area).

Slovakian Republic

Table 68 - Slovak energy mix table.

Source of energy	Slovak production in GWh
Coal and peat	4276
Gas	1970
Hydro	4604
Nuclear	14081
Oil	626
Wind	6
Biofuels	515
Waste	38
Geothermal	0
Solar PV	0
Other sources	39
Solar Thermal	0
Tide	0
Total production	26155
Import	8994
Export	-7682
Balance	27467

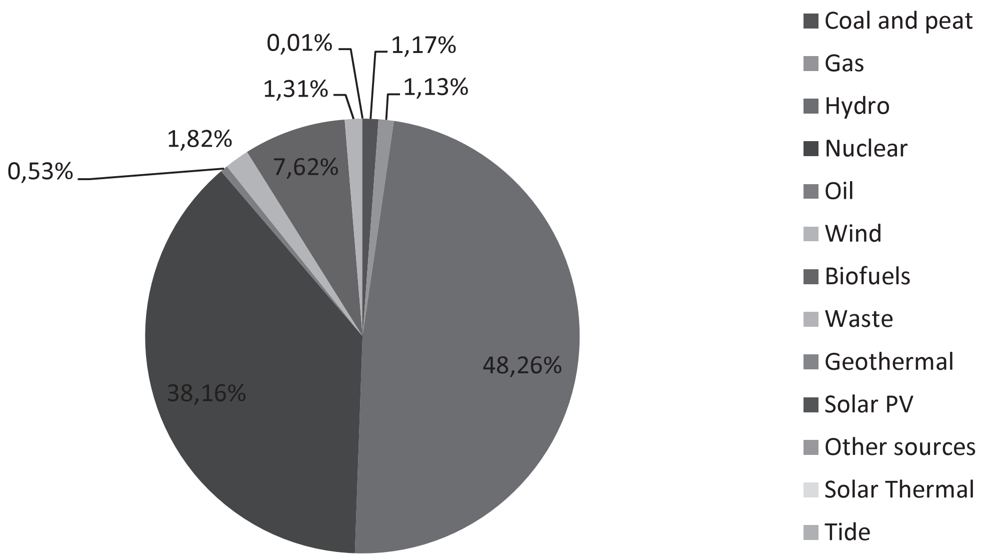

Figure 84 – Slovakian energy mix pie chart.

Sweden

Table 69 - Swedish energy mix table.

Source of energy	Swedish production in GWh
Coal and peat	1600
Gas	1548
Hydro	65977
Nuclear	52173
Oil	730
Wind	2485
Biofuels	10412
Waste	1785
Geothermal	0
Solar PV	7
Other sources	0
Solar Thermal	0
Tide	0
Total production	136717
Import	13765
Export	-9080
Balance	141402

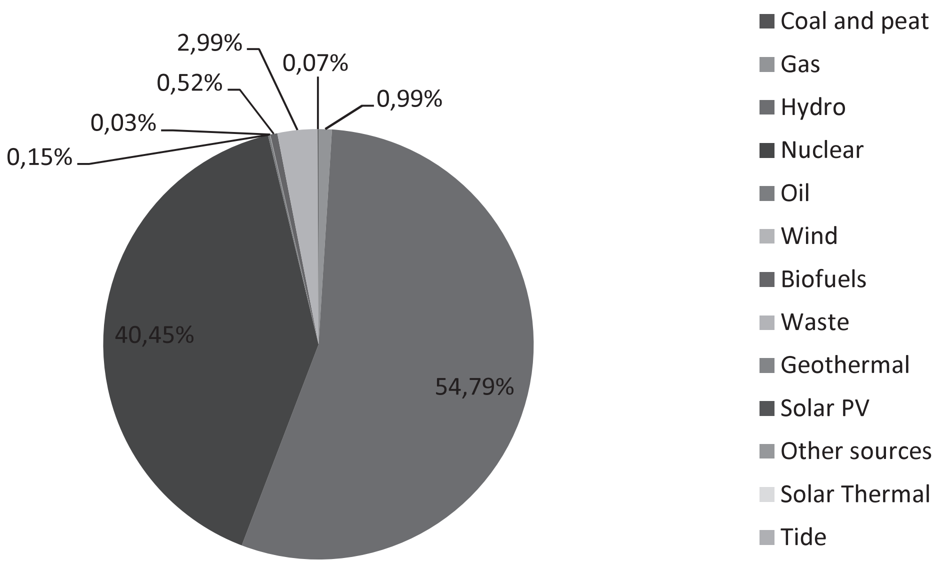

Figure 85 – Swedish energy mix pie chart.

Switzerland

Table 70 - Swiss energy mix table.

Source of energy	Swiss production in GWh
Coal and peat	0
Gas	681
Hydro	37507
Nuclear	27686
Oil	103
Wind	23
Biofuels	358
Waste	2045
Geothermal	0
Solar PV	50
Other sources	0
Solar Thermal	0
Tide	0
Total production	68453
Import	31368
Export	-33525
Balance	66296

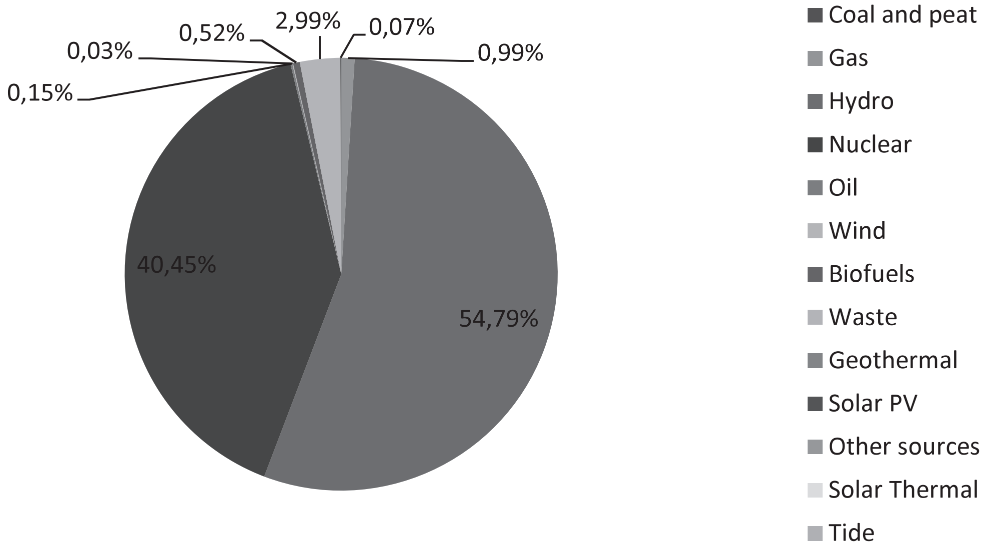

Figure 86 – Swiss energy mix pie chart.

Emissions per MJ

As previously mentioned, the following emission indexes are used to calculate the total emissions per weighted energy mix system. Waste and other renewable energy sources have been neglected given the low levels of emissions, CHP management of the plants or the low penetration of these sources in some cases.

Bio-fuels power generation

Table 71 – Emissions from Bio-fuel combustion for power generation (CPM, 2013).

	Substance	*Quantity*	*Unit*	*Geography*
Refined resource	Bio fuel	1	MJ	Technosphere
Emission	Ash	0,1	g	Air
Emission	CO	1	g	Air
Emission	VOC	0,1	g	Air
Emission	NOx	0,15	g	Air
Emission	PM	0,03	g	Air
Emission	SO2	0,03	g	Air

Coal power generation

Table 72 - Emissions from Coal combustion for power generation ***Invalid source specified.*** .

	Substance	*Quantity*	*Unit*	*Geography*
Refined resource	Coal	1	MJ	Technosphere
Emission	Ash	0,3	g	Air
Emission	CO	0,089	g	Air
Emission	CO2	94,6	g	Air
Emission	VOC	0,01	g	Air
Emission	NOx	0,292	g	Air
Emission	PM	1,203	g	Air
Emission	SO2	0,765	g	Air

Natural gas power generation

Table 73 - Emissions from Natural gas combustion for power generation (CPM, 2013).

	Substance	*Quantity*	*Unit*	*Geography*
Refined resource	Natural gas	1	MJ	Technosphere
Emission	CO	0,001	g	Air
Emission	CO2	55,2	g	Air
Emission	VOC	2E-05	g	Air
Emission	NOx	0,15	g	Air
Emission	SO2	0,002	g	Air

Oil power generation

Table 74 - Emissions from Oil combustion for power generation (CPM, 2013).

	Substance	*Quantity*	*Unit*	*Geography*
Refined resource	Oil	1	MJ	Technosphere
Emission	Ash	0,007	g	Air
Emission	CO	0,013	g	Air
Emission	CO2	75,8	g	Air
Emission	VOC	0,01	g	Air
Emission	NOx	0,15	g	Air
Emission	PM	0,03	g	Air
Emission	SO2	0,38	g	Air

Emission levels by country

Table 75 – Emissions in g per MJ of electricity generated as weighted for each territory.

Emissions	World	EU 27	Austria	Belgium	Czech R.
Ash	0,1224	0,0824	0,0278	0,0241	0,1799
CO	0,0476	0,0528	0,0649	0,0446	0,0751
CO2	53,810	39,782	18,021	24,342	56,805
NOx	0,1591	0,1200	0,0593	0,0741	0,1783
PM	0,4870	0,3201	0,0900	0,0823	0,7129
SOx	0,3286	0,2151	0,0642	0,0545	0,4543
VOC	0,0056	0,0058	0,0067	0,0045	0,0082

Emissions	Denmark	Germany	Hungary	Italy	Netherlands
Ash	0,1524	0,1347	0,0599	0,0472	0,0744
CO	0,1069	0,0828	0,0783	0,0354	0,0616
CO2	58,687	49,640	34,258	48,530	56,580
NOx	0,1841	0,1557	0,1076	0,1352	0,1672
PM	0,5880	0,5239	0,2173	0,1818	0,2836
SOx	0,3867	0,3398	0,1458	0,1488	0,1867
VOC	0,0115	0,0089	0,0082	0,0044	0,0065

Emissions	Poland	Romania	Slovakia	Sweden	Switzerland
Ash	0,2699	0,1127	0,0512	0,0112	0,0005
CO	0,1138	0,0340	0,0346	0,0773	0,0053
CO2	87,080	44,110	21,440	2,1400	0,6632
NOx	0,2718	0,1320	0,0656	0,0173	0,0025
PM	1,0696	0,4520	0,1980	0,0165	0,0002
SOx	0,6871	0,2941	0,1349	0,0133	0,0007
VOC	0,0125	0,0039	0,0038	0,0078	0,0005