logman

Logistics & Manufacturing CO_2 FOOTPRINT

LOGMAN
Management Summary I

External Factors & Carbon Footprints

Prepared for the 1st Conference
15th of June 2010, Vienna

www.logman-footprint.eu

FUNDED BY EUROPEAN COMMISSION
7TH RTD PROGRAMME

logman

Logistics & Manufacturing CO_2 FOOTPRINT

Imprint

Publisher:

AustriaTech – Federal Agency for Technological Measures Ltd.

Donau-City-Strasse 1

A-1220 Vienna

tel +43 1 26 33 444

fax +43 1 26 33 444 10

office@austriatech.org

www.austriatech.org

Picture Source: www.istockphoto.de

FUNDED BY EUROPEAN COMMISSION
7TH RTD PROGRAMME

TABLE OF CONTENTS

INTRODUCTION

The transport sector, and especially the freight sector, has been blamed in the past for increasing GHG emissions. But is this always correct, or isn't transport also an enabler for reducing emissions in other sectors?

New best practices of reducing products' carbon footprint might lead to increasing transport's GHG emissions.

INTRODUCTION

The transport sector, and especially the freight sector, is often blamed for its increasing GHG emissions. But is this always correct, or isn't transport also an enabler for reducing emissions in other sectors?

Cargo owners, the driver of freight transport, consider GHG emissions as an increasingly important design criterion (in addition to costs and customer service) for their logistics and manufacturing processes, but: When cargo owners want to optimize their products' carbon footprint, they have to consider all logistics and manufacturing processes, and European freight transport's GHG emissions are only one part of the total picture. Therefore new best practices of reducing products carbon footprint might lead to increasing transport's GHG emissions.

LOGMAN will analyse these new best practices of new logistics and manufacturing systems, and impacts on the European freight transport carbon footprint and European products' and logistics carbon footprint.

The project started in September 2009 and the duration is two years. During the project two stakeholder Forum meetings are planned to discuss the intermediate project's results.

The first Forum meeting, for which this management summary was prepared, takes place 10 months after the start of the project. The second Forum meeting will be one year after the first meeting.

Both Forum meetings should not only enable the information exchange between the project team and the stakeholders, but also between the participants. Therefore the Forum meetings consist both of presentation and participative sessions.

Goals of the Forum

The goal of the first Forum meeting is to achieve a common understanding about the following topics:

a) ***External Factors with an impact on logistics and manufacturing systems***
b) ***Wild Cards which might lead to a different future***
c) ***Europe's Freight Transport Carbon Footprint***
d) ***Europe's Products' Logistics and Manufacturing Carbon Footprint***

Ad a) As an input for the discussions the project team has analyzed the following ***External Factors***:

- trade and transport,
- legislation and policy,
- technology, and
- transport system.

In this Management Summary the key drivers and trends of each of these external factors are described. By discussing this aspect it should be avoided that the project team neglects relevant drivers of future development.

Therefore it would be a very important feedback from the stakeholders, if there is an important aspect missing, which influences current or future decision making.

INTRODUCTION

Ad b) In addition to these four external factors we will also discuss at the conference ***Wild Cards*** of a future development of logistics and manufacturing systems. Wild Cards are low-likelihood, high-impact, hard-to predict events.

These Wild Cards are relevant for future project steps where scenarios about the future will be developed. The Wild Cards can give indications about the vulnerability of the scenarios or can be basis of certain scenarios.

Ad c) With regard to GHG emissions the project uses two different indicators. The first indicator addresses the impacts of new logistics and manufacturing systems on transport emissions: ***European freight transport carbon footprint***, i.e. the freight transports emissions within the European territory.

Ad d) The second environmental indicator used within the project is ***European products logistics and manufacturing carbon footprint***, i.e. the GHG emissions during the logistics manufacturing processes of all products used and consumed within Europe.

To give an insight into these two indicators the methodology and preliminary results will be presented at the Forum meeting.

Intention of this Management Summary

The intention of this Management Summary is to sum up the main results of the reports provided by the LOGMAN project. Of course the summaries are very short and cannot give deep insights into a specific area, but they can help to give impulse for the discussion groups to be set up in the Forum. If you are interested in more details, on the project management website (www.logman-footprint.eu) reports will be available for download.

Outlook

In the next project phase new best practices of logistics and manufacturing trends will be analyzed. This Case Study analysis will be used to develop scenarios about developments of the two footprints until 2030. These project results, the Case Studies and the Scenarios will be discussed in the second Forum Meeting.

We invite you to participate and share your knowledge in a process that intends to address shaping the future of freight transport from the perspective of logistics and manufacturing systems. Being a stakeholder and/or specialist in one or more of the areas we are discussing your contribution will help to improve the results of LOGMAN.

We hope that this summary will be a sound basis and starting point for a fruitful work at the Forum meeting.

Looking forward meeting you

Stephan Helmreich
Project Coordinator

"The European freight transport carbon footprint" is the sum of all transport emissions within the European territory caused by freight transport.

"European products logistics and manufacturing carbon footprint" is the sum of all GHG emissions during production and logistics of all products used and consumed within Europe.

TRADE & TRANSPORT – KEY DRIVERS

Certain emerging markets of Asia (e.g. CN, IN) could realize a very positive economic development of almost 10% p.a. growth of their GDP in the last years, not at least resulting in an increasing private consumption.

Between regions and / or countries, huge differences can be detected concerning production costs. On the other hand, overall transport costs only play a minor role for the total cost of products facilitating the exchange of goods in a positive manner.

TRADE & TRANSPORT

The key drivers for the external factors trade and transport, which are discussed in the following chapter, are considered separately due to their different influencing factors. Moreover, transport fundamentally builds upon trade, which has its individual key drivers as we see as follows.

Key Drivers - Trade

Population

The population development is one of the main drivers regarding the trade activity of an economy based on the fact, that on the one hand the population represents the demand side of a country. On the other hand the inhabitants represent the labour force of the economy, which is a prerequisite for the production of goods. Hence, the amount of demand and trade is mainly driven the higher the population is.

GDP

The Gross domestic product, as the total market value of goods and services produced of an economy, mainly displays the importance of an economy as its whole. To a certain extent it furthermore predicts its demand, its technological status and its labour force. Within the demand sector, the (private) consumption rate plays an important role due to its impact on production and importation, with the indirect consequences for trade.

Certain emerging markets of Asia (e.g. CN, IN) could realize a very positive economic development of almost 10% p.a. growth of their GDP in the last years, not at least resulting in an increasing private consumption. Trade is mainly positively correlated to a positive GDP and often a trigger of GDP growth.

Differences in production and consumption

Between regions and / or countries, huge differences can be detected concerning production costs. Within the production costs, mostly the costs of labour play an important role, particularly in highly developed OECD economies, which not at least maintain distinctive social security systems. As a consequence, most industrialised countries have to cope with higher unit labour costs of labour intense products than other e.g. developing or emerging markets. This leads to low overall production costs of products (low value per unit), which are as a consequence, often imported by countries with higher production costs as input products.

On the other hand, overall transport costs only play a minor role for the total cost of products facilitating the exchange of goods in a positive manner.

TRADE & TRANSPORT – TRENDS

Bilateral / Multilateral trade agreements

Today, agreements tending the easement and acceleration of trade exist between several countries and regions. Subsequently, these are key drivers for trade, which are directly focussing on the easement of freight movements between the relevant economies.

Key Drivers - Transport

Trade and globalisation

Trade, triggered by economic and population development is in turn the main key driver of transportation. All transport flows rely on an exchange of goods pushed by economic growth. The more trade the more transport.

Another trigger of the transport sector represents globalisation, which implies the global supply of goods for production and customers. Within the last two decades this principle has become increasingly important for production, mainly result of the different labour costs in different regions.

Transportation costs

As it is already mentioned before, the transportation costs are a trigger and precondition of the development of transport in its present shape. Next to production costs, they determine the main factor on the overall costs concerning the acquirement of a product. The past and present developments show that the costs of transportation decreased almost steadily in relative terms to the total costs of a product, not at least as a result of infrastructure and technology improvements made until today.

The costs of transportation decreased almost steadily in relative terms to the total costs of a product.

Transport supply condition

The transport supply conditions, in particular the transport technology and infrastructure, play an important role as the main drivers for the shipment of goods. Transport infrastructure is a precondition of physical transport. In emerging and developing countries, transport infrastructure is a key enabler for trade and subsequently for more traffic. There, the improvement of cross border procedures reducing time and costs increases the efficiency of international freight transport.

Trends

Growing population, growing private consumption

The different demographic developments in several countries / sub-regions are considered as triggers for the upcoming trade and transport trends. For instance, it is expected that the world's population is growing rapidly up to 8.7 bn people to 2030, especially in the emerging and developing countries of Africa,

The different demographic developments in several countries / sub-regions are considered as triggers for the upcoming trade and transport trends.

TRADE & TRANSPORT – TRENDS

Asia's share of the worldwide GDP will grow by 12% up to 29% until 2030, especially contributed by China, India and the Russian Federation, due to their intensifying integration into the international labour division and the growing importance of their domestic markets.

Industrialised countries (e.g. Japan) are expected to reduce their share of overall world GDP by 14% to 58% between 2010 and 2030.

Asia and Latin America. In contrast, in several industrialised countries overall population will shrink due to low birth rates although its aging will continue.

Growing economic globalisation

As trend for the increasing transport activity and not at least driven by the positive economic development, the international division of labour is expected to persist in the future, due to the growing dependencies between companies and their products. The distribution of the production and consumption all around the globe is not fixed at all and will continuously develop. Changing patterns are a main trend causing new trade flows and transport flows.

More and more of the world's economic growth will be contributed by emerging and newly industrialized countries, especially those of the Asian region. Hence, Asia's share of the worldwide GDP will grow by 12% up to 29%, especially contributed by China, India and the Russian Federation, due to their intensifying integration into the international labour division and the growing importance of their domestic markets.

Nevertheless, it should be mentioned that the emerging Asian markets will only be able to continue their rapid economic growth by strengthening their domestic demand, which is of course not automatically achieved by a high growth of the absolute number of inhabitants. Social and political stability is mandatory to embed the economic development in sound structures. The future middle class with a corresponding increase of wages and the private consumption is the key to success. The promotion of the tertiary sector and the extension of the social security system are necessary requirements.

In contrast, the industrialised countries (e.g. Japan) are expected to reduce their share of overall world GDP by 14% to 58% between 2010 and 2030, due to the lower growth of their economies. Other industrialised countries, like the U.S. may have a stronger growth, because of their positive population development.

Presumably that the political and social stability will further grow in regions like Latin America, their rich resources of raw materials will strengthen their economical importance. In contrast, the African economy is not expected to make substantial progress even though the population will increase. Missing political stability is the main hindrance to sustainable welfare.

Improvement of transport supply conditions

Globally, there are several improvements expected regarding the new construction or the upgrading of transport infrastructures. Planned for the near and far future within several countries, especially in emerging and developing countries, these infrastructures

(road, rail, ports, intermodal systems etc.) are a precondition for the further development of transportation not just within these countries.

Further relevance for the future development of transportation comprises the trend to gain efficiencies in border crossing procedures, not at least based on electronically enhancements. In addition, administrative barriers regarding import or export procedures are expected to be further abolished due to trade agreements and hence will fasten up the handling of goods. Physical capacity restrictions at borders which still exist nowadays are also expected to be reduced in future.

Unequal geographical conditions

The unequal geographical location of products like raw materials and agricultural products can be determined in the trade and transport of product flows. Regarding the European trade flow structure, it is obvious that raw materials mostly accrue from regions like the Community of independent states or North America. These regions' deposits are not expected to expire in the near future.

In addition, the agricultural production of the EU being exported to other regions (e.g. East Asia, North Africa) is expected to increase. The climatic and geographical conditions within these regions often do not meet the existing and increasing demand for agricultural production. This dependence is being expected not to change in the future; in contrast the conditions for agricultural production are expected to become worse in some regions with high demand.

Conclusions

Overall developments concerning trade and transport of the EU

Basically, the whole transport volume between EU and the global regions is already strong and will become more important in the future. As the trade model expects the worldwide economy to be negatively influenced just for a few years, the trade and transport volumes will perform relatively similar and positive on the long run. Besides the already mentioned significant dependency between both parameters it can be determined that the transport will develop not as positive as the overall trade forecast in the long run, as to see in the following paragraph discussing the upcoming growth.

The total export flows (in €) of the EU will grow with 2.6% p.a. between 2008 and 2030, while imports will increase with 3.2% p.a.

According to the trade forecasts, the total export flows (in €) of the EU will grow with 2.6% p.a. between 2008 and 2030, while imports will increase with 3.2% p.a. In contrast, the transport volume is not expected to grow to such a high extent, 2.2% p.a. for export, 2.5% for import respectively.

The transport volume is not expected to grow to such a high extent, 2.2% p.a. for export, 2.5% for import respectively.

It can be stated that the transport volumes ratio differentiated for import and exports is imbalanced or unpaired. Basically, this is affected by the exchange structure of commodities, which is characterized by a high raw material import (high volume) in comparison to high value export flows (low volume).

TRADE & TRANSPORT – TRENDS

The import structure is clearly dominated by raw materials like Coal (21), Petroleum (31) and Iron-ore (41).

Within the commodity group perspective, the export of the NST/R chapters Agricultural products and live animals (0), Foodstuff and animal fodder (1), Chemical (8) and Machinery, transport equipment etc (9) represents a diverse structure.

Overall, the fastest growing demand of the European freight production up to 2030 will be initiated by East Asian (4.6% p.a.) and South Asian (3.4% p.a.) countries. The export volume is and will be significantly dominated by the North American sub-region, mainly driven by the high dependency between the markets.

In contrast the present import volume of the EU is clearly dominated by the Community of Independent States, North America and South America. This domination is expected to become less distinct in future, due to the positive developments of East Asia (6.1% p.a.) and North African countries (2.7% p.a.). Furthermore, the south Asian import volume is expected to grow significantly by 4.5% p.a. up to 2030. The positive population development, the economic growth, the different labour costs and the location of raw materials (North Africa) within these regions will positive affect European trade and transport development.

Commodity conclusions for the European trade and transport

Based on the key drivers and the main trends regarding trade and transport, the crucial sectors are as follows: In a volume point of view, goods imported by the European countries must be considered as the most important trade products.

This import structure is clearly dominated by raw materials like

- ***Coal*** (21),
- ***Petroleum*** (31) and
- ***Iron-ore*** (41).

Within the commodity group perspective, the export of the NST/R chapters

- ***Agricultural products and live animals (0),***
- ***Foodstuff and animal fodder (1),***
- ***Chemical (8)*** and
- ***Machinery, transport equipment etc (9)*** represents a diverse structure (NST/R view), which is dominated by a mix of refined and recycling products dominated of

- ***Manufactured articles (97)***,
- ***Paper pulp and waste paper (84)***,
- ***Beverages (12)***,
- ***other machinery apparatus and appliances (93)***.

Besides the identified crucial sector commodities, which will still be dominant in future, some other NST/R chapters (Export: NST/R 6; Import: NST/R 5, 6) are expected to grow significantly until 2030.

Stephan Kritzinger,
Tobias Dennisen, Jan Limbers

LEGISLATION & POLICY – KEY DRIVERS

LEGISLATION & POLICY

Key Drivers

Environmental emissions and energy consumption

Curbing environmental emissions and energy consumption has been the main driver behind the current policy and legislation relevant for transport and environment. In spite of the overall decline, Greenhouse Gas (GHG) emissions from transport increased in the EU-27 by more than 26% between 1990 and 2007. The share of emissions from transport and industrial processes in the EU-27 is 19.5% and 8.5%, respectively, as of 2007 (EEA Report No 5/2008).

According to the EU Green Paper (2000) on the security of energy supply, the oil resources will be depleted in about 50 years, and the energy dependency in the EU will be 70% by 2030, pioneering the stringent policy and legislative measures. On the other hand, freight transport tends to grow slightly faster than the economy, with road and air freight recording the largest increases in the EU-27 (43% and 35%, respectively, between 1997 and 2007), and if no decisive action is taken, total road freight transport in Europe is set to grow by more than 60% by 2013 (EEA Report No 2/2010). The combination will lead to even higher level of emissions and use of fossil fuels from transport.

Relationship between economic growth and transport

The relationship between economic growth and transport is highly crucial in determining what triggers global and EU transport and infrastructure developments. The relationship differs in developing and developed countries. In developed countries, the main driver for providing transport is high demand. In developing countries, transport is provided due to poor infrastructure and is considered as a significant part of regional development due to its function of connectivity between remote areas.

Moreover, in the Future of Transport (2009) it is reported that the increasing number of elderly in the future will induce a higher demand for health care and pensions reducing the portion of public finances devoted to transport infrastructure. On the other hand, net migration to the EU might add 56 million people to the EU's population in the next five decades. Migrants are expected to intensify Europe's ties with neighbouring regions entailing more movement of people and goods.

International agreements

Multilateral trade agreements, mainly aimed at reducing trade barriers, are becoming difficult to achieve due to

Curbing environmental emissions and energy consumption has been the main driver behind the current policy and legislation relevant for transport and environment.

In developed countries, the main driver for providing transport is high demand. In developing countries, transport is provided due to poor infrastructure and is considered as a significant part of regional development due to its function of connectivity between remote areas.

LEGISLATION & POLICY – KEY DRIVERS

Environmental issues other than emissions and energy dependency, such as decline in biodiversity and noise pollution, are becoming increasingly significant.

The recent economic downturn is expected to have a significant role on shaping future legislation and policy.

- the numerical growth of World Trade Organization (WTO)-members and their diverging interests increasingly leading polarized national interests, and
- the negotiations that no longer only touch at the liberalization of trade in goods but also at the liberalization of sensible sectors (agriculture and services) creating higher costs of adaption.

Overall, the WTO is today faced with its greatest challenge: a comprehensive reform of the institutionalised world trading system.

Biodiversity and noise

Environmental issues other than emissions and energy dependency, such as decline in biodiversity and noise pollution, are becoming significant (COM(2009) 400 final). The rate of extinctions due to human activity will accelerate 10-fold by 2050 (EC Environment Fact Sheet on Nature and Biodiversity, 2005). 311,000 premature deaths are projected in 2030, due mainly to the effects of pollution from groundlevel ozone and fine particles (EEA Technical Report 4/2006). Lastly, noise is a vital factor in the consideration of environment. Almost 67 million people are currently exposed to daily road noise levels exceeding the lower benchmark for the combined noise indicator (EEA Report No 3/2009)

Economic crisis

Lastly, the recent economic downturn is expected to have a significant role on shaping future legislation and policy. The main trigger of the 2008 economic crisis was the behaviour of households and firms, which is quite uncommon considering the causes of the previous crises, such as the increase in oil prices.

In order to recover, governments have in general accepted that a discretionary fiscal stimulus may be required in the particular circumstances of the 2009 slowdown. This obviously has implications for the proportion of the budget devoted to environmental measures and transport infrastructure (Bowen and Stern, 2010). It is important to highlight that the release of the April 2010 emissions data confirmed the impact of the crisis by illustrating that the emissions reduction and the fall in the price of carbon permits are mostly due to the economic downturn (Worthington, 2010).

Trends

Climate change

The EU Climate and Energy policy package has set targets to reduce greenhouse gases by at least 20%, to increase energy efficiency by 20%, to increase the share of renewable energy in overall consumption up to 20% and to set a 10% binding minimum target for the share of biofuels. In fact the EU Climate

LEGISLATION & POLICY – TRENDS

Commissioner, Connie Hedegaard, recently said that they were considering in going to 30% target for emission reduction by 2010 (SPEECH/10/182).

For the sectors outside of the ETS, such as transport and agriculture, the package contains an "effort-sharing" decision, which sets out binding emission-reduction targets for each member state, in line with their ability to pay, in order to reach an overall cut of 10% by 2020.

Emission trading scheme

Under the system of European Emissions Trading Scheme (ETS), EU governments set limits on the amount of carbon dioxide emitted by energy-intensive industries. Aviation will be included from January 2012. In the shipping sector there have been proposals to adopt an ETS system. In terms of road freight transport, the European Commission has focused on inclusion of car manufacturers and individual motorists.

Energy efficiency

The above-mentioned EU targets for energy efficiency and the use of renewables is accompanied by binding sustainability criteria for biofuels included in the Renewable Energy Directive and the Fuel Quality Directive. Currently, it seems that EU Member States are far from meeting the current biofuels targets.

Charging/Taxation

The key point in the Greening Transport Package is the focus on smart road charging. The infrastructure charging for heavy goods vehicles will be the main EU instrument in the road sector.

Moreover, following the potential damage by consumption around the world, taxing consumption has been one of the policy measures aimed at making markets more environmentally conscious. In the future, the revenue is expected to be used to promote further energy efficient methods. For instance, the UK Climate Change Levy is expected to increase energy bills by 5%-10%.

Infrastructure Development

The construction of infrastructure by developing countries is likely to continue and intensify, as they intend to develop their states and regions more balanced. This could have a severe impact on transport-related emissions when producing products abroad. The future development of transport policy and infrastructure in developed countries is more difficult to be foreseen due to already existing infrastructure and pending discussions on noise and climate change.

Many appear to prefer an improvement and/or enlargement of existing infrastructure, because this limits the spatial impact of changed infrastructure. The trans-European

The key point in the Greening Transport Package is the focus on smart road charging. The infrastructure charging for heavy goods vehicles will be the main EU instrument in the road sector.

The construction of infrastructure by developing countries is likely to continue and intensify, as they intend to develop their states and regions more balanced. This could have a severe impact on transport-related emissions when producing products abroad.

LEGISLATION & POLICY – TRENDS

At the EU level, the concept of Green Transport Corridors, which should allow more traffic on existing corridors between major hubs, while encouraging environmental sustainability and energy efficiency was introduced 2007.

Standard setting is an important policy instrument for transition to a new and integrated transport system.

network (TEN-T) is focusing on solving infrastructural bottlenecks and adding new infrastructure for all transport modes (road, rail, IWT and SSS). It has been assessed that completing the total network will result in a reduction of 14% reduction in road congestion by 2020, which will have strong implications for energy consumption. Lastly, the promotion of motorways of the sea includes new and upgraded infrastructure in ports, ice breaking, dredging and information systems.

Greening Infrastructure

At the EU level, the concept of Green Transport Corridors, which should allow more traffic on existing corridors between major hubs, while encouraging environmental sustainability and energy efficiency, was introduced in 2007. This concept will help to make road transport cleaner and less dependent on fossil fuels. It will be included in TEN-T and Marco Polo priorities before the end of 2010 (Jorna, et al, 2008). In this context, the use of Intelligent Transport Systems (ITS) is essential. The method provides differentiated charging of vehicles by Electronic Toll Collection systems for circulating on certain routes; and it is a way to influence traffic demand on roads.

Standardization

Standard setting is an important policy instrument for transition to a new and integrated transport system. The Directive 2004/52/EC, for instance, provides a framework for the interoperability of toll collection systems within the EU. The trend is likely to continue as both the Future of Transport (2009) and the Freight Logistics Action Plan (2007) have strongly recommended it.

Bilateralism and reduced rate of liberalization

The decelerating pace of the liberalization led to the weakening of the multilateral system and the strengthening of bilateral arrangements. In order to accelerate the opening-up of markets for European enterprises, the EU currently intensifies bilateral negotiations.

Co-modality

The EU Sustainable Development Strategy directs attention to modal shift as part of its strategy of reduction of transport emissions. Through the Marco Polo II programme (2007-2013) the Commission is supporting projects shifting freight transport from the road to sea, rail and inland waterways. A yearly aggregated shift of 20.5 billion tonne-kilometre freight from road transport to short sea, rail, inland waterway and zero-traffic (traffic avoidance) is expected (COM(2004)478 final). "Motorways of the Sea" project is also quite relevant with the modal-shift developments where the priority is given at national level to ports which have good connections to the inland network

LEGISLATION & POLICY – TRENDS

which could form parts of logistics chains.

Vehicle Design

Sustainable economics is now introduced into public procurement of vehicles and transport services (Directive 2009/33/EC). From 2012, a manufacturer will be required to ensure that the average emissions of all new cars are below the average of the permitted emissions for those cars as given by the legislation.

All of each manufacturer's newly registered cars must comply on average with the limit value from 2015 onwards. A target of 95g/km is specified for the year 2020. The Euro VI specifies the new emission standards for trucks and busses. The implementation of the Euro VI emission standards is expected to result in a reduction of approximately 30% in the number of locations where the air-quality norm for nitrogen oxide will be exceeded in 2013-2014 (MNP report 500094008, 2008).

Product Design and Content and Waste

Regulating product design and material content has been an accepted policy measure and is expected to be so given the recent legislations on production. The Waste of Electrical and Electronic Equipment (WEEE) Directive requires producers to have a product information and reporting obligation and to demonstrate recovery targets for electric and electronic equipment. The main aim is to promote reuse, recycling, and other forms of recovery as to save on the use of natural sources and reduce disposal. Other Directives in this context include the End-Of-Life Vehicle Directive for the automotive industry, the Packaging and Packaging Waste Directive, the Directive concerning the waste management of batteries and, related to the WEEE Directive, the RoHS Directive which restricts the use of selected toxic substances in electrical and electronic equipment (EEE). Eco-labelling also allows products with designed reduced environmental impact to be promoted and marketed as such with a standard label. Lastly, the EU Climate and Energy Package sets targets for fuel and biofuel contents. By 2020, fuel suppliers have to decrease by 6% climate harming emissions over the entire life-cycle of their products.

Sustainable economics is now introduced into public procurement of vehicles and transport services.

Governance, Administration and Life-cycle thinking

The EC (2007) Freight Logistics Action Plan calls for Logistics Policy to be pursued at all levels of governance. Additionally, introducing life-cycle thinking to existing policies is expected to reduce the pressures on the environment at each stage of the life cycle of resources following an emphasis on the integrated approach by the Integrated Pollution Prevention and Control (IPPC) Directive. Using the life cycle approach means that the emissions and energy used during the extraction or harvesting, use and ultimate disposal need to be counted in the total environmental effects of a product or service.

Introducing life-cycle thinking to existing policies is expected to reduce the pressures on the environment at each stage of the life cycle of resources.

LEGISLATION & POLICY – CONCLUSIONS

Llife-cycle thinking that enables an integrated approach to negative environmental trends has strong implications for the manufacturing industry as a whole. This takes the form of reporting obligations, labelling and consideration of emissions at every stage of production.

At the European level, possible inclusion of road transport in the ETS directed attention to car manufacturers and individual motorists.

Additionally, simplifying the administrative complexities will provide the efficiency of intermodal terminals, including ports and airports, is crucial for logistics performance (EC 2007 Freight Logistics Action Plan).

Conclusions

The creation of an enabling environment for curbing emissions and decreasing energy dependency, along the targets set by both global and EU agreements, requires serious and sustained policy measures. The measures should also shed light on the understanding of the forces and factors that contribute to the negative effects of human activity on the nature. Along this line, not only policy and legislative measures have been extended, but also ***different styles of thinking have been introduced into policy-making***. For instance, life-cycle thinking that enables an integrated approach to negative environmental trends has strong implications for the manufacturing industry as a whole. This takes the form of reporting obligations, labelling and consideration of emissions at every stage of production. In developed countries, this trend is stronger as they also consider all other environmental factors, such as noise and biodiversity.

As transport is considered to have a major role on increasing environmental emissions and oil dependence as well as being the main engine/indicator of economic growth, most of the measures are already aimed at transport, which also affects manufacturing of transport equipment. Legislative changes to vehicle design, to emission limits, and to fuel content, are some of the measures that would have a direct impact on the manufacturing of transport equipment. More specifically, at the European level, possible inclusion of road transport in the ETS directed attention to car manufacturers and individual motorists. If shipping is included in the future, transport of crude petroleum and fuel derivatives, which EU transports at high volumes, are expected to be affected drastically. Petroleum products are already expected to be affected through the legislation on the fuel and biofuel contents.

The latest legislation aimed at ***electrical and electronic equipments*** requires manufacturers to have certain product design, labelling and material content. The manufacturers of these products now have the reporting obligation and are subject to stringent recycling legislation.

Based on the current trends and future policy and legislation developments,

- ***manufacturing of transport equipment (NST/R 91)*** and
- ***electrical machinery, apparatus, appliances and engines (NST/R 931)***

are the most evident affected sectors and product groups. The rest of the above-mentioned products should be considered along with the other external factors, especially with the current and expected transport volumes both at geographical and product level.

Nihan Akyelken, David Bonilla, Jürgen Schmiele, Anne Holma, Patrick Beullens, Jana Ries and Jan Limbers

TECHNOLOGY – TRANSPORTATION

Key Drivers

Efficiency

Transportation is highly competitive but there is still inefficiency in the sector. Directly relevant to the environment are the inefficiencies from empty running of road vehicles (27.4% on average and 35% for over 25-tonnes rigids, 2005, Dept. of Transport UK).

Imbalances in good flows demand variability over time, incompatibility of vehicles, limits to coordinated planning, difficult constraints (time windows, congestion); they all bring current estimates of the best attainable average only down to 20%. Unused volume in vehicles ranges between 25% and 50% - dependent on the sector, often because of a limitation of warehouse pallet rack space.

Flexibility - responsiveness - just-in-time

Inefficiency also creeps in the system when customers demand flexibility, responsiveness, imposes strict time windows or just-in-time deliveries. Just-In-Time deliveries have resulted in smaller vans, which are per tonne-km more polluting, performing more frequent deliveries in smaller lot-sizes. The negative effect of this has on the environment has recently been criticised.

CO_2 emissions

The aim to reduce greenhouse emissions and the corresponding negative impact on the environment boosts new advances in transportation technology.

In 2007, the sector has caused 25% of total CO_2 emission in the EU, and a further increase in transport demand is still expected. In 2006, the share of freight transport was 65% and 9% for road and rail, respectively, while the share of waterways and air were, 23% and 6% respectively.

In the line of reducing emissions, new advances in transportation focus in particular on reducing fuel consumption per tonne-km, and developing fossil fuel alternatives. Efficiency in the sector needs to further improve by aiming for increased load factors, improved use of IT and routing, collaboration, transfer to environmentally friendly modes, city logistics (cross-docking facilities), and more environmentally friendly vehicle designs.

Noise reduction

Reducing noise level has become another driver in the sector. In the rail sector high noise levels are caused by rail-wheel interaction. In 2002, the European Directive 2002/49/EC set targets for strategic noise maps and action to be taken for major railways and large agglomeration.

Efficiency in the sector needs to further improve by aiming for increased load factors, improved use of IT and routing, collaboration, transfer to environmentally friendly modes, city logistics (cross-docking facilities), and more environmentally friendly vehicle designs.

TECHNOLOGY – TRANSPORTATION

Trends

For road transport, hybrids using fuel and electric power are expected to dominate hydrogen vehicles.

For large vehicles, the focus is on increased capacity, with the use of longer and heavier vehicles (LHV).

Alternative power strategies

For road transport, hybrids using fuel and electric power are expected to dominate hydrogen vehicles, since the latter need infrastructural solutions not yet well developed. Hybrids are ideally operating in a green electricity grid. For short distances and moderate speeds, compressed air technology could be a viable option. For longer distances, (bio)fuels will probably dominate.

Transport by sea has significantly increased. To reduce CO_2 emissions and costs, alternative power strategies are sought, such as the electrical power supply while at berth.

In rail transport, further electrification of the rail network is expected as electric locomotives provide more power for traction and offer benefits in operation and maintenance.

With CO_2 emissions by air transport being 10 times as high as by road, advances in this sector are of increasing importance. Alternatives to fossil fuel are investigated, e.g. fuels derived from coal, biomass and natural gas.

Improved designs

In road transport, most efforts target cars, with a focus on improving propulsion mechanisms, by introduction of e.g. eight-speed automatic or continuously variable transmissions, low-loss lubricants, and ceramic bearings for reduced friction.

For large vehicles, the focus is on increased capacity, with the use of longer and heavier vehicles (LHV) which are tested in several countries, most notably Sweden, Germany, and the Netherlands. The concept of LHVs is simple in the sense that in addition to more powerful motors a trailer is attached to a standard HGV. This allows flexibility in trailer combinations and avoids the necessity of large investments into vehicle fleets.
LHVs fuel efficiency is increased by reducing rolling resistance, improving aerodynamic performance and reducing engine losses.

For transport by sea, further efforts for reduced fuel consumption include slow steaming and air cavity technologies. Further technologies include anti-fouling coatings to increase fuel efficiency by preventing organisms to add resistance and improved hull insulation.

TECHNOLOGY – TRANSPORTATION

In rail transport, innovations focus on optimized diesel and electric engines, combined with weight reduction, standardization of load capacities, improved aerodynamics, regenerative breaking, and longer trains. Improved infrastructure is needed for an extended and efficient network accommodating increased train lengths, increased axle loads, and (semi-) dedicated freight rail lines.

Further trends include the use of LED technology as energy efficient lighting and the use of light-weight components like aluminium and high-strength plastics to enable greater freight loads within load limits. IT systems in rail transport are used to enable the determination of the speed which results in a theoretical optimal fuel efficiency performance.

In the aviation sector, new aircraft designs offering weight reduction and blended-wing bodies are investigated. Other advances include (hybrid) electric and 'silent' aircrafts for reduced noise and fuel consumption.

Energy and power recovery

Being firstly commercially introduced in hybrid cars, more benefits can be obtained by applying dynamic breaking in heavier vehicles including trucks or freight trains since there is more energy potential to recapture and to be used at a later stage implementing energy storage technologies such as fuel cells, capacitors and batteries.

ITS initiatives

In air transport, the Single European Sky ATM Research Programme (SESAR) investigates the design of a new air traffic management system targeting, besides an improved safety-level, the increase of capacity, energy efficiency and economic growth. This project is currently in the development phase and the system is planned to be implemented in 2014-2020. Other initiatives include the EASYWAY or E-freight project.

Operational improvements

Fuel consumption and CO_2 emissions are also dependent on logistical improvements that can be derived by using GPS navigation in order to minimise the distance to be travelled and indicators that monitor fuel economy related parameters including fuel consumption.

Similarly, loading efficiency impacts fuel consumption and can be regulated by loading multiple products to ensure optimised weight capacity.

Further efforts target driver behaviour and truck weight reduction (e.g. day cabins without sleeping compartment).

In rail transport, innovations focus on optimized diesel and electric engines, combined with weight reduction, standardization of load capacities, improved aerodynamics, regenerative breaking, and longer trains.

Fuel consumption and CO_2 emissions are also dependent on logistical improvements that can be derived by using GPS navigation in order to minimise the distance to be travelled and indicators that monitor fuel economy related parameters including fuel consumption.

TECHNOLOGY – TRANSPORTATION

The Nominated Day Delivery System allows customers to place orders in advance for a 'nominated day' on which a vehicle is scheduled to deliver in a particular area.

The use of cross-docking facilities and load-swapping may improve efficiency of JIT deliveries but requires close collaboration.

Unattended deliveries

This strategy enables deliveries being made even if no-one is there to receive them. This increases delivery efficiency by allowing out-of-hours delivery and improving flexibility. According to a study in Helsinki, the implementation of reception boxes can potentially reduce transport distances and corresponding costs by about 40%.

Nominated Day Delivery System (NDDS)

The increase of e-commerce and home deliveries may need the adoption of fixed delivery schemes. The NDDS allows customers to place orders in advance for a 'nominated day' on which a vehicle is scheduled to deliver in a particular area. By concentrating deliveries in certain areas results, costs and environmental impact are reduced by improving vehicle utilisation.

Collaboration

The use of cross-docking facilities and load-swapping may improve efficiency of JIT deliveries but requires close collaboration which can be achieved by various measures including resource sharing, backloading of vehicles and pooling.

Although in theory, due to the interest of each collaborative partner, significant savings can be obtained with respect to energy and travelled distances, in reality discussing problems within the supply chain with potential competitors is still a significant obstacle.

TECHNOLOGY – MANUFACTURING

Key Drivers

Service

The improvement of product quality, reliability, and (environmental) cost of use are key drivers to technological innovation. In addition, many firms aim for meeting many different customer preferences by offering a family of products at different price to value utility functions in order to exploit all segments of their market.

Costs

Two key drivers are dominating the cost perspective in manufacturing:

- operational efficiency and
- transport efficiency.

A wide family of similar products can be offered at minimum overall manufacturing and logistics' costs using flexible manufacturing approaches based on product designs exploiting common modular components, where customer specific functions are added in the later stages of the supply chain process.

Trends

Corporate Social Responsibility

Besides legislation and competitive pressure, increasing consumer awareness of environmental issues and the corporate ('green') image are further incentives that have let companies' take environmental performance in manufacturing strategies stronger into consideration.

Supply Chain Integration

Vertical supply chain integration, made possible with improved ERP and EDI systems, is today supplemented with horizontal cooperation to aim for more compatibility in products, such as electronic standardisation, and processes, e.g. through use of common cross-docking facilities or vehicle fleets.

Industrial Symbiosis

Industrial symbiosis engages different industries and organisations in a collective approach to add competitive advantage from the physical exchange of materials, energy, water and/or by-products, together with collaboration on the shared use of assets, logistics and expertise. Industrial symbiosis can significantly increase resource and cost efficiency, as well as lead to major improvements in environmental performance of the overall system. The city of Kalundborg in Denmark is one of the best known examples.

A wide family of similar products can be offered at minimum overall manufacturing and logistics' costs using flexible manufacturing approaches based on product designs exploiting common modular components, where customer specific functions are added in the later stages of the supply chain process.

Vertical supply chain integration is today supplemented with horizontal cooperation to aim for more compatibility in products

TECHNOLOGY – INFORMATION & COMMUNICATION

TECHNOLOGY – INFORMATION AND COMMUNICATION

A key driver for ICT in manufacturing is enhanced efficiency from planning for logistics and manufacturing through its use in ERP, APS or TMS software environments.

The main challenges for ICT integration are data mining, decision support and data protection.

Key Drivers

Economic efficiency in manufacturing

A key driver for ICT in manufacturing is enhanced efficiency from planning for logistics and manufacturing through its use in ERP, APS or TMS software environments. Positive effects on customer service, including increased product availability and shorter lead times, are also expected. The key driver for e-procurement is typically cost reduction, since quality can still be controlled at this stage in the supply chain, while in e-commerce the key driver is increasing sales.

Reliability and safety in transportation

In contrast to ICT in the manufacturing environment, ICT for Intelligent Transport Systems (ITS) is used by infrastructure operators, where the key driver is reliability and safety in the network – which includes limiting congestion at peak periods. The steady rise of demand relative to capacity has increased the attention to technologies that smooth demand or can help to divert demand to other modes of transportation.

Trends

ICT integration

ICT is increasingly important in both private and business life. Data collection with current technologies has been made easy and cheap. Real-time order and process data can be made widely available within and between companies and their suppliers or customers.

Three huge challenges are:

- data mining, or developing software to filter out the relevant data from a huge amount for a specific application;
- decision support, or developing software that can make effective use of this information in supporting decision making at various levels in logistics and manufacturing;
- data protection, or making sure sensitive data does not fall into wrong hands.

Pooling

Various technologies aim at using infrastructure more efficiently in all modes because of existing capacity constraints. For the future, many expect that by pooling information sources of all transport modes freight transport is able to improve its reliability and reduce its energy intensity. This requires a framework of transport policies which tend to make transport more expensive creating thus an economic incentive to allocate required resources and technologies on information technologies.

By pooling information sources of all transport modes freight transport is able to improve its reliability and reduce its energy intensity.

TECHNOLOGY – RECYCLING

Key Drivers

Economic drivers

Competitive pressure, especially in industries with fast moving technologies, tends to favour materials recycling above direct reuse of products or components as a business strategy.

The most significant incentive for adopting (design for) recycling would be overall cost gains from the reduced use of raw materials and energy in the forward and reverse supply chain.

This direct economic incentive, however, has not been fully realised in many industries at the moment.

Upward trends in prices for oil as well as certain raw materials have shown, however, that they can become a driver for new trends in material production and recycling, as well as in transportation systems.

Increased costs of disposal and landfill are further incentives to find recycling based alternatives to reduce costs.

Legislation

Legislation offers a second major driver for recycling, as demonstrated by the significant number of European Commission Directives, including the EU Directives for Electronic and Electric Equipment (WEEE), for Restriction of hazardous Substances (RoHS), for used batteries, and end-of-life vehicles (ELV).

Those directives set various target levels for collection, recycling and energy recovery with a trend towards increased strictness and pressure on the industries affected.

Government programmes have been introduced for taking action to decrease environmental impact, including taxation benefits and grants.

Competitive pressure, especially in industries with fast moving technologies, tends to favour materials recycling above direct reuse of products or components as a business strategy.

TECHNOLOGY – RECYCLING

Increased shortages in virgin supply relative to demand have shown to significantly boost recycling for certain materials including aluminium, but can also be unpredictable and work in the opposite direction.

As increasing oil prices result in higher production costs, the interest in the use of biopolymers will continue to grow.

Environmental drivers

The decrease of waste while reducing the use of raw materials, energy and water, have been the main drivers from the environmental perspective. Those incentives have been determining for the legal framework that includes the previously mentioned EU Directives.

Societal drivers

The so-called 'green image' has become significantly important. With an increasing environmental awareness in society, sustainable policies are of public demand and companies have an interest to be regarded as socially and environmentally responsible organisations. Public sector organisations more and more require strict environmental performance from their suppliers.

Trends

Increased shortages in virgin supply relative to demand have shown to significantly boost recycling for certain materials including aluminium, but can also be unpredictable and work in the opposite direction. Trends in recycling technologies are therefore sector-specific and may shift in focus or magnitude from year to year.

Leight-weight materials

Plastics have favourable mechanical properties in many applications and have still a low production cost. With the exception of PET plastic, other plastics suffer from complexity and competition from the virgin (petroleum-based) market.

Glass bottles reuse is (environmentally) challenged due to the transport prior to refilling; local recycling for other uses is more attractive. Lightweight plastics may continue to substitute glass bottles.

Similarly, aluminium has become a favourable alternative for steel-built products due to its mechanical properties (lightweight, insulating, rust-proof), boosting its recycling.

Biopolymers

Biopolymers are biodegradable which means they break down from complex molecular structures into simpler ones once submitted to a specific (natural) environment that is different from the environment of use.
Some types need a few weeks, while it can take several months for others. As increasing oil prices result in higher production costs, the interest in the use of biopolymers will continue to grow.

TECHNOLOGY – RECYCLING

Increasing recyclability

In the automotive industry, plastics and aluminium are favourable materials being used due to their mechanical properties. With respect to recycling, aluminium is and will remain of high value, while processing certain types of plastics is still highly complex. The search towards materials with a high recyclability rate is one of the aims for the research into natural fibres and the use of nano-composites as alternatives to plastic-electro composites.

Efforts also focus towards the design for material separability and recyclability rather than disassembly and remanufacturing, as the latter is more vulnerable in a continuously moving and highly competitive market demanding increased comfort, functionality, and environmental and operating efficiency.

Eco-Design

Principles of eco-design focus on improving the recycling process of materials that are known to be difficult to recycle. The paper industry in particular plans to target inks and adhesives using e.g. the 'deinkability scorecard' which allows the identification of the recyclability of printed paper with respect to deinking.

Greenfreeze

As an alternative to hazardous substances in fridges and freezers, 'Greenfreeze' has been introduced by Greenpeace. It is free of ozone-depleting and global warming chemicals and Greenpeace claims it also has economical value.

Information Systems

ICT can also boost recycling within a sector by helping the identification of materials and best recycling processes. In 2008, for example, a source identification system for (recycled) papers (ERPIS) was introduced to allow paper mills to identify the origin of the recovered paper purchased, received, stored and consumed by the paper mills. In the automotive industry, for example, efforts are made for an increased information exchange about efficient treatment of ELV vehicles using the International Dismantling Information System (IDIS) and the International Material Data System (IMDS).

Efforts also focus towards the design for material separability and recyclability rather than disassembly and remanufacturing.

Principles of eco-design focus on improving the recycling process of materials that are known to be difficult to recycle.

TECHNOLOGY – CONCLUSIONS

Manufacturing costs, however, often dominate transport costs per unit sold, and in addition to the focus for low inventory and short lead times, transport occurs to cover large distances at relatively high frequencies in small lot-sizes.

Key product groups that would merit a deeper analysis of best practices are electronic and electrical equipment transport equipment and vehicles, packaged goods (bottled drinks), paper and paper products, and metals.

TECHNOLOGY - CONCLUSIONS

Of the global trade and transport flows that are expected to be important in the future, only a subset make extensive use of transport on roads, rail, or air within Europe. Most of these flows are important from a manufacturing and recycling point of view.

Manufacturing costs, however, often dominate transport costs per unit sold, and in addition to the focus for low inventory and short lead times, transport occurs to cover large distances at relatively high frequencies in small lot-sizes.

Increased use of transfer and cross-docking facilities, vehicle pooling, and load swapping can all bring transport cost and carbon efficiencies, but rebound effects will reduce expected gains.

In addition to greening vehicles and the further exploitation of ICT within and across each of transport modes, transport policies may be needed that make it more expensive in order to partially redress the balance.

In order to establish the links between these three components, the trade-off between transportation and manufacturing needs closer investigation not only within a supply chain, but within industries that can find efficiencies from collaboration, synergy and symbiosis.

In the light of the above findings, key product groups that would merit a deeper analysis of best practices are therefore:

- ***electronic and electrical equipment***
- ***transport equipment and vehicles***,
- ***packaged goods (bottled drinks),***
- ***paper and paper products***, and
- ***metals***.

Jana Ries, Heidrun Rosic, Stefan Treitl, Werner Jammernegg, Patrick Beullens

TRANSPORT SYSTEM – KEY DRIVERS

TRANSPORT SYSTEM

Key Drivers

Activity

It has been repeatedly stressed the need to decouple transport activity from economic growth. However, albeit recent data confirms that passenger transport has slowed its growth compared with GDP growth, freight transport has witnessed an increase rate that has outdone that of GDP.

Even though the impact of the economic crisis on transport demand is visible for the period 2008-10, there are no structural reasons to expect a drastic change in the long term, as the reasons behind this growth remain unchanged (globalisation, reduction of transport costs). Issues such as ageing and capillarity of transport networks will also have a noticeable impact driving the demand for transport activity.

Decarbonisation

Environmental pressure is expected to continue exerting an increasing role in shaping the future of transport. The transport sector is particularly significant as it represents a 19.47% of the total GHG emissions in the EU27 for 2007 (EEA, 2009). This fact is even more striking when considering that transportation throughout Europe is one the worst performing sector overall, with a growth rate of 26% over the period 1990-2007.

Modal split brings a relevant insight into the drivers behind this growth. Road transportation has increased its share over total transport in terms of emissions. Measures such as labelling, introduction of fuel quality regulations and imposed growth of the share of renewable sources, and a possible inclusion of transport in the ETS, will put pressure on road transport.

Even though the impact of the economic crisis on transport demand is visible for the period 2008-10, there are no structural reasons to expect a drastic change in the long term.

Fuel prices

Fossil fuel scarcity will push up prices and increase their volatility. Transport systems will have to adapt by improving efficiency and introducing different engine technologies. Promotion of biofuels and other renewable sources in transport (green electricity) will help smooth the transition, as it is not foreseen that the increase in fuel prices will change modal split in a relevant way. Therefore, there is no drastic assumption on how fuel prices will impact on existing and planned transport infrastructures.

It is not foreseen that the increase in fuel prices will change modal split in a relevant way.

TRANSPORT SYSTEM – KEY DRIVERS

Transport infrastructure in Europe has to incorporate the growing role of external trade partners together with the increasing global role of Europe

Occurrence of extreme weather phenomena is becoming more frequent, which would lead to increased safety margin considerations when designing infrastructures.

Safety

Safety and, more specifically, reduction of fatalities is an important dimension to take into account in any analysis of transport systems. Road modes are most affected by this consideration, which calls for specific measures regarding transport infrastructure (careful design of network sections and improved maintenance, together with evolving regulations on elements such as tunnels).

In the case of rail networks, the increase of interoperability and market opening has been accompanied by and emphatic call to "guarantee a level of safety of at least equal to, if not higher than, that achieved today in the national context".

Air transport has a high safe record and its regulation is foreseen at international level. For maritime transport, directives are enforced for safer loading and unloading of bulk carriers, with safety standards also set at international level.

External dimension of the EU

Transport infrastructure in Europe has to incorporate the growing role of external trade partners together with the increasing global role of Europe. European harbours and airports are the gateway to the largest market in the world and also play a relevant role as links of global trade activity. For example, part of Asian freight flows crossing the Suez Canal could choose to Mediterranean ports over North Sea ones, which would have an impact in other modal infrastructures.

Network dimensioning has to evolve in order to be able to answer the challenge of increasing traffic, considering particularly long-distance and border-crossing traffic volumes.

Adaptation to Climate Change

Although the formulation of this concept in both practical and policy terms is still vague, occurrence of extreme weather phenomena is becoming more frequent, which would lead to increased safety margin considerations when designing infrastructures (entailing higher costs). The rise of sea levels could seriously compromise the operation of harbours and other infrastructures throughout coastal areas.

TRANSPORT SYSTEM – TRENDS

Trends

Co-modality and modal shift

In freight transport, intermodality plays a key role as it smoothes logistics, making a more efficient use of different transport modes and their combination. Former formulations of the concept (as envisaged in the first launch of the Marco Polo programme) aimed at shifting transport from road mode and promoting rail.

However, further reviews of this concept in the light of the importance to underpin sustainable and competitive mobility in Europe have led policy makers to introduce the concept of "co-modality", i.e. "the efficient use of different modes on their own and in combination".

Road is expected to maintain its dominant role in both passenger and freight transport, continuing its growth in the long term at a comparable rate with past trends. Air and rail are expected to grow significantly but would still represent a small part of overall transport activity.

Decreasing load factors

The trends in production and consumption patterns are expected to lead to an increase in the average transport distances and a larger share of unitized /non-bulk goods. This trend is particularly relevant in the case of road and maritime transport.

On the other hand, harmful (from an environmental point of view) and inefficient practices such as empty running in road modes seem to be declining , mainly by the use of ITS and the increasing sophistication of logistics practices, such as reverse logistics. This is relevant as any consideration in terms of GHG emissions per freight volumes is directly affected by assumptions in load factors. Thus, when comparing environmental impacts of different transport modes as regards to infrastructure planning, an informed insight into this issue is fundamental.

Development of core networks

The addressing of transport infrastructure planning at European level poses several challenges that range from the definition of pan-European objectives to the methodological approach to be followed in the strategic planning of the network deployment.

The trends in production and consumption patterns are expected to lead to an increase in the average transport distances and a larger share of unitized /non-bulk goods.

The addressing of transport infrastructure planning at European level poses several challenges that range from the definition of pan-European objectives to the methodological approach to be followed in the strategic planning of the network deployment.

TRANSPORT SYSTEM – TRENDS

The trans-European transport network programme is aimed at co-financing projects that enhance transport infrastructure according to the objectives set by the Common Transport Policy of the Union.

The trans-European transport network programme is aimed at co-financing projects that enhance transport infrastructure according to the objectives set by the Common Transport Policy of the Union. In order to better analyse the scope of the projects to be undertaken, the strategic planning is characterised by a dual layer approach that makes a distinction between the comprehensive network and the core network. The latter comprises an extensive network of links: 95700 km of road links, 106000 km of railway links (32ooo km of which are high-speed), 13000 km of inland waterways, 411 airports and 404 sea ports. They ensure spatial integration and access to transport and have been developed mainly within each Member State responsibility over infrastructure in their territories.

Geographical, economic and cohesive issues are complemented by an approach that actively incorporates intelligent transport system applications and new technologies for demand management and logistics operation.

The core network overlaps with this impressive network, but is envisaged as a means to articulate axes traversing the Member States, strategically chosen to enable long distance and trans-national corridors for both passenger and freight transport. Interconnectivity of the different modes throughout these corridors is actively pursued in the network configuration. Emphasis is given to external and global trade flows, foreseeing the importance of major airports and sea ports, and hinterland connectivity.

Thus, from a modal point of view, seaports will play the most important role, extending their significance by better linkages with final destination points, and also allowing for short sea shipping as a means to alleviate congestion. Rail network might continue deploying, though factors such as improved interoperability and the fact that it has to accommodate traffic flows of significant different nature call for complementary measures beyond mere infrastructure development. Air freight is increasing but volumes are not still significant enough to have an impact on the network. Future rail freight links might accommodate part of this future flows.

Well established considerations when adopting strategic planning for transport networks, such as geographical, economic and cohesive issues are complemented by an approach that actively incorporates intelligent transport system applications and new technologies for demand management and logistics operation. Some transport policy initiatives in this field include the Freight Logistics Action Plan, the proposal for a Directive on Rail Freight Corridors and the Single European Sky.

TRANSPORT SYSTEM – TRENDS

Market opening and interoperability

Market opening is a compulsory step in order to achieve a competitive internal market for transport – efforts are specifically directed towards air and rail transport operation. Whereas the former has experienced a successful liberalisation with new incumbents, the latter is still in need of further advances. As of January 2007, international and domestic freight services were open to liberalisation, after a European directive imposing separation of infrastructure and operations paved the way to restructuring incumbent operators.

The results of such policy measures are not yet fully visible. Liberalisation is difficult to achieve only by means of legislative measures and other factors must be taken into consideration, mainly interoperability considerations (particularly relevant for the cross-border aspirations of rail transport) and cutting red-tape for new entries.

In the case of maritime transport, there is a clear differentiation in the degree of competition between sea and inland waterway transport. Member States remain somewhat reluctant to further developments in this area. Nevertheless, there is an ongoing effort to at least eliminate technical and administrative barriers at European level.

Demand management

There are a myriad of policies and measures aimed at effectively impacting demand for transport – the ultimate driver for transport systems. In the case of passenger transport, the last years have evinced a moderation of demand whereas in the case of freight transport, flows and volumes have increased above GDP growth. As transport demand can only be characterized as a derived demand, identifying factors beyond the most straightforward have proved elusive. Instead, internalisation of costs, that is, making the public aware of social costs incurred by transport activity (including pollution, global warming, noise and use of infrastructures) could be an effective alternative. Any initiative of the sort, though, calls for a common approach at EU level.

Congestion is one of the most pre-eminent issues that arise when addressing demand management. Some initiatives applying pricing schemes have proved successful in the Member States that have applied such measures. However, implementation seems rather unpopular and more over, falls under the subsidiary principle and thus, are exclusive competence of national or local authorities.

Efforts for liberalisation are specifically directed towards air and rail transport operation. Whereas the former has experienced a successful liberalisation with new incumbents, the latter is still in need of further advances.

Freight transport flows and volumes have increased above GDP growth.

TRANSPORT SYSTEM – TRENDS

With regard to emissions in the EU, the routing via the South Range ports is advantageous due to the much shorter total travel distance.

Recent trends point to an increased co-operation between the carriers and the port operators.

Port of Call strategies

Instead of calling several ports in a port range, container ships now only call one or a few main ports. Thus, competition among ports belonging to the single market is increasing. Worth noticing is the strife between north-range ports and Mediterranean ports. Here, a trend towards changes in Europe-Far East trade can be regarded leading to alterations in port of call strategies.

With regard to emissions in the EU, the routing via the South Range ports is advantageous due to the much shorter total travel distance, even though part of the advantage is offset by lower consumption of the larger ships taking the route to North ports. In addition, the hinterland distances are much shorter. But it has to be checked if this changes of the transport chain affects the carbon footprint per unit of the single goods in a positive way. Due to the additional costs of transhipment, the economic incentives for the shipping lines due not coincide with the optimal solution from the ecological point of view, even when fuel costs are high.

Joint operation between carriers and terminals

Recent trends point to an increased co-operation between the carriers and the port operators. One form of cooperation is joint ventures between carriers and terminal operators for terminal operations while the operation of dedicated terminals is the second option. Both forms of cooperation have impacts on carriers' port of call strategies – and consequently also on carbon footprint developments.

Characterization of maritime transport has evolved throughout the last decades and the most relevant aspects include growing short-distance maritime traffic as result of containerization and increasing regional traffic, increasing average ship sizes and generally rising cargo volumes, therefore the increasing pressure on the port capacity.

TRANSPORT SYSTEM – CONCLUSIONS

Conclusions

Transport systems face a global increasing demand that is counterbalanced, particularly in the EU, by pressure on reducing GHG emissions. These conflicting factors shape the trends that we have identified as relevant for this project.

On a global scale, transport systems will continue being articulated by bulk and container transport – in this respect, not only fleet is growing in numbers, but also vessels' sizes are increasing, thus calling for larger ports and more complex operations. The spatial concentration of such activity induces further transport needs in order to reach the final destination, thus inducing increased transport volumes in road and rail networks. Therefore, it is difficult to set a clear link between more efficient sea-born transport and overall reduced emissions.

In Europe, the success of a competitive transport system will depend on a common approach by all Member States, and the definition of a strategy that is able to deliver added value over single-handed projects.

Articulation of truly operative corridors throughout the continent, and interoperability and real intermodality should provide potential for the expansion of this sector in Europe.

Therefore, planning strategy needs to be further defined in a more systematic way – cost-benefit analysis carried out to evaluate prospective priority projects should integrate any consideration, from congestion to environmental impacts. Thus, favouring certain modes of transport over other would be avoided unless proven advantageous in a sound and transparent analysis. Forecasting future transport activity from internal demand plus the growing external trade dimension of the Union is paramount to a well-dimensioned deployment of the network.

Liberalisation of the market together with availability of technological platforms should provide margin enough to better and safest transport, foster new applications and innovative solutions in the field of demand management and logistics operations. This would contribute to a fostering leadership of European transport sector in new and expanding markets at a global scale

Elena Navajas-Cawood

In Europe, the success of a competitive transport system will depend on a common approach by all Member States.

Articulation of truly operative corridors throughout the continent, and interoperability and real intermodality should provide potential for the expansion of this sector in Europe.

EUROPEAN FREIGHT TRANSPORT CARBON FOOTPRINT

The approach is a bottom-up strategy that takes into account detailed data from surveys, fleet composition databases, traffic counts and life-cycle test of vehicle, among others.

… to simulate and analyse the impacts of changes in transport networks, pricing measures, and in logistics and distribution systems.

Methodology

Transport emissions analysis is an ongoing major concern given the pressure on reducing GHG in order to address climate change. However, estimations of emission by such a diffuse sector[1] as transport poses some questions that need to be fully understood and tackled when possible.
In this context, two general approaches are followed in order to quantify emissions originated by transport activities.

The first approach, a purely inventory one, estimates emissions by applying the appropriate conversion factors to fuel consumption in a given country or geographic entity with statistical data. The obvious caveat in this case involves the fact that there is no detailed characterisation of transport activities – differentiation between passenger and freight transport, actual traffic flows or representation of vehicle technologies – which proves determinant for policy formulation.

The second approach is a bottom-up strategy that takes into account detailed data from surveys, fleet composition databases, traffic counts and life-cycle test of vehicle, among others. The estimation of emissions by JRC-IPTS follows the latter strategy, combining modelling of traffic flows after calibration with existing databases with the application of emission factors as derived from test-cycles and corrected by factors derived from analysis of real-life conditions (see more in the Assumptions section).

TRANSTOOLS is a network-based transport model that follows a classical 4-step approach. The model estimates transport demand for each NUTS 3 zone in Europe and distributes it on the networks of the various modes available. In the case of freight, the flows are taken from the ETIS-BASE that contains the freight flows tons for NSTR commodity group. The model then uses a trade module in order to forecast future flows that are accommodated among routes and modes based on the transport capacity and minimal transport costs criteria.

The model was designed specifically as a support tool tailored to the main priorities of EU transport policy. It covers the networks of all main modes in both passenger and freight transport, at NUTS 3 level.

Its features have been selected in order to best simulate and analyse the impacts of three types of measures:

- Changes in transport networks, especially TEN-T
- Pricing measures
- Changes in logistics and distribution systems

[1] Transport as an economic activity is well-defined in statistics and in accounting models such as I-O tables. However, part of goods transportation is carried out by the supplier company belonging to a different category, as it is the main activity that determines the sector to which a company is usually assigned. TRANSTOOLS uses count data and aims at capturing transport activity irrespective of such statistical differentiations.

The model can simulate the impact of changes in costs or the trends that affect demand and estimate the impacts in terms of:

- demand per mode
- traffic on the network links
- transport costs (per origin-destination pair, commodity type, specific corridor and/or link, etc.)
- regional GDP
- welfare

The development process of TRANSTOOLS includes linkages, common development and comparisons with the results of other models and projects addressing transport issues at EU level.

Such models include TREMOVE and PRIMES, as well as ASTRA through the work of the iTREN2030 project (7FP project). In addition, the results and scenarios of ASSESS, TEN-Connect and TRANSVISIONS have been taken into account for the validation of TRANSTOOLS results.

Assumptions

In order to estimate emission from the output by TRANSTOOLS, which is strictly transport activity, the use of results from TREMOVE was required. This model estimates transport demand, traffic flows by category (freight and passenger at the most aggregate level), fleet composition and vehicle stock renewal so it can apply COPERT methodology[2] to calculate emission of air pollutants out of total fuel consumption by the estimated traffic flow.

TREMOVE estimates transport demand, traffic flows, fleet composition and vehicle stock renewal.

COPERT estimates are corrected by contrasting the results with available national statistical data on emissions and fuel consumption by vehicle category. Adjustments are then incorporated to the model or taken into account when analysing results from COPERT. Finally, TREMOVE yields a range of results that allow extracting modelled emission factors after taking into account transport activity and traffic flow characterization. This stylized emission factors by vkm are country-specific (reflecting the different fleet compositions, steepness of surface, etc) for both passenger and freight traffic.

COPERT calculates emission of air pollutants out of total fuel consumption by the estimated traffic flow.

TREMOVE also incorporates recently adopted legislative measures that mainly modify the efficiency of transport and thus modify emission factors. The table on the following two pages summarizes those directives:

[2] For an exhaustive overview of COPERT, refer to the Emission Inventory Guidebook 2009, Road Transport Section.

Mode	Vehicle type	Policy	Period	Area of application / Level
all	all	Directive 2003/30/EC and Directive 2009/28/EC on the promotion of renewable energy	2005-2020	By 2010: 5.75% share of renewable energy in the transport sector. By 2020: Minimum 10% share of renewables in transport in each Member State.
all	All	Fuel quality Directives 98/70/EC 2009/30/EC	2011-2030	Art 4: concerns sulphur content in diesel fuel for non-road mobile machinery, including inland waterway vessels (<1000 mg/kg by 2008; 20 mg/kg by 2011). For rail vehicles, sulphur can be kept at 1000 mg/kg. Art 7a: Life cycle greenhouse gas emissions from fuel to be reduced by suppliers by 10% by 2020: 1. 6% from the use of biofuels and alternative fuels and reductions in flaring and venting at production site. 2. 2% from carbon and storage technologies, electric vehicles 3. 2% in purchase of credits under the Clean Development Mechanism In the reference scenario, the 6% reduction is considered.
Road	HDV and buses	Euro V and Euro VI (Regulation (EC) No 595/2009)	2012-2030	Emission limits set by Euro V and Euro VI regulation
Road	Cars and LDVs	Euro 6 (Regulation (EC) No 715/2007)	2015-2030	NOx, PM emission limits for new cars and LDVs to be met from 2015 onwards
Road	cars	Binding CO2 emission targets for cars (Regulation (EC) No 443/2009)	2009-2030	2015: 135 g CO2/km; 2020 115 g CO2/km 2025-2030: 95 g CO2/km This is to be achieved with vehicle motor technology improvement and additional measures (Low resistance tyres and labelling; low viscosity liquids) -
Road	vans	Binding CO2 emission targets for vans (COM/2009/0593 final)	2009-2030	2012: 181 g CO2/km; 2016: 175 g CO2/km; 2025-2030: 135 g CO2/km
Road	cars, vans and HDVs	Low rolling resistance tyres and low viscosity liquids, tyre labelling	2010-2030	Concerning passenger cars, this measure is one of the additional measures contributing to reaching the binding CO2 emission targets (see measure (8)). It is assumed to result in 10 g CO2/km reduction per new vehicles, achieving the 95 g CO2/km level in 2025.
Road	Cars, vans, buses, HDVs	Directive 2009/33/EC on the Promotion of Clean and Energy Efficient Road Transport Vehicles	2010-2030	Total annual vehicle procurement by public authorities has been estimated to be in the order of 110 000 passenger cars, 110 000 light commercial vehicles, 35 000 lorries and 17 000 buses for the EU. The expected effect is the biggest for buses as the corresponding market share represents one third of total sales (below 1% for cars, around 6% for vans and lorries).
Rail	diesel trains	Emission standards for diesel trains (UIC Stage IIIA)		http://www.dieselnet.com/standards/inter/uic_loco.php

Table 1: Legislative measures and assumptions in the model

Population assumptions follow the 2009 Ageing Report (European Economy, April 2009), though the relative evolution of different demographic groups is not taken into consideration, as TRANSTOOLS lacks of different trip generation rates per age group. Projections on population mainly influence passenger transport demand since they affect the number of trips generated, but it is of relevance to this project as congestion affects the overall trip costs.

Another element that influences the results relates to oil prices. The evolution of the oil price is difficult to predict, especially in view of its recent volatility. Furthermore, it leads to an additional complication regarding its relationship with economic growth and with transport demand. The TRANSTOOLS reference scenario does not examine the impacts of oil prices on GDP (or vice versa), but is limited to simulating –to the extent possible- the impact of oil prices on transport demand.

Neither is the impact of EU transport demand on oil prices examined here, which is expected to be rather limited (i.e. EU oil consumption currently represents about 16% of the world oil demand). An exogenous assumption for the evolution of the oil prices is used, common with the PRIMES reference scenario to 2030. (see table 2)

For the LOGMAN project, the baseline scenario has been adapted by incorporating the economic forecasts for 2005-2030 by PROGNOS, thus ensuring consistency with other areas of the project.

TRANS-TOOLS is a European transport network model covering both passengers and freight, as well as intermodal transport. It combines advanced modelling techniques in transport generation and assignment, economic activity, trade, logistics, regional development and environmental impacts.

$'2008/boe	2005	2010	2015	2020	2025	2030
Oil	59.4	71.9	72.6	88.4	101.6	105.9

Table 2: Oil price projection used in the reference scenario (consistent with PRIMES reference scenario)[3]

[3] The reference price assumptions for EU27 in PRIMES are the result of world energy modelling (PROMETHEUS stochastic world energy model) that derives price trajectories for oil, gas and coal under a conventional wisdom view of the development of the world energy system.

EUROPEAN FREIGHT TRANSPORT CARBON FOOTPRINT

As no long-term effects are foreseen in the analysis, transport activity assumes a growth rate reflecting GDP, trade and population forecasts for 2030.

Results

The use of the TRANSTOOLS model in the LOGMAN project allows not only quantifying the contribution of transport to the overall GHG emissions of Europe, but also incorporating assumptions and results from other partners.
The preliminary results presented here estimate the GHG emissions of freight transport activity in EU-27. The total is expressed in CO_2eq – the bulk of the emissions is of course due to carbon dioxide, with methane (CH_4) and nitrous oxide (NO_2) representing no more than a 2% of total emissions even when their Global Warming Potential (GWP) is taken into account in order to compare all gases.

In Figure 1, the evolution of transport activity for goods is presented. The estimates of tonne-kilometres take into account data available up to 2005, plus estimates of the impact of the economic crisis. However, as no long-term effects are foreseen in the analysis, transport activity assumes a growth rate reflecting GDP, trade and population forecasts for 2030.

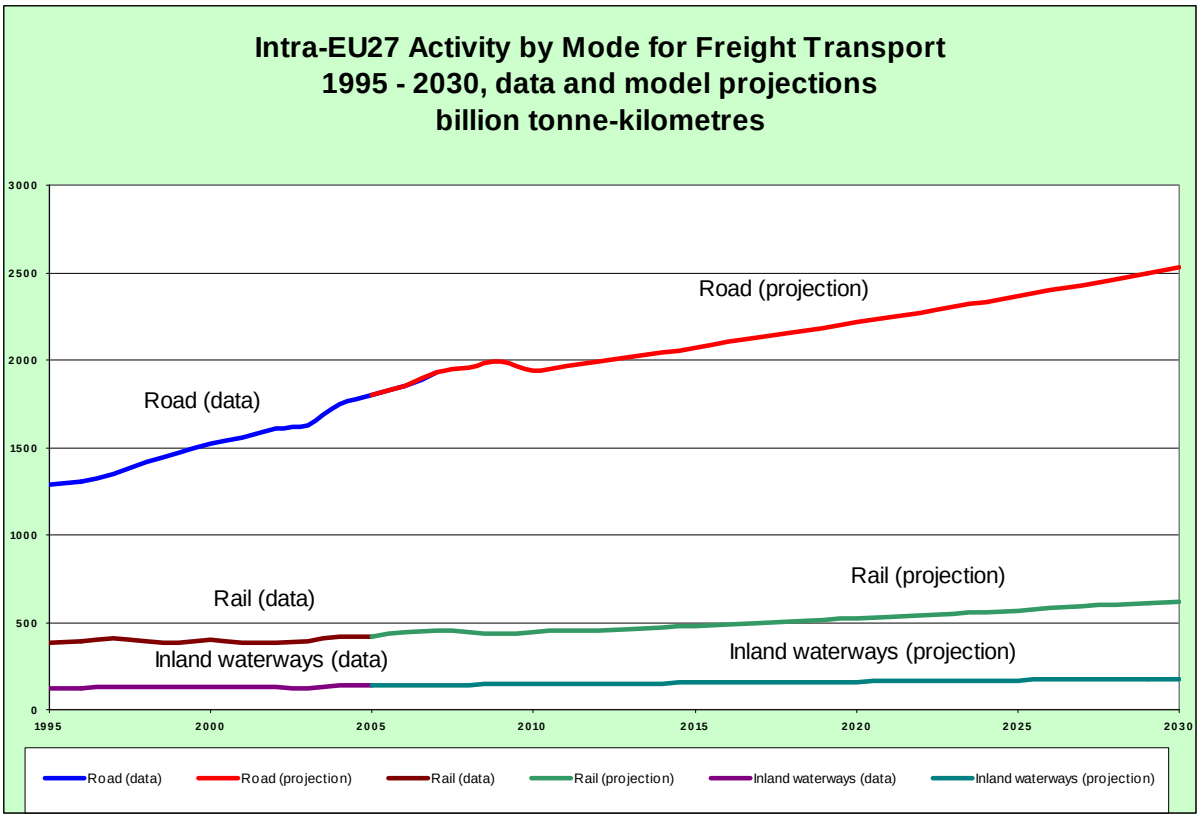

Figure 1: Transport activity (billion tkm) projections by mode

EUROPEAN FREIGHT TRANSPORT CARBON FOOTPRINT

Although several variables influencing the freight transport sector are expected to change gradually during the period 2005-2030, there is no visible disruptive change in the overall trends.

The trends in production and consumption patterns are expected to lead to an increase in the average transport distances and a larger share of unitized /non-bulk goods. Total freight transport volumes are expected to grow by 42%, with road and maritime transport growing at comparable rates. Rail is expected to grow faster (by almost 50%), aided by an expected slower increase in fuel costs and the positive impacts of the opening of the rail markets.

The geographic distribution of transport growth is not uniform. In absolute terms, road transport in EU-15 will attract most of the growth in demand. EU-10 and EU-2 will increase their transport volumes much faster though in relative terms, by 76% and 96% respectively. Growth is expected to be high for all modes in these member states, with road being the one growing faster. Inland waterways traffic, especially in the Danube, is also expected to grow by more than 80%.

The estimation of transport disaggregation by commodity type for 2030 is shown in Figure 2.

Total freight transport volumes are expected to grow by 42%, with road and maritime transport growing at comparable rates. Rail is expected to grow faster (by almost 50%).

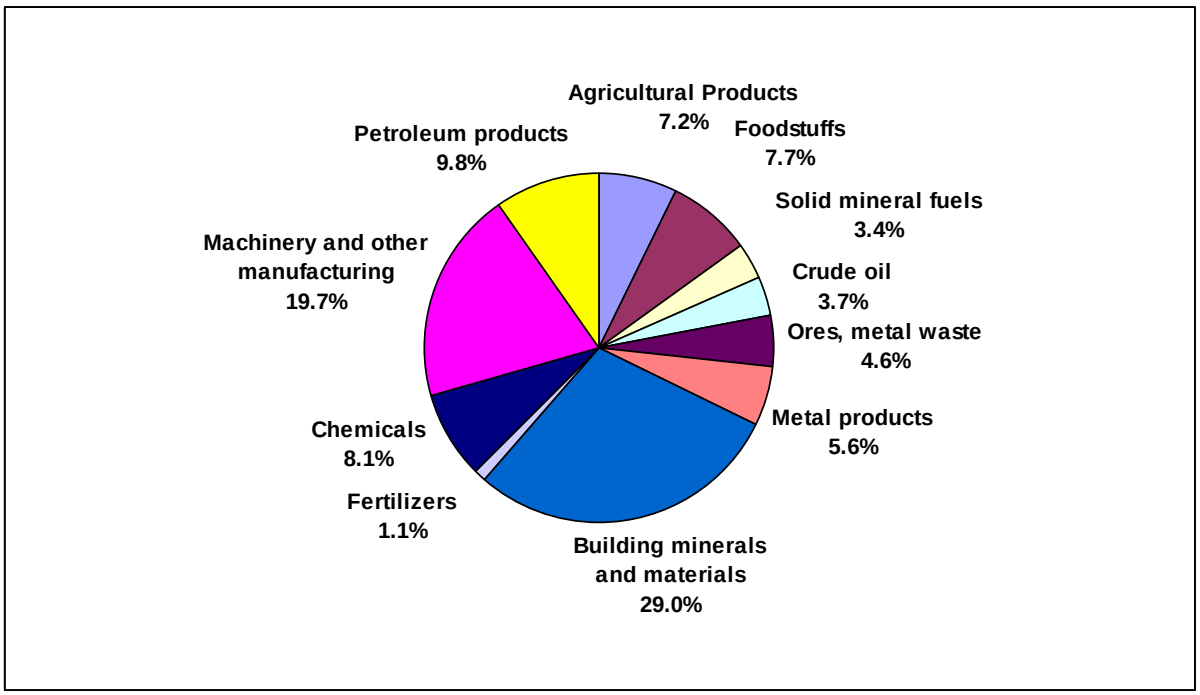

Figure 2: Freight transport activity in 2030, intra-EU27, distribution by commodity type (share of total tkm)

EUROPEAN FREIGHT TRANSPORT CARBON FOOTPRINT

… moderate increase of emissions when compared to total activity growth.

The evolution of transport activity and modal split needs to be completed with estimations of how they reflect in overall emissions, after taking into account efficiency improvements and regulatory changes.
Thus, the result of such analysis is presented in Table 3, comparing emissions in CO_2eq (in mio tonnes) by country for years 2005 and 2030. The result is a remarkably moderate increase of emissions when compared to total activity growth per mode.

Elena Navajas-Cawood

	2005				2030			
Country	**Total**	**RoadFreight**	**RailFreight**	**IWWFreight**	**Total**	**RoadFreight**	**RailFreight**	**IWWFreight**
Austria	1.35	1.03	0.20	0.12	1.47	1.05	0.26	0.15
Belgium	4.60	3.31	0.23	1.06	4.24	2.99	0.21	1.04
Denmark	2.10	2.04	0.06	n.a.	1.88	1.81	0.08	n.a.
Finland	3.36	3.20	0.16	n.a.	3.37	3.14	0.23	n.a.
France	15.03	14.18	0.41	0.45	15.99	14.95	0.56	0.48
Germany	23.57	20.43	1.05	2.08	20.97	17.97	1.03	1.98
Greece	3.24	3.22	0.02	n.a.	3.37	3.33	0.04	n.a.
Ireland	1.83	1.79	0.04	n.a.	3.12	3.05	0.06	n.a.
Italy	16.37	16.25	0.12	n.a.	15.78	15.49	0.29	n.a.
Luxembourg	0.91	0.90	0.01	n.a.	1.21	1.20	0.01	n.a.
Netherlands	11.07	8.11	0.08	2.88	9.70	6.73	0.10	2.87
Portugal	3.69	3.60	0.09	n.a.	4.26	4.13	0.13	n.a.
Spain	23.33	23.09	0.25	n.a.	29.78	29.31	0.47	n.a.
Sweden	3.50	3.32	0.18	n.a.	3.91	3.61	0.30	n.a.
Un. Kingdom	13.10	12.03	1.07	n.a.	15.57	13.88	1.68	n.a.
Cyprus	0.41	0.41	n.a.	n.a.	0.45	0.45	n.a.	n.a.
Czech Republic	3.49	3.33	0.16	n.a.	5.32	4.98	0.34	n.a.
Estonia	1.26	0.98	0.28	n.a.	1.68	1.18	0.50	n.a.
Hungary	2.17	2.00	0.11	0.07	2.42	2.14	0.17	0.10
Latvia	1.90	0.99	0.91	n.a.	1.74	0.98	0.76	n.a.
Lithuania	1.21	1.16	0.05	n.a.	1.32	1.24	0.08	n.a.
Malta	0.07	0.07	n.a.	n.a.	0.07	0.07	n.a.	n.a.
Poland	10.19	9.83	0.34	0.02	16.09	15.20	0.85	0.04
Slovakia	2.17	2.08	0.09	n.a.	2.80	2.61	0.19	n.a.
Slovenia	0.27	0.26	0.01	n.a.	0.31	0.29	0.02	n.a.
Bulgaria	0.92	0.74	0.07	0.12	1.52	1.10	0.11	0.31
Romania	8.60	5.63	0.46	2.50	15.03	10.13	1.26	3.64
EU27	159.72	143.97	6.46	9.30	183.37	163.01	9.74	10.62

Table 3: GHG Emissions for freight transport in CO_2 equ (mio tonnes)

EUROPEAN PRODUCTS LOGISTICS & MANUFACTURING CARBON FOOTPRINT

Methodology

The Carbon footprint measures the amount of greenhouse gases emitted in order to satisfy a given amount of final consumption of a specific good or service or of a basket of goods and services.

Although the term carbon footprint has been coined only few years ago, the measurement of the CO_2 emissions associated to a specific activity of consumption or production has been a field of application of both process based, bottom-up type of analysis, like for instance Life Cycle Analysis (LCA), or of top-down macroeconomic models like Input Output Analysis (IOA).

In both cases, tough with a different scope, i.e. a specific process in the case of the LCA or the entire economy in the case of the IOA, the aim of the carbon footprint practice has been the same.

While LCA is a modelling practice which analyses a specific process or activity at a very detailed level but neglects a large part of the interaction of this process with the rest of the economy, the IOA is a modelling framework which analyses the economic activity at a lower level of detail compared to LCA, but captures all the interactions of the process or activity under study with the rest of the economy.

IOA is based on Input Output Tables (IOT) showing for a specific country the financial transactions between all the economic agents: economic sectors, households, the public sector and the rest of the world economy in terms of imports and exports. IOT is a relevant piece of the national account a country publishes normally on a yearly basis and is used to make a correspondence between final demand for different commodities, which is what is required to the economy to be produced in a year, and the total sectoral output, which is what is actually produced by the economic sectors to satisfy that level of consumption in the same year.

IOT can be extended with what are called environmental satellite accounts to have an environmental pressure indicator linked to the level of activity of a specific sector. With Environmentally Extended IOT (EEIOT) it is possible to have the same type of correspondence as described above between final demand by commodity and associated environmental pressure at a sectoral level.

More than a simple accounting framework, EEIOT is the main data set required for the implementation of an Environmental Input Output (EIO) model. An EIO model is a general equilibrium model of a very stylized form and can be used to quantify the consequences of a change of the household final demand, government consumption or of exports on the output produced by a sector and the associated environmental pressure including direct plus indirect effects.

The Carbon footprint measures the amount of greenhouse gases emitted in order to satisfy a given amount of final consumption of a specific good or service or of a basket of goods and services.

IOT can be extended with what are called environmental satellite accounts to have an environmental pressure indicator linked to the level of activity of a specific sector.

In LOGMAN a set of Input Output Tables for the EU member states have been extended with consistent data about the emissions of green house gases: CO_2, CH_4 and N_2O.

Relevant assumptions are a distinction between the green house gases emitted to produce goods domestically or outside, exogenous energy efficiency improvement and a changing factor input structure at sectoral level.

Direct and indirect environmental pressures include not only the emissions directly associated to the process or economic sector under investigation, but also the indirect emissions linked to the production of the goods and services required as inputs from the main process under study and also the emissions associated to the production of the inputs necessary to produce the goods and services that enter the main process as inputs and so on following the entire supply chain.

In the LOGMAN a set of Input Output Tables for the EU member states have been extended with consistent data about the emissions of green house gases: CO_2, CH_4 and N_2O. The resulting modelling framework has been used to quantify the carbon footprint of the economic forecast delivered by PROGNOS for the years 2005-2030.

Assumptions

An EIO model portrays the economic reality in a very stylized form. The markets are assumed to be perfectly competitive without economies of scales. This implies a linear response of the change in the total output as a consequence of a change in the final demand. In other words, if the final demand for a specific good or service in crease by 10% there is a 10% increase of the total gross output produced by the corresponding sector as well as a 10% increase of the associated environmental pressure, green house gases emissions in this particular case.

Another relevant assumption underlying the model concerns the environmental pressure quantified for the goods produced domestically or imported and so produced elsewhere.

More in detail, a commodity produced in different country is likely to have a different underlying technology, which in turn implies a different associated environmental pressure. This difference is even more pronounced whenever the country from which a good is imported is extra European or a developing country.

A distinction between the green house gases emitted to produce goods domestically or outside the country would be possible if a full multiregional model based on IOT published by Eurostat were available. However, the current state of the art of this particular field of research has at least two on-going research initiatives (Exiopol and WIOD) which have not yet come to the final deliverable of a consistent database. For this reason an ad-hoc adjustment based on the use of external data sources (GTAP-E) will be implemented in order to reflect differences in technologies between domestically produced or imported goods.

Another relevant assumption is about technology development and structural change. So far the model captures only changing shares of domestic and imported intermediate inputs and final demand as effect of structural change. An improved version of the model might include an exogenous energy efficiency improvement and a changing factor input structure at sectoral level.

Results

This last section discusses the results (preliminary) of the carbon footprint analysis conducted for 23 EU Member States[4]. This carbon footprint analysis accounts for three different green house gases, CO_2, CH_4 and N_2O expressed in terms of their Global Warming Potential (GWP).

The first graph (Figure 1) shows an increase of the overall emissions associated to final consumption and export from 2005 to 2030.

The graph also compares the carbon footprint calculated with the 'production based approach' (Carbon Footprint/PB), which includes the emissions occurring domestically, and the 'consumption based approach' (Carbon Footprint/CB), which instead do not include emissions associated with export and includes emissions embodied in imports. The two accounting principles yield results different by 27% on average during the whole period. The difference increases due to increasing imports especially of carbon intensive commodities.

The two accounting principles yield results different by 27% on average during the whole period.

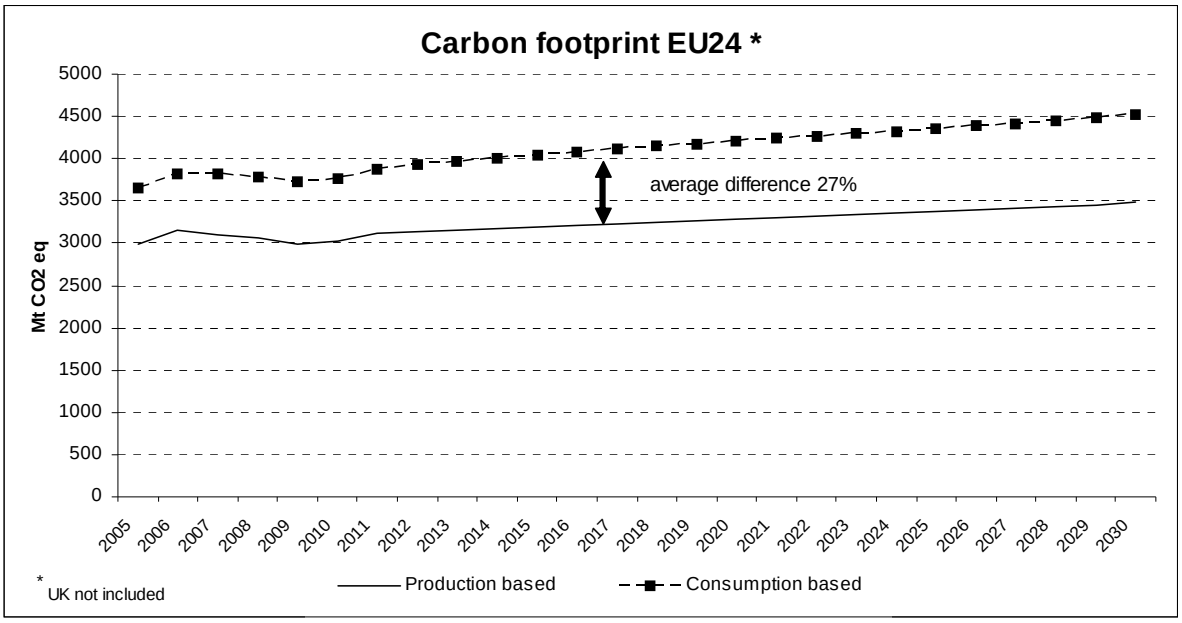

Figure 1: overall carbon footprint for the 23 analysed Member States.

[4] The economic forecast includes the largest EU24 Member States, i.e. EU27 without Cyprus, Malta and Luxemburg. However, these preliminary results do not include UK as its Supply Use tables present data covered by confidentiality. This issue will be anyway solved in the final version of the analysis.

All countries will experience an increase of the overall carbon footprint/CB.

The second graph in Figure 2 shows the percentage increase of the carbon footprint/CB from 2005 to 2030 for the 23 EU Member States.

All countries will experience an increase of the overall carbon footprint/CB, with the largest rates calculated for Romania, Poland, Estonia.

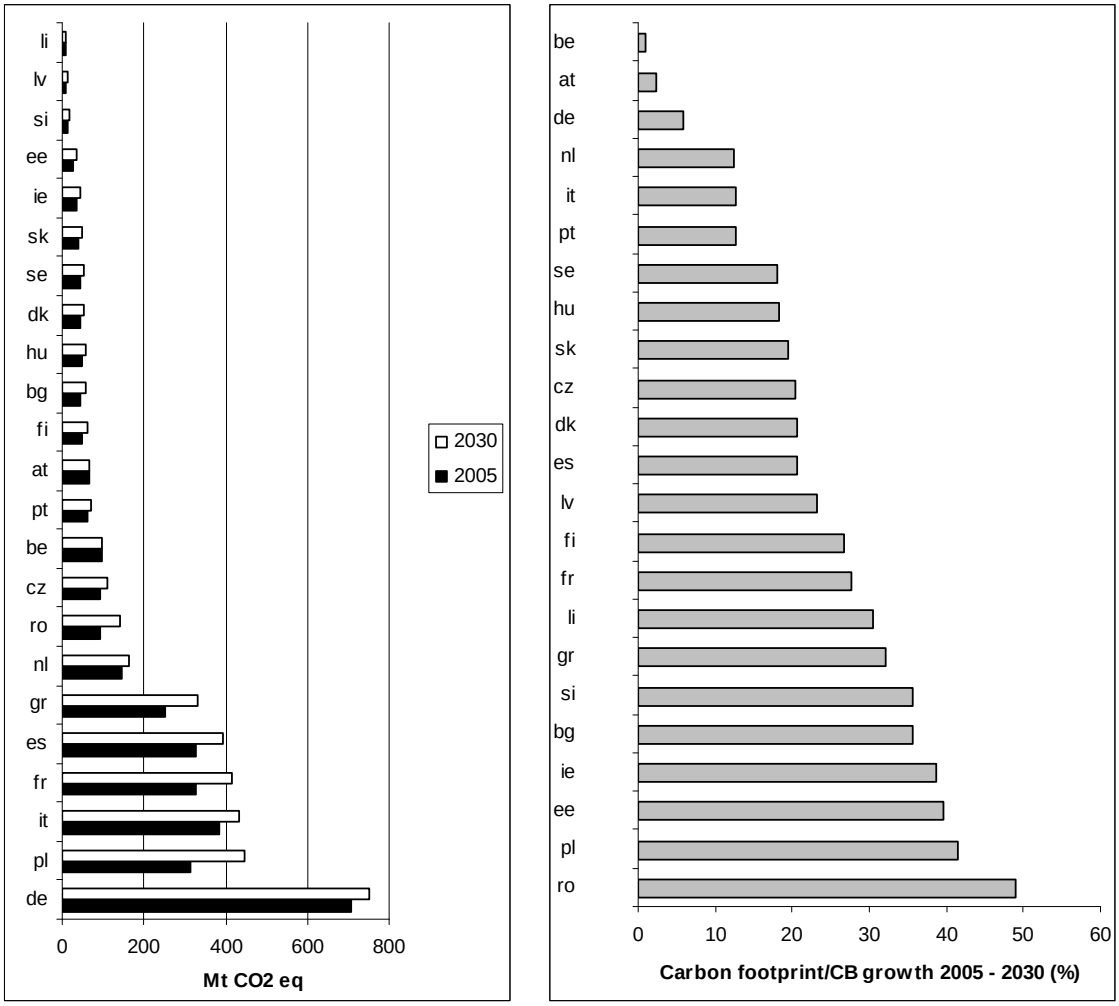

Figure 2: carbon footprint/CB growth between 2005 – 2030 for the analysed 23 Member States

EUROPEAN PRODUCTS LOGISTICS & MANUFACTURING CARBON FOOTPRINT

In Figure 3 the results for the carbon footprint/PB are shown at sectoral level. In this case the carbon footprint/PB is preferred to the carbon footprint/CB, which is the indicator used throughout the analysis, since it better differentiates sectors on the basis of their carbon footprint growth rate.

In Figure 3, the carbon footprint/PB growth rates from 2005 to 2030 for each sector are plotted vs. the total CO_2eq emissions of the same sectors in 2030.

The graph must be read in this way: sectors are singled out based on their total emissions and growth rates 2005-2030. Sectors with both high growth rates, either positive or negative, and large overall emissions are those that will deserve further analysis at micro level.

The sectors which experience high growth rates together with high emissions of CO_2eq are those plotted in the north-east quadrant of the graph. In the north-west quadrant are relevant sectors (in red) which experience large negative growth rates, i.e. a decrease of the CO_2 emissions calculated according to the 'production based principle'.

The sectors that will experience a negative growth rate are those that will most likely undergo a deep restructuring of their supply chain with increasing offshoring.

The decrease depends on increasing import in Europe of some basic materials, i.e. 'Basic metals', 'Chemicals' and 'Pulp and Paper', and manufactured products, i.e. 'Electrical equipments and machinery'.

Ignazio Mongelli

The decrease depends on increasing import in Europe of some basic materials, i.e. 'Basic metals', 'Chemicals' and 'Pulp and Paper', and manufactured products, i.e. 'Electrical equipments and machinery'.

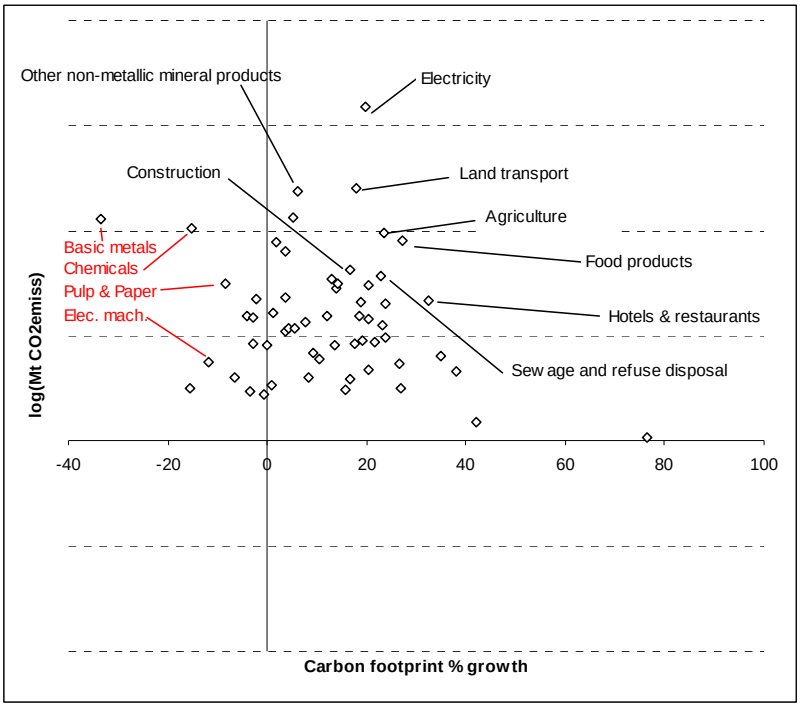

Figure 3: carbon footprint/PB growth differential (%) plotted against the overall CO2eq emissions by sector in 2030.

REFERENCES

- EEA (2008),Greenhouse gas emission trends and projections in Europe, Report No: 5
- EC (2000), Green Paper on Energy Security and Supply
- EEA (2010), Term 2009 Report, Towards a resource-efficient transport system, Report No: 2
- EC (2007), Mid-term Review of Sixth Environmental Action Programme
- EC, 2009 Review of the European Union Strategy for Sustainable Development, COM(2009) 400 final
- EC (2005), Environment Fact Sheet: Nature and Biodiversity
- EEA (2006) Air Quality and Ancillary Benefits of Climate Change Policies. EEA Technical Report 4/2006. Copenhagen: European Environment Agency.
- Worthington B. (2010), Sandbag UK climate Change Campaign Blog, http://www.sandbag.org.uk/node/276
- EEA (2009), Term 2008 Report,Transport at a crossroads, Report No: 3
- EC (2009), Proposal for establishing the second "Marco Polo" programme for the granting of Community financial assistance to improve the environmental performance of the freight transport system (COM(2004) 478 final)
- EC (2009) Directive on Clean Vehicles, (2009/33/EC)
- MNP report 500094008, M. Visser, W.L.M. Smeets, G.P. Geilenkirchen, W.F. Blom, Impacts of the Euro VI heavy duty emission standard for the Netherlands, January 2008

PROJECT PARTNERS

Coordinator:

AustriaTech - Federal Agency for Technological Measures Ltd.

Partners:

European Commission Joint Research Centre

Institute of Shipping Economics and Logistics

Suomen Ympäristökeskus (SYKE)

Transver GmbH

University of Portsmouth

WU Vienna University of Economics and Business

The Chancellors, Masters and Scholars of the University of Oxford

Prognos

ProgTrans AG

logman

Logistics & Manufacturing CO_2 FOOTPRINT

LOGMAN is a project funded by the European Commission – DG Mobility and Transport – in the 7th Framework Programme.

For further information please contact Stephan Helmreich, project coordinator, AustriaTech (helmreich@austriatech.org)
or Frederik Rasmussen, project officer, European Commission (frederik.rasmussen@ec.europa.eu).

www.logman-footprint.eu