EU Transport GHG: Routes to 2050?

EU transport demand: Trends and drivers

Carlo Sessa and Riccardo Enei (ISIS)

25 March 2009 - DRAFT

Partners

AEA CE Delft TNO ISIS milieu

The project is funded by the European Commission's Directorate-General Environment

EU transport demand: Trends and drivers

Carlo Sessa and Riccardo Enei (ISIS)

25 March 2009 - DRAFT

Reviewed by Ian Skinner (AEA)

Suggested citation: Sessa C and Enei R (2009) *IEU transport demand: Trends and drivers* ISIS, paper produced as part of contract ENV.C.3/SER/2008/0053 between European Commission Directorate-General Environment and AEA Technology plc; see www.eutransportghg2050.eu

Contact details

Ian Skinner

AEA
Central House
14 Upper Woburn Place
London UK
WC1H 0JN

T +44 (0)870 190 2817
E EUTransportGHG2050@aeat.co.uk

Ian Hodgson

Clean Air and Transport Unit
Environment Directorate General
European Commission
ENV.C.3 Brussels
Belgium

T +32 (0)2 298 6431
E Ian.Hodgson@ec.europa.eu

Project

www.eutransportghg2050.eu

Partners

www.aeat.co.uk

www.cedelft.nl

www.tno.nl

www.isis-it.com

www.milieu.be

Table of contents

1 Introduction

1.1 Background to project and its objectives

The background of the project "EU Transport GHG: Routes to 2050?" is to serve the Commission's long-term objective for tackling climate change, which entails limiting global warming to 2^{o}C and includes the definition of a strategic target for 2050. As far as transport is concerned, there are various new policy measures that are aimed at controlling emissions from the transport sector, but these measures are not part of a broad strategy or overarching goal. Hence, the key objective of this project is to provide guidance and evidence on the broader policy framework for controlling GHG emissions from the transport sector.

In order to fulfil this objective the project has been structured along 10 Tasks, which can be classified in three parts, according to their overall objectives:

- Part I ('**Review of the available information**') involves Tasks 1 to 4 aiming at collating the relevant data and providing the context for the project (e.g. potential emissions reductions that transport may have to deliver, transport trends and drivers) and an initial analysis of technical and non-technical options and policy measures for reducing GHG emissions from transport.

  Part II ('**In depth assessment and creation of framework for policy making'**) involves Tasks 6 to 8, bringing the work of Part I together to develop a long-term policy framework for reducing transport's GHG emissions. In particular, the following objectives have been identified:

- Part III ('**Ongoing tasks'**) covers Tasks 5, 9 and 10. These tasks mainly concern with dissemination aspects, as the Task 5 (stakeholder engagement, aiming at providing insights into the feasibility of various GHG reduction measures) and Task 9, supporting the discussion with the development of papers. Task 10, project management, will support the effective realization of the work throughout the project lifetime.

1.2 Background and purpose of the paper

This paper, "EU transport demand: Trends and drivers", has been drafted under Part I of the project, Task 3 "Assessment of transport demand trends and drivers". Its main objective is to review EU transport trends and identify and to analyse the main drivers affecting the future transport demand at EU level in a long term prospective (2050).

Transport demand is at the centre of the analysis, therefore it is necessary to specify how the transport demand is taken into account in the analysis. In this paper transport demand has to be considered under the following point of view:

- Quantitative: how much travel, trips, mobility (in passenger km and tons km) is going to be affected by the evolution of transport drivers;
- Qualitative: how transport demand will be met, i.e. through which transport modes
- Geographical: where the transport demand will take place; in particular the long/short average distance and the likely geographical area (e.g. urban, regional, wide European scale) of the future transport demand will be considered

In the context of this study, there are other two important aspects or sub tasks directly addressed by this paper:

1. To provide insights on the possible evolution of the main drivers influencing the future transport demand, which is an important component of the scenarios for greenhouse gas emissions reduction to be developed under the Task 2 of the project

2. To facilitate the identification of the potential transport policy measures addressing the GHG emissions from transport, which is the objective of the Task 4 of the study (Development of a range of measures for reducing emissions from the transport sector)

More specifically, concerning the former aspect, it should be stressed that the identification and the assessment of the future trends of the key transport drivers can be considered the necessary preliminary analysis for setting transport scenarios. In fact, to shape transport scenarios, supported by modelling exercises, or to devise transport visions, using qualitative "storytelling", narrative approaches, mainly consists in combining appropriately and according to specific assumptions the supposed drivers for transport changes. Hence, the identification and the analysis of transport drivers considered "in isolation", i.e. before their combination in scenarios, represents the building blocks that make possible the construction of complex scenarios. At this stage of the project, one of the results of this task is also to foresee which developments are likely to happen in the transport system in the absence of a targeted long term GHG policy.

Concerning the latter aspect, i.e. the input to the policy analysis, it should be stressed that the identification of the most important drivers acting on transport mobility and GHG emissions, represents in itself an indication of promising areas for policy interventions, to the extent that the targeted policies should address those transport drivers for which the impacts in terms of GHG emissions are considered to be more significant.

In general, it is important to stress that this paper only represents the first step toward the fulfilments of the Task 3 objectives. In particular, the consultation with stakeholders, further research inspired by new literature sources, new evidence, etc, will represent the necessary input for the completion of the work.

1.3 Overview of the paper

The structure of this paper is the following:

- Chapter 2 indicates the sources used for the review of transport demand trends. They are basically those that were reviewed as part of the TRANSvisions study, developed as a service contract for the EC DG TREN, supplemented with additional reports, e.g. EEA technical report on managing the external drivers of transport demand (EEA, 2008) and the ITF Preliminary report on Greenhouse Gas Reduction Strategies in the Transport Sector (ITF/OECD, 2008).

- Chapter 3 provides an overview of past and future transport demand patterns by transport mode, distance and destination

- Chapter 4 reviews the transport drivers. There are 10 drivers reviewed (population ageing, migration, urbanization, energy prices, GDP growth, globalization, development of ICT, impacts of new infrastructures, tourism and lifestyle changes), selected from a wide range of 31 potential transport drivers as the most promising in terms of impacts on transport demand. Policy drivers, as the EU cohesion policy, etc, have been deliberately excluded at this stage of the analysis. For each driver, the review provides a brief introduction about the driver characteristics and its likely future trends (the time horizon of the analysis is 2050).

- Chapter 5 is the final chapter in which the impacts on transport demand for each driver are summarised in terms of: a) the type of transport domain addressed (passenger or freight); b) the GHG relevance c) the geographical area of interest (urban area, regional, wide European scale, etc). The related uncertainties have been indicated as well.

2 Review of existing information

The analysis of transport drivers has a good background of research; from the International ECMT Seminar "Managing the Fundamental Drivers of Transport Demand" (ECMT, 2002) to the recent EEA Technical report (EEA, 2008).

However, the main source of the analysis, which in itself includes an extensive literature review on transport drivers and scenarios (see the Annex 1 for the complete list) is the literature reviewed as part of the TRANSvision study (2009)

The study, developed as a service contract for the EC DG TREN, aims at providing technical support to a debate on transport scenarios with a 20 and 40 year horizon through, *inter alia*:

- collecting and analysing information on transport long-term scenario forecasting,
- developing long-term transport scenarios including modelling work and case studies,
- suggesting long-term objectives for the European transport policies.

Relevant to the present study on the routes to 2050 for reducing EU GHG emissions from transport is that a comprehensive analysis of the drivers related to transport has been carried out in the study.

The methodological approach distinguishes between external and internal transport drivers; namely:

- the external drivers are those driving forces which act on the transport system from the outside: energy, economy, demographic change, technological change, social change.
- the internal and impact drivers are those driving forces which originate in the transport sector or as a consequence of the transport impacts on the environment and technological development, as new type of infrastructure, vehicles and fuels

Another category of drivers considered in the TRANSvision study is policy drivers, that is broad policy responses, including the EC transport policy, which affect the evolution of the transport system, and in particular the governance of the transport sector. However, in the context of this study, this category of transport drivers plays a minor role; given that one of the objectives of the analysis is to inform policy makers on transport future trends in order to set appropriate policies.

Furthermore, it is important to mention that in the context of the TRANSvisions study, the drivers identified and analysed in their likely long-term developments have been discussed in a Workshop held on 9th July 2008 in Brussels in the presence of a panel of transport experts and stakeholders. The workshop was held after a DELPHI survey on transport drivers and scenarios has been done by means of a questionnaire shared on-line by the internal and external experts.

The results of the DELPHI[1] can provide useful input to the discussion. For example, the experts were asked to indicate which was respectively the first, second and third more relevant transport driver among those listed in the questionnaire[2]. Considering the aggregate score – i.e. the total number of first, second or third ranking positions received by each driver – we gathered the following priority list:

1. Energy, and in particular the evolution of energy prices

2. Economy, and in particular the evolution of globalization and trade patterns

3. Infrastructure and technologies, and in particular the building of new transport infrastructure in Europe and the evolution of fuel and vehicle technologies

[1] Available on line at http://www.isis-it.net/survey4/Login.asp; Username and Password: guest
[2] 39 indicators representative of the following five key transport drivers have been considered: society, economy, energy, technology, and environment

4. Demography, and in particular the impact of ageing trends and the related structure of working/retired population; urbanization is also considered an important trend

5. Climate changes, their impacts and the related mitigation/adaptation policies

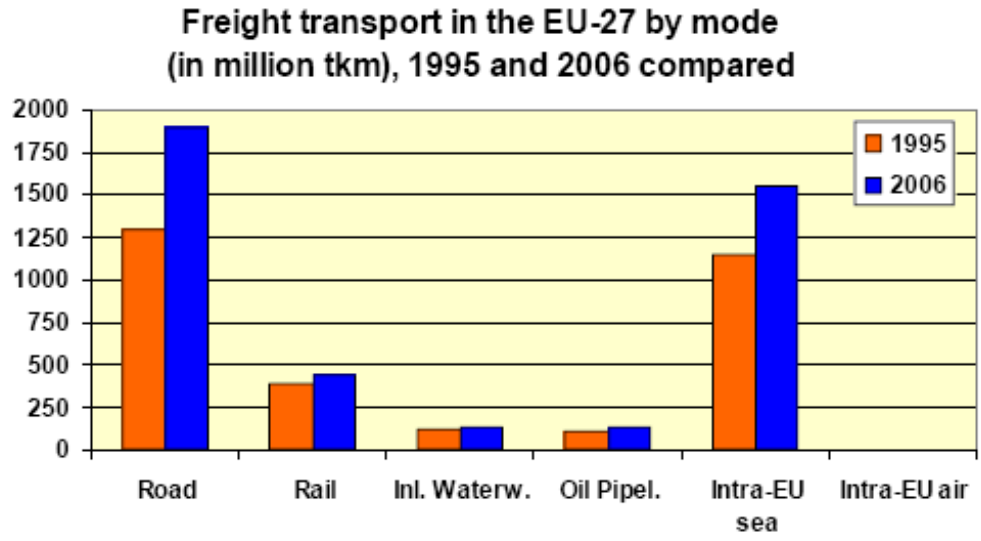
6. Innovation, i.e. the diffusion in society of new ICT or other frontier technologies (e.g. nanotechnologies)

7. Society, and in particular change of working/leisure time regimes and consumption lifestyle

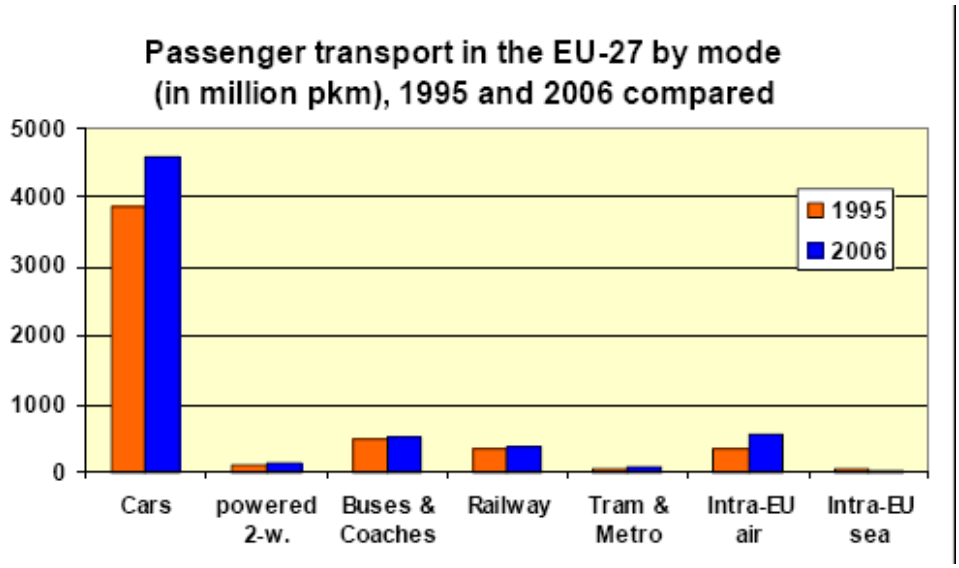
For particular indicators, the experts have also been asked to indicate their evolution at 2050 with reference to a BAU (Business as Usual) projection taken from statistics and research projects. Their views have been included, when appropriate, in the chapter 4 describing the trends in transport drivers.

3 Review of EU transport demand trends

The graphs below show the past trends in EU 27 transport demand from 1995 to 2006. The transport demand is measured in terms of activity, i.e. passenger kilometres for passenger transport and tonnes kilometre for freight transport, by transport mode and with reference to the intra EU- 27 movements.



Source: DG TREN (2008)



Source: DG TREN (2008)

The graphs show the following trends:

- Concerning freight transport, road and rail account for the higher shares of growth; respectively by 44% and 14% in terms of tkm;

- Concerning passenger transport, car and air transport modes have shown the higher growth rates, respectively by 20% and 25% in terms of pkm.

About 98% of trips are on 'short' distance (not longer than 100 km), However, in terms of pkm the remaining 2.5% of trips account however for more than half (53%) of all pkm.

	Billion pkm per year				Billion trips per year			
Mode	<100km	%	>100km	%	<100km	%	>100km	%
Air	0.0	0.0	560.0	100.0	0.0	0.0	0.5	100.0
Bus/Coach	249.0	37.6	412.8	62.4	35.4	95.4	1.7	4.6
Car driver	1443.4	59.4	987.1	40.6	235.8	98.1	4.6	1.9
Car passenger	809.6	53.8	694.8	46.2	134.7	97.9	2.8	2.1
Rail	64.8	22.5	223.9	77.5	5.4	85.2	0.9	14.8
Total	2566.8	47.1	2878.6	52.9	411.3	97.5	10.6	2.5

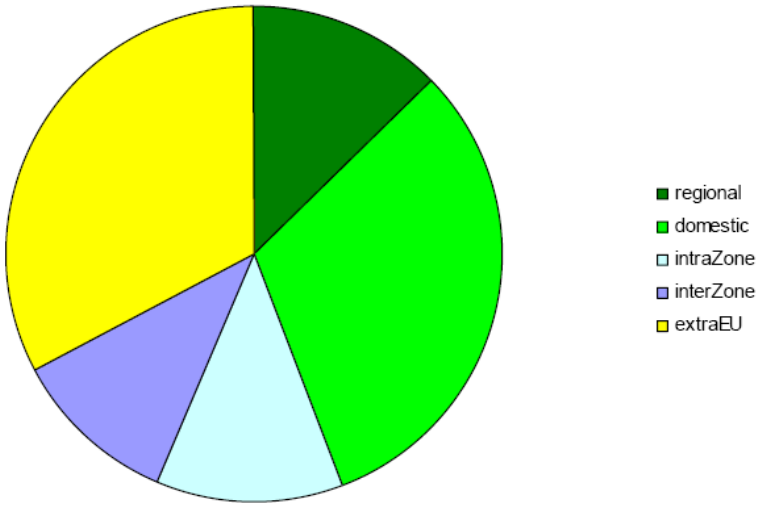
Source: TRANSTOOLS, from the DG TREN paper "The future of transport" (2009)

Concerning the regional distribution, the TRANSvisions study (2009) on the basis of the TRANS-TOOLS model has classified the transport activity (2005 and 2030) in the following categories:

- Regional: intra EU 27 NUTS2 trips
- Domestic: rest of trips with origin and destination inside the same country
- IntraZone: trips with origin and destination inside the same macrozone: South (Portugal, Italy, Greece, Spain), North - Centre (rest of EU - 15), East (rest of EU - 27)
- InterZone: trips with origin and destination in different macrozones
- ExtraEU: trips with origin or destination outside EU - 27, in one of the neighbouring countries

The following graph shows the freight traffic distribution (only inland modes) at 2005.

2005 Freight Ton-km geographic distribution according to distance of trip (only inland traffic included)

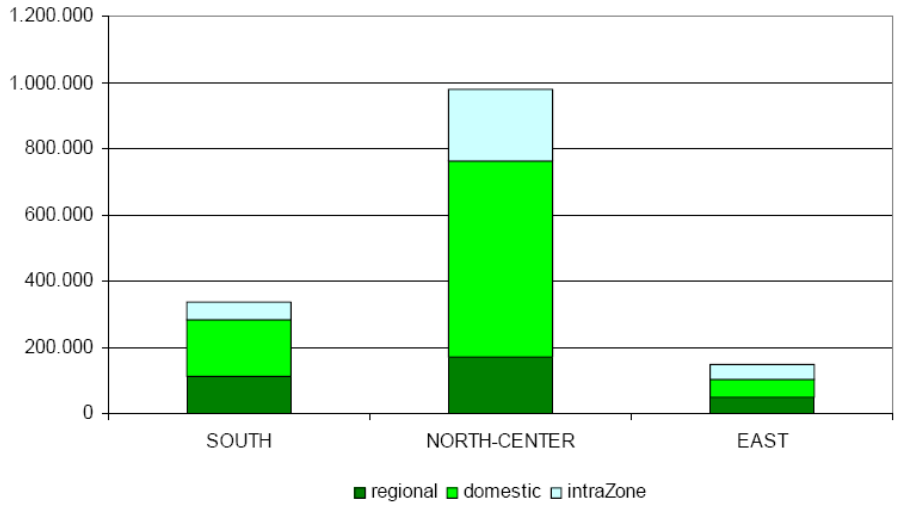


Source: TRANSvisions (2009)

It can be observed that domestic and regional traffic account for the highest shares of traffic distribution.

In particular, the short and mid-distance trips concerning the EU 15 zone are the most significant, both in terms of domestic, intra zone and regional movements (M tonkm).

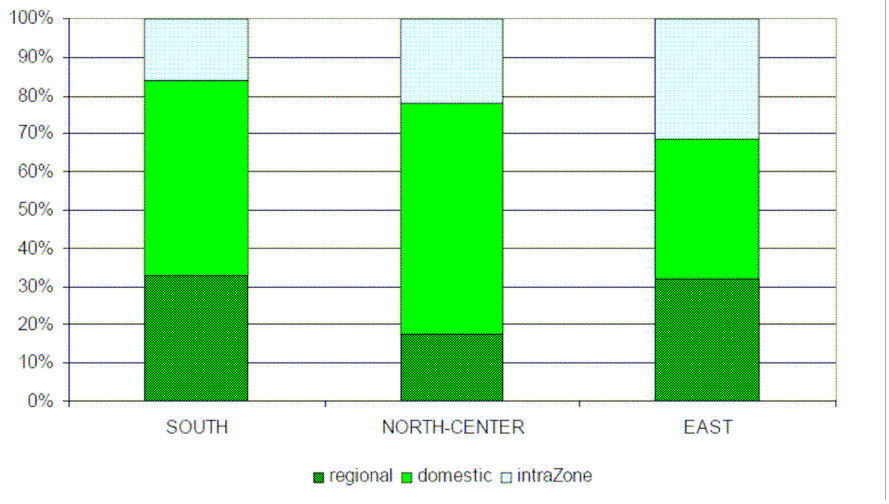
2005 Freight Ton-km volume of short and mid-distance trips according to European Macrozone (only inland traffic included)



Source: TRANSvisions (2009)

The shares of short and mid distance freight trips show that the East zone accounts for the highest share of intra zone traffic (about 30%) and the lowest share of domestic trips (about 30%)

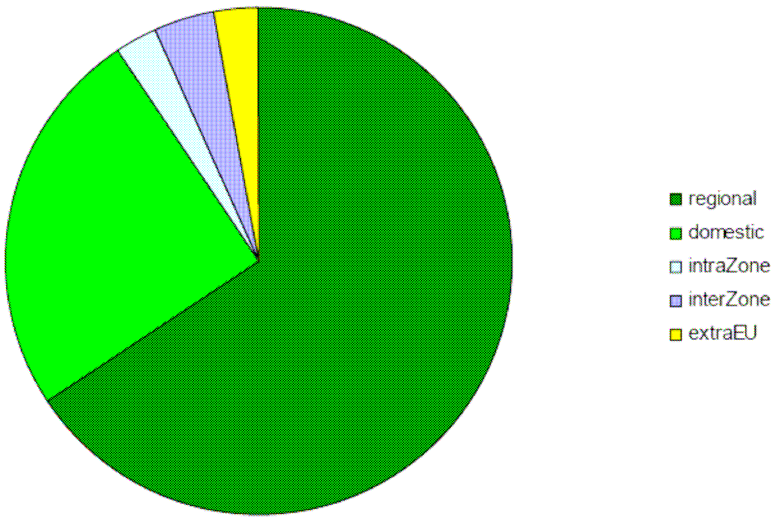
2005 Freight Ton-km distribution of short and mid-distance trips according to European Macrozone (only inland traffic included)



Source: TRANSvisions (2009)

Concerning passenger traffic, the following shows the trips distribution at 2005. All modes are included, except air traffic to overseas (only neighbouring countries are considered).

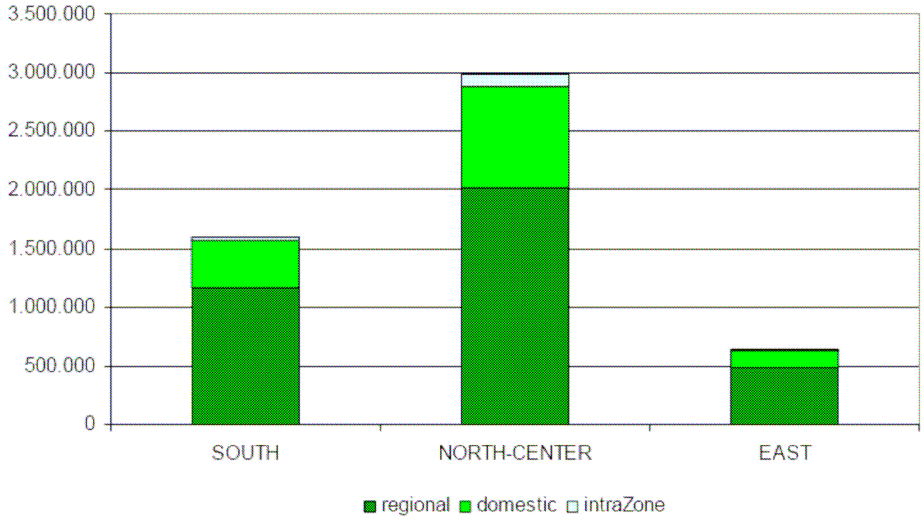
Passenger-km geographic distribution according to distance of trip (all modes included)



Source: TRANSvisions (2009)

The graph shows that regional and domestic trips account for the higher shares, in particular in the EU 15 zone, as shown below (M pkm):

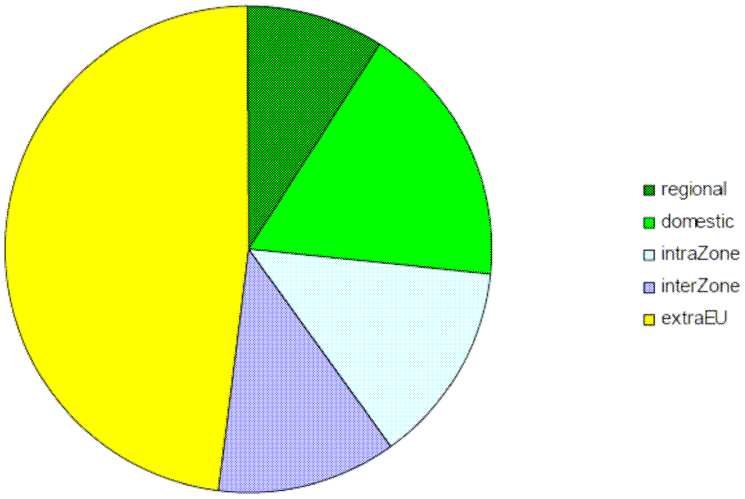
Passenger-km volume of short and mid-distance trips according to European Macrozone (all modes included)



Source: TRANSvisions (2009)

It may be interesting to show how the future transport demand may evolve according to the TRANS-TOOLS baseline projections to 2030 (see Annex III for details).

2030 Baseline Freight Ton-km geographic distribution according to distance of trip (only inland traffic included)

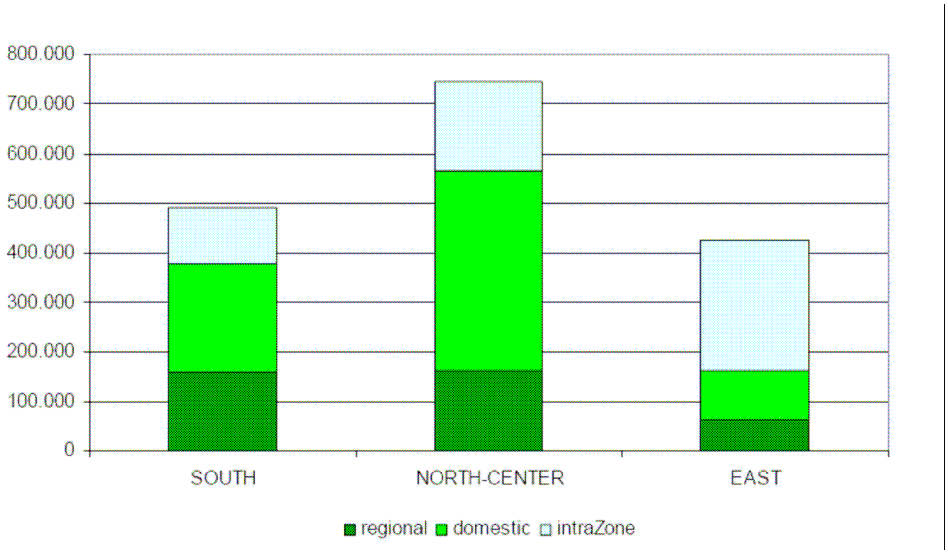


Source: TRANSvisions (2009)

The freight trip distribution at 2030 (only inland modes) shows an increasing share of extra EU trips, with a corresponding decrease of domestic and regional trips.

The short and mid-distance trips will shows a significant grow compared to the 2005 level in the east zone, in particular the intra zone trips, due to the consolidation of the internal market.

2030 Baseline Freight Ton-km volume of short and mid-distance trips according to European Macrozone (only inland traffic included)



Source: TRANSvisions (2009)

The same can be said for the passenger traffic, for which the Intra zone variation in the East zone in terms of pkm between 2005 and 2030 (baseline) will be the highest, as shown in the graph below.

Passenger-km 2005-2030 Baseline variation according length of trip

Source: TRANSvisions (2009)

Summing up, the future trends in transport demand can be summarised as follows:

- The average passenger trip will become longer, to the extent that more intra European trips and relatively less regional and domestic trips will be made. Trips increase 1% annual in the baseline scenario up to 2030, while passenger-km increase 1.9% in the same period. Passenger-km of trips with neighbouring countries might grow at 6% annual, increasing the share of total passenger-km in EU27 from 3% to 9%.

- Passenger traffic will grow following the travel time and budget constraint (approximately 15% of personal available income allocated in transport, in average). While daily commuting trips may remain stable, business, personal visits or leisure trips abroad will grow faster.

- There are no major changes in the relation between trips and trip-km for road passenger traffic, meaning that trips do not become significantly longer or shorter in the future.

- Freight trips will likely become longer as the share of intra European and extraEU27 increase against regional and domestic movements. Economic integration of Eastern European countries and the globalisation process (increase on imports and exports for overseas) may act as causal factors

- In central and northern regions, domestic freight traffic will remain stable, decoupled from the economic growth, while traffics originated or having a destination outside EU27 grow faster than the economy.

- Eastern countries will have the biggest increase of freight transport (4.3% ton-km per year), compared to the South (1.6% per year) and the North-Centre (-0.3% per year)

4 Review of transport drivers

The drivers influencing transport demand (indicated in round brackets) have been classified in the following 5 broad categories:

1. Population (Ageing, Migration, Urbanization patterns)
2. Energy (Fuel price)
3. Economy (GDP growth, Globalization)
4. Technology (ICT, new infrastructures)
5. Social (tourism, lifestyle changes)

These drivers have been selected after the outcome of the TRANSvisions DELPHI survey has been made available, from a larger list of 31 potential drivers (see Annex 2 for this list).

The selected drivers are also consistent with the recent EEA survey on transport demand drivers (EEA, 2008), which has identified the following drivers: socio-demographic changes, economic growth and globalisation, physical changes to urban form/land use, organisational changes at workplaces and schools, socio-cultural changes and technological developments.

4.1 Impacts of ageing

Globally, the process of population ageing is seen as a result of two factors; fertility decline and increase of life expectancy. In fact, the primary consequence of fertility decline, especially if combined with increases in life expectancy, is **population ageing**, whereby the share of older persons in a population grows relative to that of younger persons.

Indeed, global **life expectancy** at birth, which is estimated to have risen from 47 years in 1950-1955 to 65 years in 2000-2005, is expected to keep on rising to 75 years in 2045-2050. In the more developed regions, the projected increase is from 76 years today to 82 years by mid-century. Among the least developed countries, where life expectancy today is 51 years, it is expected to be 67 years in 2045-2050.

As a consequence, globally the number of persons aged 60 years or over is expected almost to triple, increasing from 672 million in 2005 to nearly 1.9 billion by 2050. An even more marked increase is expected in the number of the oldest-old (persons aged 80 years or over): from 86 million in 2005 to 394 million in 2050. In developed countries, 20% of today's population is aged 60 years or over and by 2050 that proportion is projected to be 32%. The elderly population in developed countries has already surpassed the number of children (persons aged 0-14) and by 2050 there will be 2 elderly persons for every child. In the developing world, the proportion of population aged 60 or over is expected to rise from 8% in 2005 to close to 20% by 2050. The figure below shows a growing proportion of older people in all the regions of the globe, with a more accentuated increase in Europe:

	Percentage distribution in 2005				Percentage distribution in 2050			
Major area	*0-14*	*15-59*	*60+*	*80+*	*0-14*	*15-59*	*60+*	*80+*
World	28.3	61.4	10.3	1.3	19.8	58.3	21.8	4.4
More developed regions	17.0	62.9	20.1	3.7	15.2	52.2	32.6	9.4
Less developed regions	30.9	61.0	8.1	0.8	20.6	59.3	20.1	3.6
Least developed countries	41.5	53.4	5.1	0.4	28.2	61.5	10.3	1.1
Other less developed countries	29.1	62.3	8.6	0.9	18.4	58.7	22.9	4.3
Africa	41.4	53.4	5.2	0.4	28.0	61.7	10.4	1.1
Asia	28.0	62.7	9.2	1.0	18.0	58.3	23.7	4.5
Europe	15.9	63.5	20.6	3.5	14.6	50.9	34.5	9.6
Latin America and the Caribbean	29.8	61.2	9.0	1.2	18.0	57.8	24.3	5.2
Northern America	20.5	62.7	16.7	3.5	17.1	55.6	27.3	7.8
Oceania	24.9	61.0	14.1	2.6	18.4	56.9	24.8	6.8

Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat (2007). *World Population Prospects: The 2006 Revision. Highlights.* New York: United Nations.

Aggregate figures showing the population ageing in the EU-15, new Member States (NMS) and the (then) EU-25 as a whole, according to the low fertility, medium fertility and high fertility variants, are presented in the following table:

		2005			2050		
		0-14	**15-64**	**65+**	**0-14**	**15-64**	**65+**
EU-15	Low Variant	0.16	0.67	0.17	0.11	0.56	0.33
	Medium Variant	0.16	0.67	0.17	0.15	0.56	0.29
	High Variant	0.16	0.67	0.17	0.19	0.56	0.25
NMS	Low Variant	0.16	0.70	0.14	0.08	0.56	0.35
	Medium Variant	0.16	0.70	0.14	0.13	0.57	0.30
	High Variant	0.16	0.70	0.14	0.19	0.56	0.25
EU-25	Low Variant	0.16	0.67	0.17	0.10	0.56	0.33
	Medium Variant	0.16	0.67	0.17	0.15	0.56	0.29
	High Variant	0.16	0.67	0.17	0.19	0.56	0.25

Source: World Population Prospect. 2004 Revision

In 2050, Europe will represent the world's major area with the highest share of older persons (more than 65 years old) in its population. By 2050 the elderly people will increase in all the assumed scenarios: in particular, in the *Medium Variant* scenario the percentage of older people on the total EU-25 population will pass from 17% in 2005 to 29% in 2050, whereas in the *Low Variant* scenario it will reach the higher level (+33%).

The ageing trend will be reinforced by the expected improvements in health services and technologies. Gene therapy will help eradicate inherited diseases, enormous advances in science and medicine will bring vigorous health at 80 and 90 years of age.

In terms of the likely impacts on transport demand, the following factors should be taken into account:

- Despite the fact that above a certain age, people tend to travel less than when they were younger, it can be expected that the future old people will travel more than previous generations of older people did. Increase of life expectancy, social attitudes (old people

today generally travel more than the same age group used to), better health condition, etc, may lead towards an increase of mobility

- On the other hand, the demographic trend, reducing the supply of labour and skills, may reduce the demand for work and business trips. However, apart from the consideration of net migration flows (see the next driver), this may be offset by the increase of the **retirement age** that is expected to be postponed – perhaps of another 5 or 10 years - thus we can expect ageing to generate a higher transport demand for daily passenger transport of the growing segment of older workers.

- It should be considered that in the future older people will compose a larger share of the driving population than in the past. Older people will wish to retain their driving licence as long as possible and therefore licence holding among older people will reflect licence holding among younger and middle aged people now.

- Besides **car ownership** and driving habits, the ageing of society will also affect the transport system through its impacts on the structure and **patterns of leisure activities**. Nowadays older cohorts are more interested in travelling in their leisure time. In view of the current ageing trends, this will result in the future in an increase of demand for collective forms of transport by road and air. Public transport is in fact mostly seen as a substitute for walking and cycling, but not for car journeys.

In conclusion, population ageing may originate in a long term perspective, more medium-long distance trips by car/air and more short (urban) distance trips by public transport

4.2 Impacts of migration

Concerning migration flows, during the period 2005-2050, the net number of international migrants to more developed regions is projected to be 98 million or an average of 2.2 million annually. The same number will leave the less developed regions. For the developed world, such a level of net migration will largely offset the expected excess of deaths over births during 2005-2050, which amounts to a loss of 73 million people.

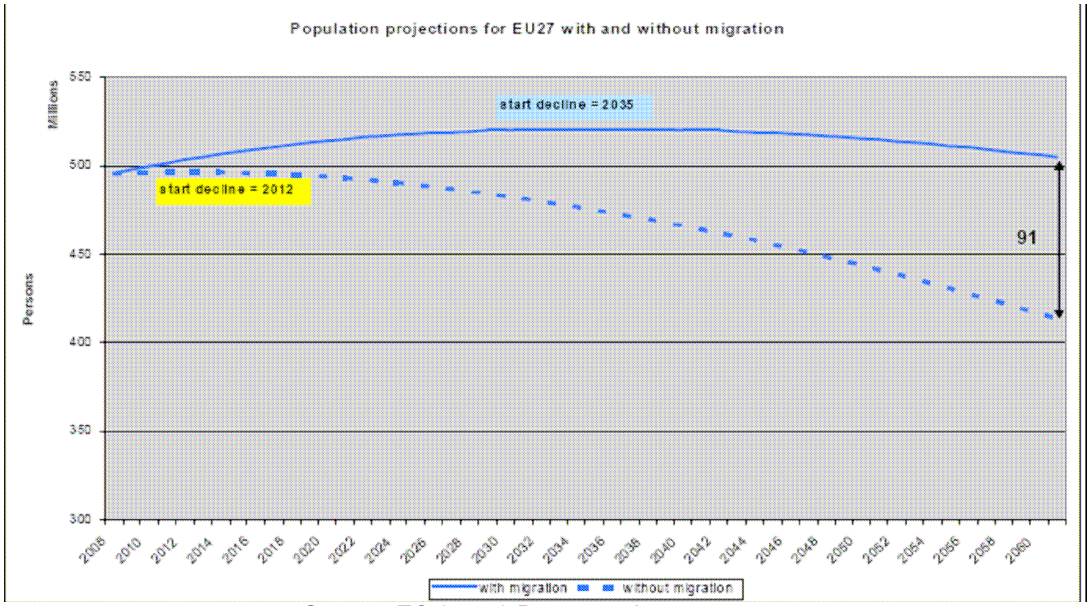
For the developing world, the 98 million migrants represent less than 4% of expected population growth. In terms of annual averages for the period 2005-2050, the major net receivers of international migrants are projected to be the United States (1.1 million annually), Germany (202.000), Canada (200.000), the United Kingdom (130.000), Italy (120.000) and Australia (100.000). The major countries of net emigration are projected to be China (-327.000 annually), Mexico (-293.000), India (-241.000), the Philippines (-180.000), Indonesia (-164.000), Pakistan (-154.000) and the Ukraine (-100.000).

The aggregate yearly average of net migration over the period 2005-2050 for the EU-15, New Member States and the EU-25 as a whole is presented in the table below:

	EU-15	NMS	EU-25
Scenario	808	45	853

Source: World Population Prospects, 2004 Revision

Over the next decades, Europe is expected to be one of the primary recipients of **international migration patterns**, with a net migration projected to be more than 800 thousands of persons per year. EU-15 represents the major receiving area; in particular Germany, Italy and United Kingdom are foreseen to absorb the greater share of migrations by 2050. On the contrary several NMS such as Estonia, Lithuania, Latvia and Poland, are expected to have a negative average net migration.



Source: EC (2008) Demography report 2008

The experts' evaluations provided in the TRANSvisions DELPHI survey indicate that at 2050 the impact of net immigration will exert an upward pressure on the total EU population. In fact, 94% of the answers consider the future net immigration of more than 20% higher than the BAU trends (from the Ageing Working Group of the EU Economic Policy Committee). This will imply higher EU population (61% of the answers consider the future EU population of more than 20% higher than the BAU trends) and, it may be guessed, younger than the BAU forecasts (72% of the respondents consider the share of people > 65 years living in Europe in the future to be more than 10% lower than the BAU trends).

Migration alone will not ensure a long-term growth in the EU population; in fact, as shown in the above graph, without immigration the Europe's population would start shrinking from 2012. The forecast trend in immigration would delay the decline by 23 years, postponing the starting shrinking period in 2035.

The impacts in terms of transport demand may be higher short distance trips in urban areas by car and public transport, given that in general migrants tend to be young, with higher fertility rates, living in urban areas (particularly suburban areas).

4.3 Impacts of urbanization

In Europe the proportion of the population residing in urban areas is expected to increase from 72% in 2005 to 78% in 2030. The aggregate percentage of population residing in urban areas of EU-15, New Member States and EU-25 as a whole is presented in the following table:

	2005	2010	2015	2020	2025	2030
EU-15	73.8%	74.8%	76.0%	77.3%	78.7%	80.2%
NMS	63.0%	63.6%	64.4%	65.5%	66.8%	68.1%
EU-25	72.1%	73.0%	74.1%	75.4%	76.9%	78.4%

Source: World Urbanization Prospect, the 2005 Revision

This trend is expected to continue to 2050, when the proportion of the population residing in urban areas could reach 84%, according to the World Urbanization prospect (2007 revision).

These trends have been considered likely to happen from the experts evaluations carried out in the TRANSvisions survey, that basically agree with the BAU trend at 2050 (from the UN World Urbanization Prospects). In fact, the views of 90% of the respondents ranged between +-10% from the BAU trend.

Concerning the urbanisation driver, urban growth is accompanied by **urban sprawl** – a relative shift in the location of activities (housing, industries, retail and other services) towards the peripheries of the urban agglomeration. This was and currently is an established trend that affects the growth of modern cities, which can be assessed by taking into account global trends in the housing, retail and business sectors, in order to understand why this phenomenon has steadily marked the development of urban areas over the last decades. It has also important consequences in terms of associated trends of increasingly land consumption and car dependent mobility.

With regard to the housing sector and **residential patterns**, lower housing prices at some distance from city centres make it more convenient for a growing share of households in Europe – and especially young couples and families – to rent or buy houses in the suburbs or even in satellite towns around large agglomerations, as the sum of housing prices and transport prices compare favourably for a given house quality (i.e. available space and comfort) to those derived from living city centres.

From around 1960 onwards, the European retail sector has experienced an important development at the urban peripheries and in suburban areas. This evolution was basically spurred by the considerable emigration flux towards the outskirts of the agglomerations (suburbanisation of houses and workplaces), the increasing economies of scale in the retail sector, the changes in the shopping behaviour of consumers, problems in city centres (congestion, parking, high ground prices, scarcity of parcels and buildings), the intention of urban planning to improve services in the urban agglomeration and, finally, the internationalisation of the retail sector (with the increasing presence in our cities of hypermarkets Carrefour, IKEA etc.).

The new peripheral retail centres are the result of two tendencies, namely the introduction of new retail techniques - self-service and hard discount – and, secondly, the appearance of shopping centres, combinations of retail businesses and warehouses. New trends in the retail sector respond also to the intention of diversifying – shopping centres become also leisure centres, sports centres, cultural centres and congress centres.

Current urban development – at least in Western Europe - has been characterised also by the shift of **business activities to suburbs**. Indeed, tendency for jobs to increase faster in the suburbs and on the urban fringes than in the centres and inner districts of metropolitan areas is characteristic of all developed countries. Nowhere this is truer than in the USA, but decentralisation of employment is also taking place in most European cities. The location of high-tech and often footloose enterprises is relatively independent of the location of raw materials and markets. Fast accessibility to regional, national and international markets is gaining importance at the expense of proximity. “Gates” - namely nodes of internationally oriented, multimodal and goods-intensive activities such as major airports and railway stations - are becoming increasingly strategic in the development of trans-national market networks. Nearby these nodes all kinds of economic activities locate themselves in order to have a fast connection to the rest of Europe or to be accessible for a big market. At the moment this trend is especially evident in the North West European area, where internationally oriented airports and railway stations are increasingly taking the status of urban poles re-shaping the spatial structure of the surroundings.

However, it is important to note also the signals of a reverse trend towards **re-urbanisation** and revitalisation of the inner cities, with a number of brown field development projects creating a mixture of workplaces and residences in city centres, increasing the level of residential densities, combined with the realisation of attractive public spaces and the availability of efficient public transport systems. Active urban redevelopment and renewal policies in many urban areas seem

to be having some success in reversing the depopulation and decay of urban centres. This reverse trend is facilitated by the **decline of household size** – single or two-persons households have a higher propensity to locate in the urban centres – and by the growth of the creative knowledge intensive economy, with its strong preference for inner city environments. Urban centres have usually succeeded also in maintaining their position in the retail sector by specialising, offering a wider high-quality products selection.

As a main consequence of urbanisation, per capita urban land consumption is increasing, including the land that has been converted from rural to urban use to provide for jobs, recreation and entertainment, shopping, parking, transportation, storage, government services. Transport network and corridors are still the major consumers of space. Land resources in most of Europe are relatively scarce, and achieving a sustainable balance between competing land uses is a key issue for all development policies. Large-scale urban agglomerations and extended peri-urban settlements resulting from the increasing urban sprawl fragment large landscapes and threaten various ecosystem processes through near-complete reliance on importing material goods and unsustainable resource use.

Finally, there is an important relationship between the urbanisation driver and **daily commuting patterns**. Indeed, one of the consequences of urban sprawl is an increasing dependence on the automobile for intra- and inter-metropolitan travel. Urban sprawl entails building extensive transportation systems because houses are increasingly far away from workplaces and commercial centres.

This newly constructed infrastructure, in return, spurs further urban sprawl – investments made in new motorways or road connections attract new development along the improved transport lines. Growing car ownership and the concentration of work and shopping in out-of-town locations have resulted – and may continue to result - in continuing **increases in journey length for all purposes, but particularly for commuting**. Trends in trip lengths in some EU 15 countries (e.g. the United Kingdom, Denmark and Belgium) showed a growth in travel during recent decades, with people living further away from work, leisure activities, shopping centres and schools (EEA, Indicator Fact sheet – TERM 2001 14 EU).

Increased average trip length and suburb to suburb trips increase fuel consumption and related emissions of air pollutants and greenhouses gases.

Empirical evidence on the relationships between transport-related energy consumption and the degree of urban density confirm that car dependency and car ownerships tend to be lower in presence of more compact cities (EEA, 2008).

Summarising the likely impacts of urbanization on future transport demand, assuming that current trends will continue, the following aspects can be identified:

- Increase of local and short distance trips, through collective transport, in urban areas due to the growing urbanization trends

- Increase of short-medium distance trips in particular by car due to the urban sprawl trends (commuting and leisure purposes)

4.4 Impacts of energy prices

The oil price is surely one of the most important drivers in the world, as has been stressed by the sudden rises in prices in July 2008.

Future oil prices have been the subject of several oil price forecasts. However, recent experience has demonstrated the uncertainty around such forecasts. For example, the US Energy Information Administration's official 2007 prediction indicated that even in the high-price scenario, oil prices would not exceed $100 USD/barrel until 2030. It should be recalled, however, that prices reached $120 USD/barrel in July 2008.

Oil currently plays an important role in the transport system in three primary ways. Firstly, and most obviously, oil provides the fuel that powers the majority of vehicles. Secondly, oil is the major input into the asphalt and bitumen used to construct and maintain road surfaces. Finally, the majority of public transport services are dependent on diesel – although to a lesser extent than private vehicles. Thus, when oil prices rise and consumers are faced with higher prices for petrol and diesel, government agencies are confronted with higher costs for maintaining and constructing road infrastructure as well as higher costs for operating public transport services. The price of oil is therefore a key driver of the cost of using, maintaining, constructing, and operating the transport network.

A distinction shall be done in this respect between **oil shocks and sustained high prices**. A shock is defined as a large transient increase in price which subsequently subsides. Sustained high prices are, by contrast, a large and persistent increase in price. These two events differ in terms of what responses people are prepared to take and also in terms of what responses government agencies are able to provide.

The responses of individual households to an oil shock are likely to be dominated by short **term measures**, such as telecommuting. These decisions are typically made in the knowledge that reversion to standard travel patterns will be possible in the near future. In contrast, when exposed to sustained high fuel prices individuals are likely to opt for more permanent and enduring responses, such as **locating closer to their usual destinations.**

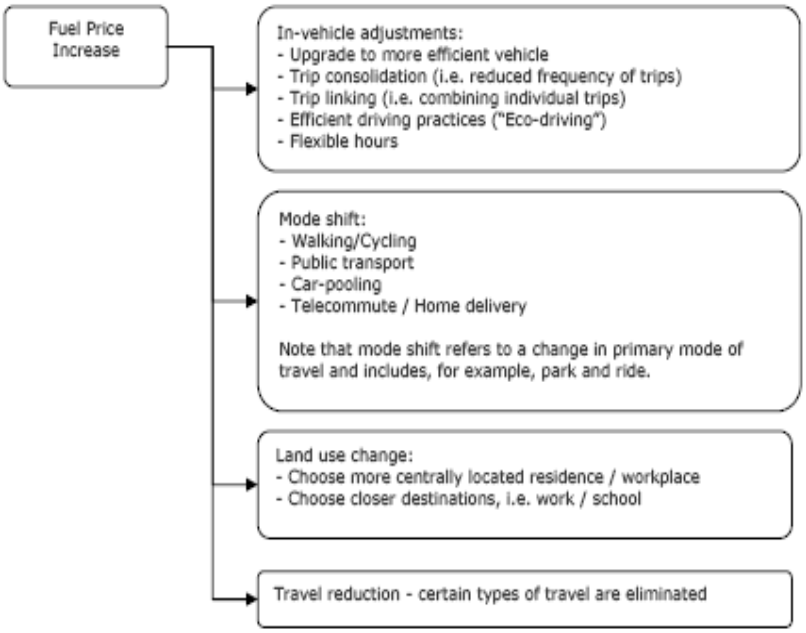
It should be also considered that improvements **in vehicle technology** may be also expected to mitigate the impacts of rising fuel prices, by reducing the sensitivity of travel demands to increasing fuel prices. Improvements in vehicle technology generally fall into one of two key categories: **improvements in fuel economy and alternatives to oil.**

Fuel economy describes the amount of transport fuel consumed to travel a certain distance, often in litres of fuel consumed per 100km travelled. Technological improvements have resulted in sustained improvements in fuel economy.

Alternative transport fuels are also receiving increasing attention as a means to decouple motorised travel from oil based transport fuels. These fuels include technologies such as electric vehicles (EV) and hydrogen fuel cells, which may allow for the substitution of oil based transport fuels with electrical energy.

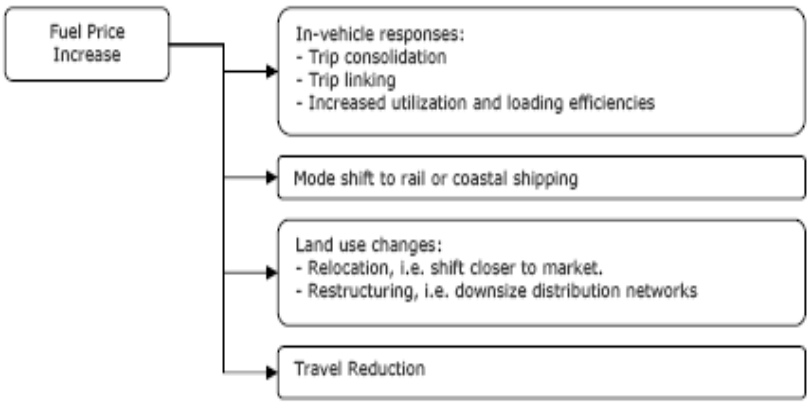
All in all, it is important to note that there are uncertainties in understanding consumers' reaction to changes in fuel prices, and, as a consequence, to assess the impacts in terms of transport demand. This is in part due to the substitution of the more expensive oil-based fuels trips with alternative fuels, i.e. investing in more fuel efficient vehicles.

In general, for passenger transport the types of responses they may include are illustrated in the figure below. They provide a simple behavioural framework though which the effects of higher oil prices may be interpreted.



Source: New Zealand Transport Agency, 2008

In the freight transport sector, commercial travel demands are expected to be less sensitive to oil prices than light passenger travel demands. This reflects the latter's higher economic utility as well as the fact that fuel represents only a small component of overall operating costs. Commercial travel demands are thus more strongly linked to economic growth. Commercial travel demand responses to rising fuel prices are summarised in the figure below. This is similar to that previously considered for passenger transport.



Source: New Zealand Transport Agency, 2008

In relation to international freight movements, high oil prices may be expected to give international shipping an increased price advantage over air for the movement of non-time critical international freight. This is likely to reinforce the importance of ports as the origin and destination of international freight movements, as well as increase the importance of high capacity terminals able to both physically accommodate and rapidly unload large ships.

High fuel prices may also drive consolidation in international freight movements around fewer larger terminals located close to markets, increasing the potential benefits of coordination, cooperation, and specialisation between individual port companies. Sustained high oil prices may have specific implications for major airports, which may be expected to suffer from lower volumes of air passengers.

However, recent developments in sea freight transport have led to increased sensitivity to higher energy prices. This thesis is supported by a recent study of the Canadian Investment Bank (Rubin & Tal, 2008), based on the assumption that when high energy prices – as those currently experienced today (in 2008) - are impacting transport costs so much that the cost of moving goods, not the cost of tariffs, is the larger barrier to global trade.

On the other hand, it is evident from the ECOTRA Study (IPTS, 2006) that transport is almost fully outsourced and transport prices are low as compared to the final product prices, despite the recent rocketing increase in maritime transport rates. To what extent will steep increases in transport costs offset the reducing share of sea transport costs for different long distance routes and products is difficult to say.

In conclusion, in terms of impacts on demand, it can be concluded that in the presence of persistently high energy prices:

- Passenger transport: travel reduction in long distance trips due to change of more centrally located residence, and trip consolidation; modal shift toward walking and cycling.

- Freight transport: when energy prices are high – in the order of 3-digits per barrel – proximity matters, and regional trade will grow faster than long distance trade (rail transport could be favoured). Major consolidation in freight movement may contribute to a reduction in long distance trips by road. Long distance trips by shipping and air could be reduced too; while the contrary will happen when the energy prices are low.

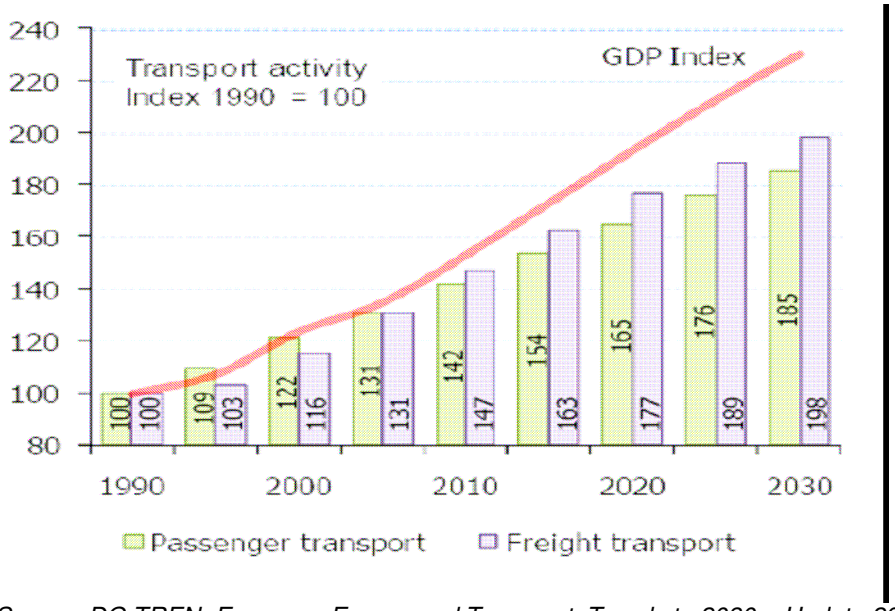
4.5 Impacts of GDP growth

According to the analysis presented in the EC DGTREN Baseline scenario to 2030, in the period 1990 to 2005, the **GDP elasticity of transportation activity** in the EU was estimated at 0.90 for both passenger and freight transport. This is a remarkably high value indicating great dependence of economic and social activity on transportation.

A closer look at the period 2000 to 2005 shows that the GDP elasticity of passenger transport remained constant at a level just below one, but for freight transportation it became as high as 1.45. This reflects the considerable increase in commodity trading following the EU enlargement and the market integration.

The projections for the EC DGTREN Baseline scenario show values of the GDP elasticity of transportation activity that remain **stable over time** as far as passenger transport is concerned and **decreases over time** for freight transport reflecting saturation and productivity gains.

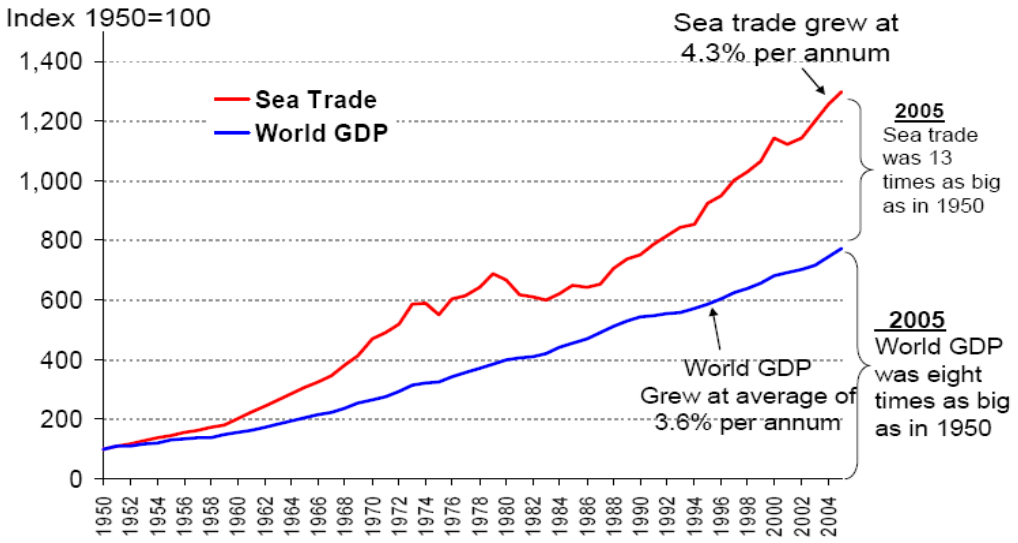
For passenger transport, the GDP elasticity is equal to 0.65 on average for the period 2005 to 2030. For freight transport, the GDP elasticity of activity is projected to decrease gradually, first down to 0.92 in 2005-2010, and then further down to 0.72 between 2010 and 2030. As the values of GDP elasticity of transportation activity are lower than one, the Baseline scenario displays therefore a gradual decoupling of transportation from GDP growth (see figure below).



Source: DG TREN, European Energy and Transport, Trends to 2030 – Update 2007

The volume of transportation of passengers is projected to increase at a rate of 1.4% per year between 2005 and 2030 while the volume of freight transport is projected to increase by 1.7% per year during the same period.

One of the possible reasons for the **decoupling of freight transport** could be the dematerialisation of the economy. Decoupling may be greatly facilitated also by growing regional trade patterns, as they could be stimulated by a future persisting high energy prices context. For passenger transport decoupling is already taking place due to low demographic growth, the saturation of the car park in some countries and congestion. Past evidence has shown a tight correlation between maritime trade growth and GDP growth rates.



Source: Martin Stopford, Hong Kong Shipowners Association, Will the next 50 years be as Chaotic in Shipping as the Last, 18th January, 2007

A literature review of recent analysis on the decoupling of transport activity with economic growth allows us to stress the following trends:

- Transport activity is still closely correlated with economic development (GDP growth), despite the emergent trend of weak decoupling that is occurring, i.e. the elasticity of transport volume in relation to GDP growth is between 0.5 and 0.8. However, more evidence is needed for deriving long-term stable trends. For example, evidence in the UK (Lenthonen, 2006) warn that the apparent decoupling in road freight transport (McKinnon, 2006) might be at least partly a statistical illusion, due to the non inclusion of freight activity by foreign vehicles.

- The decoupling should be particularly evident in relation to passenger transport. Local mobility flows, characterised by short-medium distance trips, may be considered in fact uncorrelated to growth trends in household income, actually depending on land use factors. Demographic components as later retirements and population ageing may act as counteracting factors. The opposite trend may be found for long-distance passenger flows, in particular by cars and airlines, heavily affected by economic growth and higher disposable income.

- The possibility to widen the decoupling trends between economic growth and transport activity (in particular for freight transport) in the long-term depends on two factors: a) the reverse trends in logistics processes, through the diminishing rate of spatial concentration and domestic supply chains; b) change in GDP composition, in the direction of a diminishing weight of economic sectors producing and distributing tangible goods .

Summing up, transport demand is closely linked to economic growth. In particular:

- Freight transport demand tends to grow faster than GDP growth in time of economic growth; albeit with some regional differences within the EU. In fact, in the last decade, freight transport grew faster than GDP in the EU-15 area, but slower in the EU 10, due to the shift from heavy industries towards the service sector in that economies (EEA, 2008)
- Passenger transport demand tends to be more strongly decoupled from GDP growth; even if it may be guessed that a reduction (increase) of disposable income may induce lower (higher) transport demand for long distance trips (leisure) by air and ship. Increased short/medium trips by car in urban areas may be expected due to the higher car ownership levels in the new Member States, to the extent that the catching up with EU 15 Member States GDP per capita growth will succeed.

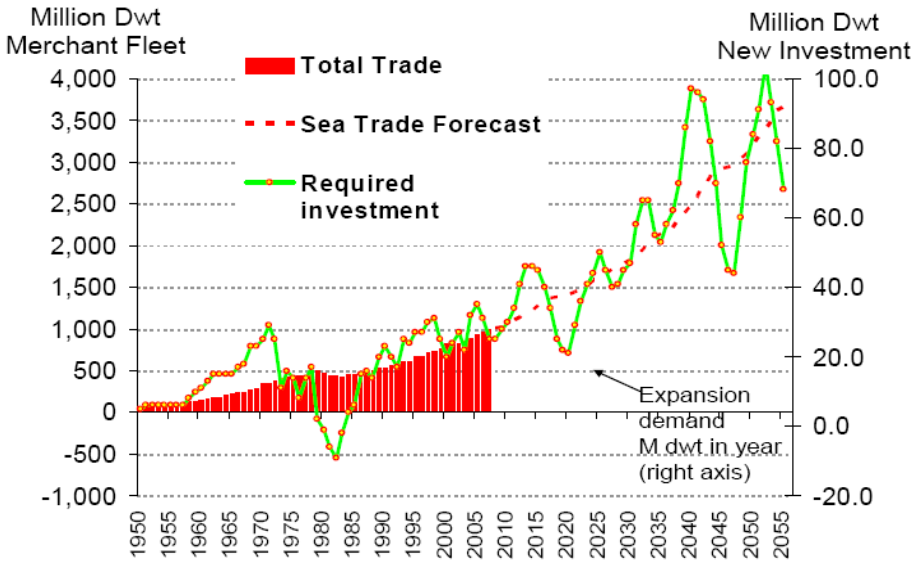
The experts' evaluations for the Economy indicators reflect the major uncertainties underlying the assessment of the future economic situation compared to the most predictable demographic projections. The indications about the future GDP growth rates show in fact both a component of pessimistic evaluation of the future situation (35% of the experts consider it possible that a reduction of more than 20% higher than the forecast value) and elements of optimism (41% consider an increase by 10% of the forecasted growth rates). Where the pessimistic approach is dominant is in the future employment rates, with all the respondents considering possible a reduction between 10% and 20% of the forecasted levels.

4.6 Impacts of globalization

An important feature of globalisation has been the ever increasing **international trade**, In fact, while the globalisation process itself is not new, the present phase has witnessed a significant acceleration over the last one to two decades, with the integration of China, India and the former Soviet block countries into the world economy and trade. This acceleration in integration has resulted in a 50% increase in the world's non-agricultural labour force, with a large proportion of these additional 700 million workers comparing well in human capital terms with the low skilled workers of the "developed" world. This labour supply boost has also coincided with a period rich in technological progress, most notably in the ICT area, with positive effects from the sharp

reduction in communication costs being reflected in the growing tradability of many traditionally sheltered service sectors.

If the globalization process is going to continue, the growing demand and supply from China India; Central Asia; Russia; the Baltic states; South America; and Africa may be expected. Sea trade and investment are expected to growth, as consequence.



Source: Martin Stopford, Hong Kong Shipowners Association, Will the next 50 years be as Chaotic in Shipping as the Last, 18th January, 2007

Another important feature of the globalization is the process of **regional integration** of national economies (EU, NAFTA, China area), increasing the division of labour and level of specialisation across EU countries and world regions. As consequence, increases in trade, regional specialisation and the length and complexity of the **logistical chain** have grown faster, resulting in the increase of total freight transport volume.

The impacts in terms of freight transport demand are likely to be the following:

- The current globalization pattern in the industrialized countries, i.e. outsourcing, warehousing concentration, frequent deliveries, consumption patterns, etc, is going to increase the average distance and frequency of freight movements, increasing the long distance freight trips by road, sea and air.

- Growth in parcel shipments, creating an increase in demand for small package delivery, resulting in an increase in short distance by van/LDV (urban) trips.

4.7 Impacts of ICT

The impact of Information and Communication Technologies (ICT) on transport is a much debated and still somewhat controversial issue. Indeed, ICT technology is enormously influential in transport, and perhaps this is its main role, namely to influence the operation of transport systems, to provide in-vehicle monitoring and control systems, and to provide information to users of all transport systems (i.e. by means of widespread diffusion of ITS). The overall impacts are usually categorized by means of two possible contrasting effects:

- Stimulation of more travel as new opportunities become available
- Substitution for travel as activities can now be carried out remotely rather than by travel

E-commerce and teleworking reduce the need to move, but, at the same time (in particular the growing of e-commerce) this trend is counterbalanced by more frequent deliveries: smaller loads, faster delivery and more air movements.

Concerning **production**, the impacts affect both the manufacturing systems and logistic and freight distribution. There are two main aspects affecting manufacturing systems. One relates to the direct selling of goods and services over the Internet (e-commerce), which can be business to business or business to customer, and the other relates to changes in the production processes themselves (mainly business to business, such as just-in-time production). The main advantage of ICT is that it provides the potential to cut costs and increase efficiency (by some 20–30%) through electronic transactions that allow the use of computer-aided manufacturing and electronic data interchange. Another aspect relates to production schedules that can be changed weekly according to the variability in demand patterns, with suppliers increasingly acting as retailers. Such developments have led to a reduction in the transport requirements as orders are now processed electronically from the supply of goods to the invoicing of customers. However, as requirements become more demanding, there may be an increase in the number of deliveries required to meet production deadlines with smaller loads.

Logistics and freight distribution have been revolutionized by the increased use of ICT. This is perhaps the area in which the impact of ICT on transport is greatest. The structure of the supply chains has changed as the location and size of production, processing and warehousing sites have adapted to the new technology. This has affected the spatial concentration of production and inventory activities, the development of new break/bulk and transhipment systems, and hub satellite networks. The alignment of supply chains has also been altered with the concentration of international trade on hub ports and airports, the rationalization of the supply base, the vertical disintegration of production, the wider geographical sourcing of supplies, customization and the increase in direct delivery. Such changes have been reflected in the increased use of road freight vehicles, as these can be more easily adapted to the new logistics. Transport costs have been further reduced through improved design, the use of containers, and an increase in the freight capacity of ships and aircraft. New automated handling for freight at distribution centres, airports and ports, together with greater modularity and reductions in packaging, have all helped to revolutionize freight systems. ICT has played an instrumental role here in information exchange, tracking and tracing, in enabling new concepts for production and services to be introduced, in cutting turnaround time, and in determining shipment size and improving loading factors (e.g. according to Mansell, 2001, 28% of lorry distance in the UK involves empty running, and this has been reduced by 20% through freight exchanges).

Concerning **living,** a number of activities can be done now through the Internet (e-Everything): these include e-shopping, e-medicine, e-education, e-banking and e-entertainment. In each case, there is a potential substitution effect for existing activities, but the intention is to allow 'low-level' activities to be carried out remotely (e.g. self-diagnosis of minor illnesses or primary-school education). Higher-order activities would still have to be carried out through face-to-face contact, involving travel. The direct effects on transport may be some replacement of existing travel, but in the longer term new patterns of longer distance travel may take place as the ICT becomes embedded in lifestyles.

Car sharing and innovative forms of leasing may result in less city car ownership. Online booking and debiting systems can be combined with personal digital assistants with embedded intelligence to ensure that high-quality options are presented to allow customized mobility. Finally, another important effect on long-distance passenger travel will be provided by the increasing opportunities of last-minutes deals done through the Internet. These have become increasingly important as the flexibility of the Internet has been used to sell excess capacity, particularly for flights, hotels and holidays. The direct effects have been higher occupancy rates on airlines, railways and hotels, as space is sold at costs slightly above the margin. At one level, this may just be using up excess capacity and so there is little additional travel, but in the longer term it may result in additional capacity being designed as new markets are developed. In this case, the growth in long-distance travel is likely to be substantial.

Concerning **working**, much of the debate has concentrated on the potential of teleworking to reduce commuting travel. Indeed, much of the evidence is limited (Banister and Stead, 2004), and it seems that there is a substantial potential for substitution of travel to work for home working, but that potential has not been fully realised so far.

A summary of the ICT impacts, separately on passenger and freight transport demand, can be summarised as follows:

- For passenger transport:
  a) more long-distance travel for business meetings and services by air due to the new opportunities favoured by new technologies (transport cost reductions);
  b) reduction in travel frequency; but perhaps longer distance travel (when individuals move further from work) and also substitution of work travel with other travel (with time saved by not travelling to work), due to widespread diffusion of flexible and remote working technologies
  c) reduces the need for individuals to travel for many transactions, but may also lead to new journeys to replace the ones that would have been necessary in the absence of the e-activity or to completely new demand resulting from social networking. E-ticketing may increase the convenience of public transport
  d) modal shift in favour of public transport, due to new technologies (Integrated public transport planning information, e.g. real time information on bus schedules)
  e) saving in congestion and travel time, but may add to journey distance, due to real-time route guidance and hazard warning

- For freight transport:
  a) more long-distance transport for goods, due to the new technologies allowing a global market scenario for production and good distribution
  b) reduction for the movement of goods in certain cases, e.g. music is downloaded from the web, and orders are transmitted electronically, but increase of freight deliveries, due to e-commerce development
  c) more frequent deliveries, smaller loads, faster delivery, more air movements, due to the just in time production
  d) savings in reliability and travel time, but may add to journey distance. There are possibilities for trip chaining and load matching. Also savings in terms of vehicles and route choice, due to real-time route guidance, track and trace technology optimizing delivery vehicles and routes
  e) saving in congestion and travel time spent by road haulers, but may add to journey distance, due to real-time route guidance technologies

4.8 Impacts of new infrastructure

Given that the geographical scope of this study is the European wide area, the discussion of this section is based on the impact of the new TEN-T routes on future transport demand.

Transport infrastructure is established for serving the demand for transport, and the investment in new transport infrastructure is a key driver of technological progress in the transport sector. At least two different issues can be stressed:

1. The provision of **new vehicles** (maglev trains, high speed trains, new generation of shipping, aircraft, etc) and energy equipment (fuel cells, hydrogen technologies)
2. The provision of the **new infrastructure**, e.g. the planned TEN-T priority projects

For the purpose of this paper, only the second issues is relevant, due to the fact that the new vehicles will mainly affect the efficiency and energy consumption of transport operation, but not in itself the volume of transport demand (even if the development of new trains, new shipping lines may lead to significant modal shift from road and additional transport demand), The uncertainties, however, are high, in particular the high costs associated with the new technologies.

On the other hand, the development of new infrastructure, e.g. new rail/road lines, airports, etc, is going to have a significant impacts on transport demand and regional development at European level.

The TEN-policy deals with the infrastructure development in the EU. The infrastructure and its planned implementation is the main object for the TENCONNECT study (2008), developed as a contract service for the DG TREN and aiming at:

- analysing future traffic flows (at 2020 and 2030) at EU 27 level
- Identifying major transnational axes most relevant for the Single market and Cohesion;
- Identifying bottlenecks affecting traffic flows along the axes or stemming from the traffic using these axes;
- Assessment of the economic, environmental and social impacts of policy and infrastructure packages aiming at removing the bottlenecks;
- Analysis of transport costs along competing trade routes.

The study, updating and applying the TRANS-TOOLS model in the context of the EC revision of the TEN policy, can provide indications about the impact on future transport demand and its geographical distribution.

The results for the Baseline scenario and the Sustainable Europe in fact, takes account respectively of the *progress* in the implementation of the TEN-T infrastructural Priority Projects, and of the *completion* of the projects considered in the priority projects, and the pan European Corridors. The influence of other transport drivers, e.g. population, GDP growth and travel costs, is considered as well.

The following tables show the impact of the Baseline scenario compare to the 2005 situation in terms of absolute change in the volume of passenger trips, tonnes lifted and the corresponding values in terms of pkm and tkm.

Mode	Mio. Trips			Relative change	
	2005	2020	2030	2005-20	2005-30
Car driver	240,385	283,655	315,500	18,0%	31,2%
Car passenger	137,560	166,051	184,388	20,7%	34,0%
Bus	37,110	35,964	34,950	-3,1%	-5,8%
Train	6,362	6,408	6,378	0,7%	0,3%
Airplane	0,483	0,578	0,650	19,6%	34,6%
Total	421,900	492,656	541,866	16,8%	28,4%

Mode	Mio. tones			Relative change	
	2005	2020	2030	2005-20	2005-30
Truck	20,555	23,348	23,943	13.6%	16.5%
Rail	1,743	2,217	2,470	27.2%	41.7%
Inland waterways	421	512	565	21.8%	34.3%
Sea	5,425	6,959	7,916	28.3%	45.9%
Total	28,144	33,037	34,895	17.4%	24.0%

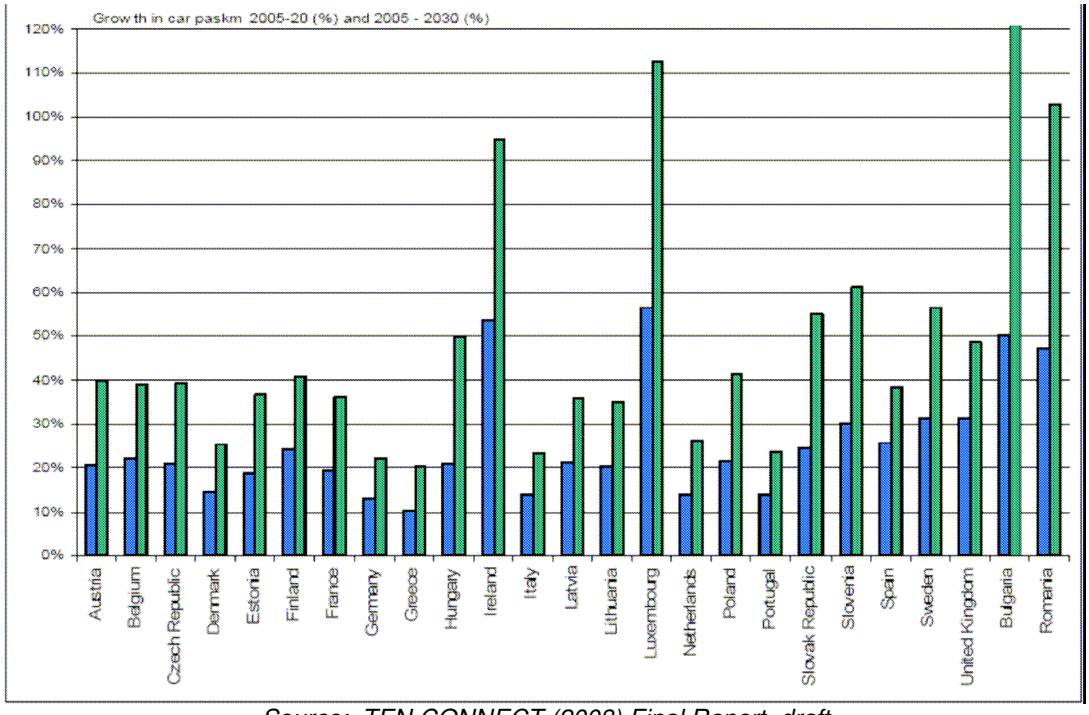
Mode	Model 2005	Model 2020 baseline	Diff. (%)	Model 2030 Baseline	Diff. (%)
Passenger car, 1000 mio pkm	4507	5434	21%	6124	36%
Railway, 1000 mio. Pkm (excl. Tram and Metro)	375	512	36%	587	56%
Truck, 1000 mio. tonkm	1712	2191	28%	2442	43%
Railway, 1000 mio. Tonkm	447	662	48%	797	78%
IWW, 1000 mio. tonkm	130	165	27%	181	39%

Source: TEN CONNECT (2008) Final Report, draft

Two main trends can be observed:

1. Despite the fact that the growth of trips by train is below 1%, the corresponding increase by pkm is 56%, indicating an increase in the kilometres travelled (long distance), as the effect of the high speed rail lines new infrastructure
2. Road freight traffic growth is limited compared to the other modes, both in terms of tonnes lifted and tkm.

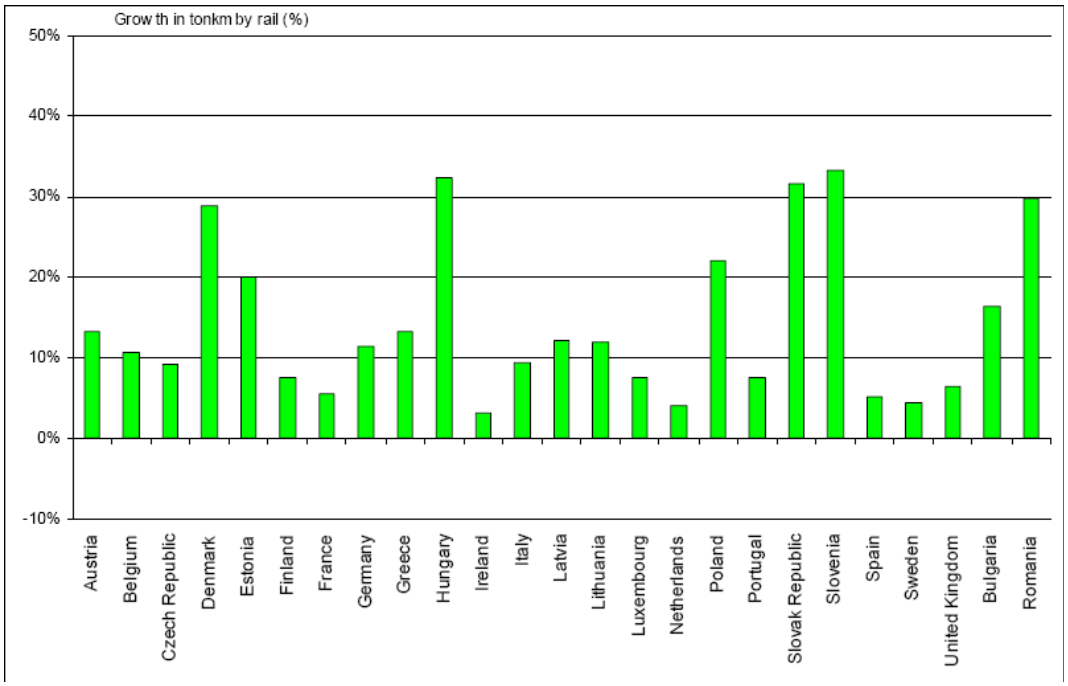
Concerning the regional distribution of transport demand, the following graph shows that the growth in passenger km by car is mainly located in the New Member States, plus Ireland and Luxembourg, as effect of the expected higher GDP growth % of increase.



Source: TEN CONNECT (2008) Final Report, draft

Concerning rail transport, the key factor is the set up of new infrastructures, in particular in Denmark, Hungary, the Slovak Republic, Slovenia and Romania, where major infrastructure

projects are being made (comparison between the Sustainable Europe scenario and the Baseline 2030)



Source: TEN CONNECT (2008) Final Report, draft

The TRANS-TOOLS forecasts at 2030 have been extrapolated to 2050 through the METAMODEL approach, in the context of the TRANSvision study. The METAMODEL approach takes account of a set of macroeconomic indicators aggregated at European level, down to transport demand generation, for passengers and freight. The demand is then distributed by local, regional and long distance and by macrozones, within EU and overseas, by trip purposes and modal split.

In aggregate terms, the 2050 projection confirms that long distance (inter NUTS) rail freight transport demand (passenger and freight) will mainly benefit from the TEN-T infrastructure provision.

2005 Baseline-2050 % variation

Annual EU27 intra-NUTS3 passenger traffic variation	Road passenger Rail passenger	0.9% 0.9%
Annual EU27 inter-NUTS3 traffic variation	Road passenger Rail passenger	0.6% **2.7%**
Annual Extra EU27 passenger traffic variation	Air passenger	2.1%
Annual EU27 intra-NUTS2 freight traffic variation	Road freight	0.4%
Annual EU27 inter-NUTS2 traffic variation	Road freight Rail freight	1.3% **2.3%**
Annual Extra EU27 freight traffic variation	Sea freight Sea freight outside EU	1.5% **2.0%**
EU27 traffic variation 2005/2050	Pkm Tkm	44.7% **89.6%**
Annual EU27 traffic variation	Passenger Freight	0.8% **1.4%**

4.9 Impacts of tourism

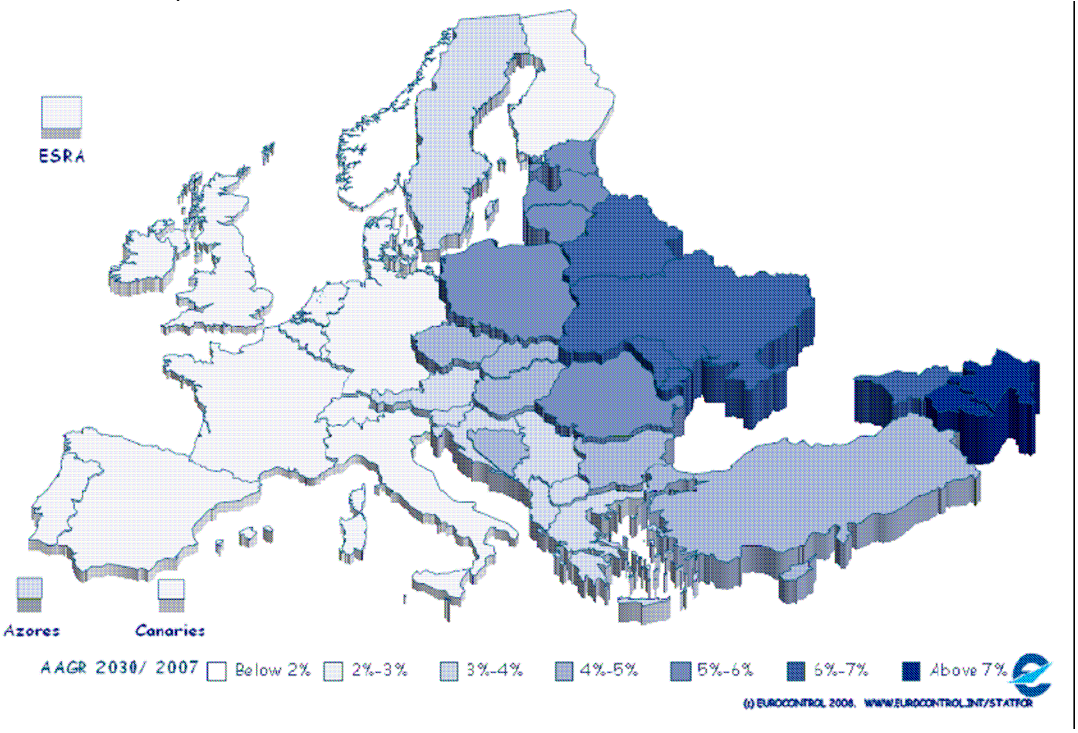
The OECD has explored in the past years the relationships between tourism and transport (OECD, 2000). Most tourism travel is made by car. However, tourism travel – especially international - is also driven by the growth in availability of low cost air transport. Tourism is estimated to account for about 75% of the demand for aviation, which is growing rapidly. Low cost carriers have been moving passengers over longer distances for shorter and more frequent holidays with 10-20 times environmental impact per trip compared with tourism by road and rail.

Leisure is estimated to account for 75% of all international travel. The World Tourism Organisation (WTO) estimated there were nearly 900 million international tourist arrivals in 2007 from 846 million in 2006, an increase of about 6%. This represent nearly 52 million more arrivals than in 2006 and they are expected to reach 1.6 billion by 2020 (The Economist, 2008). To appreciate these figures we may consider that international tourist arrivals in 1950 were only 25 million. Domestic tourism (people going on holiday in their own countries) is generally thought to be 4-5 times greater than international arrivals.

Factors in tourism growth include:

- Increasing leisure time: In 1936, the International Labour Organisation convention provided for one week's leave per year for workers in developed countries. In 1970, this was expanded to three weeks, and in 1999 to four weeks.
- Increased disposable income: the strong economic growth of Asian economies such as China, India and Singapore has resulted in greater disposable income resulting in increased demand for foreign travel.

The following graph shows the 2030 forecasts of EUROCONTROL of the increase of air movements compared to 2007.



It may be observed that the growth is stronger in Eastern Europe countries and neighbour countries where the market is relatively less mature and the States are catching up with the more developed Western economies.

4.10 Impacts of lifestyle changes

The impact of an emerging **"sustainable consumption**" culture on transport could be important. In a radical change in cultural attitudes, car ownership could be affected most, with owning a car starting not to be seen much as a status symbol (at least among parts of the younger generation) and the only provider of "mobility freedom" in the younger generations. A new sustainable mobility freedom concept could take ground, especially in the urban environment, with a greater attention of people towards active travel (walking and cycling) combined with the use of high quality public transport and information services as the main way to ensure freedom of movement. On the other side, distributed energy and information systems could lead to a pattern of distributed human settlements as a superior way of organisation, giving rise to a landscape of scattered new homogeneous motorized neighbourhoods which would keep down congestion and CO_2 emissions.

Despite the fact that lifestyle changes are hard to predict, the growing pressure of environmental concerns could increase the demand for public transport in metropolitan areas, leading in general towards a reduction of long distance trips.

5 Summary of key findings and issues for discussion/research

The following table summarises the key findings of the analysis. The columns of the table identify the topics of the analysis: the type of transport demand driver; the expected impacts on transport demand distinguishing passengers and freight sectors; the relevance in terms of GHG emissions ("+" indicating increase of emissions, "-" indicating reducing emissions) and the regional or geographical area interested.

Drivers	Impacts on Transport demand		GHG Relevance	Geographical area
	Passenger	Freight		
Population ageing	Increase in medium/long distance trips by car/air Increase in short distance trips by public transport		High: + Low: -	European wide area Urban/Metropolitan
Migration	Increase in short distance trips by car/public transport		Medium +	Urban
Urbanization	Short distance trips by car/public transport Short/medium distance trips by car (commuting)		Medium + High: +	Urban Urban/Metropolitan
Energy prices (persistently high)	Modal shift towards short/medium distance trips by walking/cycling/public transport	Reduction of long distance trips by road/air Increased of regional trade by rail	High: - High: - High: -	Urban/metropolitan European wide area, TEN-T corridors European wide area, TEN-T corridors
GDP growth	Increase in long distance trips by air/ship (leisure) Increase in short distance trips by car	Increase in short/medium trips by road/rail	High: + High: + High: +	Regional (EU New Member States) due to the development of the single market European wide area Regional (EU New Member States) due to the catching up of the GDP per

Drivers	Impacts on Transport demand		GHG Relevance	Geographical area
	Passenger	Freight		
				capita level with the EU 10 club
Globalization		Increase in long distance trips by road/air/ships Increase in short distance trips by van/LDV	High: + High: +	European wide area Urban/metropolitan
ICT	Increase in long distance trips by air/ships/rail Increase in short/medium trips by public transport	 Increase in long distance trips by road/air/ship	High: + Low: - High: +	European wide area Urban/metropolitan European wide area
New infrastructures	Increase in long distance trips by rail	 Increase in long/medium distance trips by rail	High: - High: -	 Regional, the EU Member States interested by the TEN-T projects (mainly the New Member States)
Tourism	Increase in long distance trips by air		High: +	Regional, the EU Member States interested
Lifestyle	Increase in short distance trips by public transport		High: -	Urban/metropolitan

The above table should be accompanied by warning notes about the uncertainties that are inevitably associated to long–term predictions. In general, they are more pronounced for social (lifestyle) and economic-related drivers (GDP, globalization trends, energy prices), while less uncertainties may affect the demographic drivers. The impacts of new infrastructure on transport demand are mainly derived from modelling exercises, and therefore have all the intrinsic limitations of these approaches.

Taking that into consideration, it may be concluded that **demographical, economical and infrastructural factors** are going to shape the future transport demand, with an expected increase of demand in the eastern part of Europe (both passenger, i.e. by car and freight, i.e. by rail)), due to the impacts of new infrastructures and the catching up trends with the other members GDP higher levels. Urban and metropolitan areas will be under strain due to the expected higher demand for public transport and short distance trips by car. Air transport demand in expected to increase at widespread levels across Europe. All this trends will have relevant GHG emissions effects.

These conclusions will support both the Task 2 (Scenario development), to the extent that it may benefit from the identification of the possible drivers to be considered in assessing future GHG emissions trends, and the Task 4 (Measures to affect GHG emissions) due to the indication of GHG relevant transport domains to be addressed with targeted policies.

References

Banister and Stead (2004) "*Impact of Information and Communications Technology on Transport*", Transport Reviews, Vol 24, No 5, 611-632

DG TREN (2008) " *EU energy and transport in figures. Statistical pocketbook 2007/2008"*

The Economist (2008 *"Travel and Tourism a New itinerary*", May 15th 2008

ECMT, (2002) *The driving forces behind transport growth and their implications for policy*, International Seminar, Brussels

EEA (2008) *Beyond transport policy — exploring and managing the external drivers of transport demand. Illustrative case studies from Europe, Technical report, NO 12/2008*

IPTS (2006) ECOTRA "*Energy use and Cost in freight TRAnsport chains*", TRT

ITF/OECD (2008) "Greenhouse Gas Reduction Strategies in the Transport Sector", Preliminary Report

Lenthonen, M. (2006) "*Decoupling freight transport from GDP – conditions for a 'regime shift*' Paper to be presented at the 2006 Berlin Conference on the Human Dimensions of Global Environmental Change, Berlin, 17-18 November 2006

Mc Kinnon, (2006)" *The Decoupling of Road Freight Transport and Economic Growth Trends in the UK: An Exploratory Analysis*", Logistics Research Centre Heriot-Watt University

OECD (2000) *"Transport and Leisure",* Economic Research Centre, Round Table 111

Rubin J., Tal B. (2008) "*Will Soaring Transport Costs Reverse Globalization* ?" CIBC World Markets InC

TEN CONNECT study (2008) "*Traffic flow: Scenario, traffic forecast and analysis of traffic on the TEN-T, taking into consideration the external dimension of the Union*". Draft Final Report

TRANSvisions (2009) *Study on Transport Scenarios with a 20 and 40 Year Horizon,* Service contract A2/78 2007 for the DG TREN

Annex 1: Literature review

List of the studies and reports reviewed (time horizon 2050)

Topic	Issuing Institution
1.1 International studies and data focusing on demographic and urbanisation changes	
World Population Prospects- The 2006 Revision	UNITED NATIONS
World Urbanization Prospects- The 2007 Revision	UNITED NATIONS
Long-term population projections at national level	EUROSTAT
1.2 International and EU studies focusing on macro-economic perspectives	
Globalisation: Trends, Issues and Macro Implications for the EU	Directorate-General for Economic and Financial Affairs
Long-term labour force projections for the 25 EU Member States: A set of data for assessing the economic impact of ageing	Directorate-General for Economic and Financial Affairs
The long-term sustainability of public finances in the European Union	Directorate-General for Economic and Financial Affairs
The impact of ageing on public expenditure: projections for the EU25 Member States on pensions, health care, long-term care, education and unemployment transfers (2004-2050) Pensions Schemes and Projection Models in EU-25 Member State	Economic Policy Committee and the European Commission (DG ECFIN) Economic Policy Committee and the European Commission (DG ECFIN)
1.3 International and EU policy outlooks	Directorate-General for Economic and Financial affair
Great Transition The Promise and Lure of the Times Ahead	Stockholm Environment Institute
Back casting approach for sustainable mobility 2008	Joint Research Centre
1.4 International and EU climate change and energy outlooks	
Climate Change 2007: Synthesis Report	IPCC
Very Long Term Energy-Environment Model	European Research Project

Topic	Issuing Institution
	EC/DG Research
World Energy Technology Outlook – WETO H2	EUROPEAN COMMISSION
Energy Technology Perspectives - Scenarios & Strategies to 2050	International Energy Agency (IEA)
1.5 Relevant foresight studies produced by EU Member States	
A sustainable energy system in 2050: promise or possibility?	ECN – Energy research Centre of the Netherlands
Foresight Intelligent Infrastructure Futures The Scenarios – Towards 2055	Department for Transport (UK), Office of Science and Technology
UK Air Passenger Demand and CO2 Forecasts	Department of Transport (UK)
Long range Transportation Plan – 2050 -	Conseil Général des Ponts et Chaussées
Four futures for Europe	CPB Centraal Planbureau
Perspectives énergétiques de la France à l'horizon 2020-2050	Centre d'Analyse Stratègique
1.6 Relevant foresight studies produced by business and other stakeholders	
Pathways to 2050: Energy and Climate Change	WBCSD
1.7 Relevant foresight studies produced by business and other stakeholders	
Shell energy scenarios to 2050	Shell International BV

List of the studies and reports reviewed (time horizon 2030)

Topic	Issuing Institution
2.1 International and EU policy outlooks	
ESPON Programme	European Union
2.2 International and EU climate change and energy outlooks	
Global Climate Policy Scenarios for 2030 and beyond	JRC-IPTS
VIEWLS project "Clear Views on Clean Fuels"	ED DG TREN
EurEnDel - Technology and Social Visions for Europe's Energy Future, European Energy Delphi	EC DG Research
Climate change and a European low-carbon energy system	European Energy Agency (EEA)
World Energy Outlook 2006	International

Topic	Issuing Institution
	Energy Agency (IEA)
Transport strategies under the scarcity of energy supply	EC DG Research
European Energy and Transport Trends to 2030 –Update 2007 -	DG TREN
2.3 Relevant foresight studies produced by business and other stakeholders	
Hydrogen Energy and Fuel Cells - A vision of our future	European Hydrogen & Fuel Cell Technology Platform (HFP)
The Vision 2030 Project – Final Report	UK Highways Agency
Mobility 2030: Meeting the challenges to sustainability The Sustainable Mobility Project – Overview 2004	World Business Council for Sustainable Development

Annex 2: TRANSvision list of transport drivers

1.SOCIETY

1. Population growth and ageing
2. Migration
3. Urbanization
4. Work-time regimes (teleworking)
5. Tourism and leisure
6. Lifestyle
7. Safety
8. Security

2.ECONOMY

9. Growth and productivity
10. Trade
11. Employment
12. Public budget constraints

3.ENERGY

13. Energy supply
14. Energy demand
15. Energy prices

4.TECHNOLOGY

16. New energy infrastructure
17. New transport infrastructure
18. New fuels and vehicles
19. ICT development

5.ENVIRONMENT

20. Pollution
21. Waste
22. Greenhouse gas emissions
23. Climate change
24. Natural resource consumption

6.POLICY

25. EU enlargement
26. EU integration
27. EU territorial cohesion
28. EU taxation policy
29. Global trade governance
30. Global Climate Change governance
31. Global security governance

Annex 3: TRANS-TOOLS assumptions

The assumptions behind the TRANS-TOOLS scenarios can be subdivided in socio-economic trends, policy actions and TEN policies. The socio economic trends depict the expected development in the following basic parameters:

- Population,
- Income growth
- Car ownership
- Oil price and travel costs.

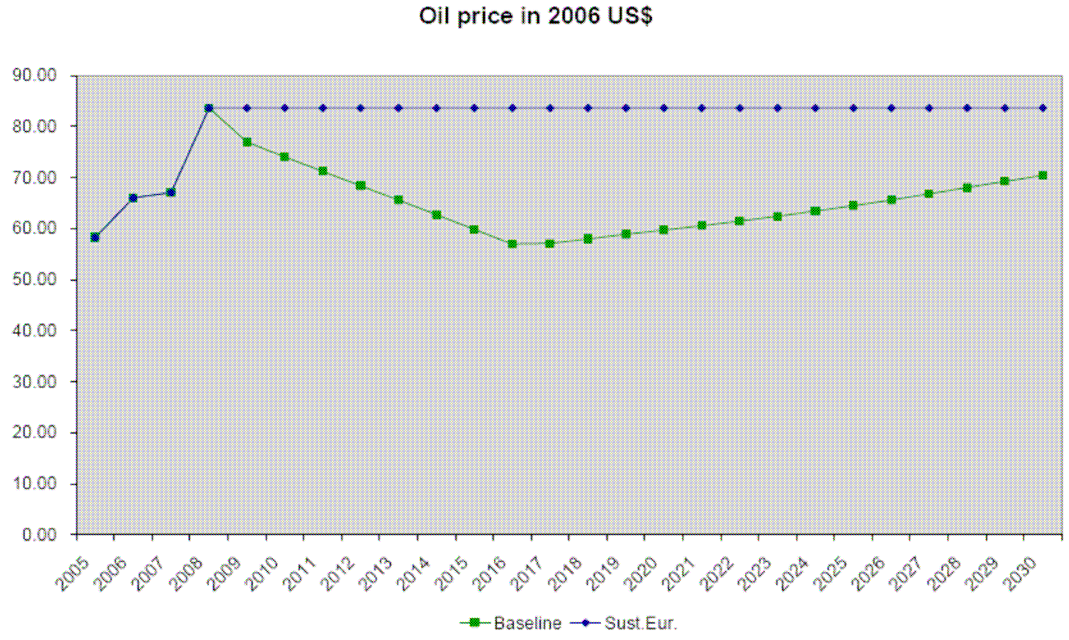
Very briefly (major details can be found in TEN CONNECT (2008) In 2005 the total EU population was about 491 m. people (census). The TREND forecast from EUROSTAT assumes almost a constant population (496 million in 2020, 495 million in 2030). Population in the EU 15 will be growing slightly, whereas a fall in population is expected in the EU 12.

The population of Europe grows older and the old age group is making up a greater part of the total population. This has the effect that a productive population, which decreases, has to feed a fast increasing non-productive population. In EU27 the age group above 64 increases with almost 50% up to 2030, while the age group below 18 decreases with 14%, and the productive age group decreases with 7%.

The economic development up to 2030 in GDP per capita is fastest in the eastern part of Europe and less in the western part. This is also in line with the development experienced in the last 10 years. The ratio between GDP per capita in EU15 and in EU 12 is expected to decrease from 4.7 to 2.9.

The car ownership increases continuously in particular in the New Member States, however with a decreasing speed.

It is expected that the world oil price will follow the development indicated by the US Energy Information Administration in their latest forecast (spring 2008).



The policy actions are a suite of actions aimed at improving transport, strengthening the competition between modes on a level playing field and improving interoperability, cohesion and accessibility within the community and the neighbouring countries. The TEN policy addresses the infrastructure. The measures are summarized in the table below.

Policy issue	Baseline
Effective charging for transport	The existing charging regime is maintained. Where charges apply they are based on cost recovery.
Promoting freight transport corridors	A limited number of freight transport corridors will be available in the rail network. Some new construction of additional tracks is assumed. The assumed corridors are: Betuwe line, Iron Rhine,
Promote the use of intelligent transport systems	The use of ITS will be widespread, and the applications will help ensuring an increase in safety and a better utilisation of the congested road systems. In freight transport there will be efficiency gains. Satellite positioning systems (Galileo) have lead to other more efficient ways of arranging transports. Possible efficiency gains could amount to 15 %.
Advance the technological change in transport	It is assumed there will be a 0.5 % improvement in fuel technology per year up to 2030, indicating a 15 % improvement for road vehicles. The development is accomplished through a mixture of fuel engine technology improvements and development of emission free vehicles.
Support the development of freight logistics	Improved utilisation of the transport modes, which is particularly true for road and rail. The level of empty driving in international transport has been reduced, and this has lead to a 5 % increase in efficiency.
Improve interoperability in the rail transport sector	Improvement of interoperability is continuous an issue in 2030. But considerable improvements have been seen particularly in the centre of Europe. This has lead to reduction of delays at borders, which in turn has lead to faster train systems and more punctual arrivals.

The Gemini Building
Fermi Avenue
Harwell International Business Centre
Didcot
Oxfordshire
OX11 0QR

Tel: 0845 345 3302
Fax: 0870 190 6138

E-mail: info@aeat.co.uk

www.aeat-env.com