EU transport demand: Trends and drivers

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Executive summary

The analysis of transport drivers and scenarios carried out in this paper has benefited of an extensive 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). Furthermore, of particular interest in carrying out the analysis has been the recent ITF International Forum on Intermodal Transport and Supply Chains (Leipzig, 26 May 2009), as far as the analysis of the impacts of globalization on future transport demand is concerned, and the TRANSvisions study (2009) developed as a service contract for the EC DG TREN, and aiming at providing technical support to a debate on transport scenarios with a 20 and 40 year horizon.

The review of the transport drivers and their impacts on GHG emissions has showed that demographic, 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. ICT development will cause contrasting effects on transport demand; on the one hand they can substitute short term and commuting trips, on the other, they may favour rapid and more efficient deliveries in urban areas by car, associated to the reduction of transport costs which is going to favour long distance trips. Globalization is another important factor in raising demand for maritime and air transport (passenger and freight); however, the impacts of the current economic crisis and trade imbalances may reduce its future influence on transport demand. Furthermore, a reduced globalization may hamper the fleet renewal in the short term, leading to higher emissions. Air transport demand (passenger) is expected to increase at widespread levels across Europe, spurred by tourism and income growth.

Concerning freight transport, the long term likely trends shaping the long term forecasts and projections to 2050 at EU 27 level (basically from the TRANS-TOOLS model) are the following:

**Moderate economic growth**: The average annual GDP growth rate by 2% at EU 27 level is assumed. However, significant differences at regional and national level are expected, with relative higher growth rates in Eastern and Baltic countries. Due to the strong relationships between GDP growth and road freight transport, a corresponding higher growth rates in these countries are to be expected.

**Oil price will continue to rise**: However, the growing trend of oil prices, in particular over the 2030-2050 period is not going to reduce significantly the freight transport growth. This is mainly due to technological improvements, i.e. the energy consumption by road oil-based transport will drop by 19% to 2050, in addition to load factors improvements due to the application of new technologies in freight logistic, allowing the reduction of the impacts of higher oil prices on transport costs. Maritime transport has shown a low elasticity of traffic growth to higher oil prices, while rising fuel prices could undermine the relative price of air cargo.

**Globalization and international trade will be not subjected to radical changes**. It is likely to be expected that China will rely less on export-led growth patterns, while, at the same time, US trade deficits could be adjusted in the long term. However, the integration of the world economy should not been undermined and the European international trade should continue to growth at higher rates compared to the intra European transport.

The implications of these trends in terms of where freight transport will be directed, what type of goods will be involved and how they will be carried, could be the following:
Where

The evolution of freight demand will be diversified geographically. In the EU central and northern regions, domestic freight traffic will remain stable, decoupled from economic growth, while traffic originating or having a destination outside the EU-27 will grow faster than the economy. Besides, if measured in value instead of weight, foreign trade is increasing in terms of value, and the proportion of international traffic will be higher in the European North/Centre zones.

To 2030, the European Eastern countries are expected to have the biggest increase of freight transport (4.3% ton-km per year), while the South will grow less (1.58% per year) and the North/Centre even loses some traffic, -0.3% per year. Freight transport between the zones increases most from/to the eastern countries to the rest, with the East-South exchanges growing at 4.1% per year and East-North/Centre growing at 3.3% per year. The South-North/Centre relation grows at a more modest rate of 1.1% per year. Freight traffic with neighbouring countries grows most in the eastern countries at a rate of 4.1% per year. In the South this rate is 2.7% and in the North/Centre 2.3%. To 2050, the projections of the above trends should continue, even if with higher uncertainties.

What

While freight transport for shorter distances will be dominated by minerals and building material, for longer distances, it will be more mixed with machinery and other manufacturing, especially for the more industrialised zones. Crude oil, oil derivatives and to a lesser extent solid mineral fuels will be also important in the long distances.

Total motorised freight transport with origin or destination in the EU-27 (measured in ton-kilometres) will keep growing, following previous patterns, but the elasticity to GDP will change largely in relation to the type of products and the type of movement considered. When only considering freight with origin and destination within EU-27 territory, the growth rate could be very low in average for all products, less than 1.2% per year. The addition of freight with origin or destination in EU-27 neighbouring countries (except northern Africa) increases the growth rate to 2.25% per year, mainly due to the great amount of oil, coal and other fuels moved by sea mode coming from Norway and Russia.

How

The following table summarises the long term projections by transport mode:

<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th>2020</th>
<th>2030</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>P.a % Freight traffic</td>
<td>-</td>
<td>2.0%</td>
<td>1.9%</td>
<td>1.4%</td>
</tr>
<tr>
<td>P.a % Road Freight traffic IntraNUTS2</td>
<td>-</td>
<td>0.2%</td>
<td>0.6%</td>
<td>0.4%</td>
</tr>
<tr>
<td>P.a % Road Freight traffic InterNUTS2</td>
<td>-</td>
<td>1.5%</td>
<td>1.7%</td>
<td>1.3%</td>
</tr>
<tr>
<td>P.a % Rail Freight traffic InterNUTS2</td>
<td>-</td>
<td>2.5%</td>
<td>2.3%</td>
<td>2.3%</td>
</tr>
<tr>
<td>P.a % Maritime Freight traffic EU 27</td>
<td>-</td>
<td>2.5%</td>
<td>2.2%</td>
<td>1.5%</td>
</tr>
<tr>
<td>P.a % Maritime Freight traffic overseas</td>
<td>-</td>
<td>2.5%</td>
<td>2.2%</td>
<td>2.0%</td>
</tr>
<tr>
<td>Freight rail share long distance</td>
<td>25.3%</td>
<td>28.0%</td>
<td>28.6%</td>
<td>34.2%</td>
</tr>
</tbody>
</table>

Source: TRANSvisions (2009)

The table shows that in the long term, rail freight and maritime transport are expected to grow at higher rates than road transport, due to the high growth of goods imported and exported overseas and among the European Inter zones traffic. External trade is expected to increase significantly, so there is a good chance for rail as the loads will tend to concentrate in ever fewer points, such as main ports, to gain share by connecting these freight terminals. In congested corridors linked to large industrial centres and ports, freight train services will also tend to be provided through dedicated lines in the long term.
1 Introduction

1.1 The contribution of transport to GHG emissions

The EU-27’s greenhouse gas (GHG) emissions from transport have been increasing and are projected to continue to do so. The rate of growth of transport’s GHG emissions has the potential to undermine the EU’s efforts to meet potential, long-term GHG emission reduction targets if no action is taken to reduce these emissions. This is illustrated in Figure 1 (provided by the EEA), which shows the potential reductions that would be required by the EU if economy-wide emissions reductions targets for 2050 of either 60% or 80% (compared to 1990 levels) were agreed and if GHG emissions from transport continued to increase at their recent rate of growth. The figure is simplistic in that it assumes linear reductions and increases. However it shows that unless action is taken, by 2050 transport GHG emissions alone would exceed an 80% reduction target for all sectors or make up the vast majority of a 60% reduction target. This illustrates the scale of the challenge facing the transport sector given that it is unlikely that GHG emissions from other sectors will be eliminated entirely.

Figure 1: EU overall emissions trajectories against transport emissions (indexed)\(^1\)

The extent of the recent growth in transport emissions is reinforced by Figure 2, which presents a sectoral split of trends in CO\(_2\) emissions over recent years. Whilst the CO\(_2\) emissions from other sectors have levelled out or have begun to decrease, transport’s CO\(_2\) emissions have risen steadily since 1990. It should be noted that whilst Figure 2 is presented in terms of CO\(_2\) emissions, very similar trends are evident for GHG emissions (in terms of CO\(_2\) equivalent) since CO\(_2\) emissions represent 98% of transport’s GHG emissions.

\(^1\) Graph supplied by Peder Jensen, EEA
Figure 2: Carbon dioxide emissions by sector EU-27 (indexed)$^2$

Notes:
   i) The figures include international bunker fuels (where relevant), but exclude land use, land use change and forestry
   ii) The figures for transport include bunker fuels (international traffic departing from the EU), pipeline activities and ground activities in airports and ports
   iii) "Other" emissions include solvent use, fugitive emissions, waste and agriculture

The vast majority of European transport's GHG emissions are produced by road transport, as illustrated in Figure 3, while international shipping and international aviation are other significant contributors.

Recent trends in CO$_2$ emissions from transport are also expected to continue, as can be seen from Table 1 below. Between 2000 and 2050, the JRC (2008) estimates that GHG emissions from domestic transport in the EU-27 will increase by 24%, during which time emissions from road transport are projected to increase by 19% and those from domestic aviation by 45%. It is important to note that these projections do not include emissions from international aviation and maritime transport, which are also expected to increase due to the growth in world trade and tourism.

Figure 3: Greenhouse gases emissions by transport mode (EU-27; 2005)

![Pie chart showing greenhouse gases emissions by transport mode: Road 71%, Civil aviation 2%, Navigation (domestic) 2%, International aviation 10%, International navigation 13%, Other 1%]

Note: The figures include international bunker fuels for aviation and navigation (domestic and international)

Table 1: CO₂ emissions projection for 2050 by end-users in the EU-27, in Millions tonnes of Carbon

<table>
<thead>
<tr>
<th>End user Category</th>
<th>1990</th>
<th>2000</th>
<th>2010</th>
<th>2020</th>
<th>2030</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road transport</td>
<td>695</td>
<td>825</td>
<td>905</td>
<td>980</td>
<td>1002</td>
<td>1018</td>
</tr>
<tr>
<td>Rail</td>
<td>29</td>
<td>29</td>
<td>27</td>
<td>27</td>
<td>21</td>
<td>20</td>
</tr>
<tr>
<td>Domestic Aviation</td>
<td>86</td>
<td>134</td>
<td>179</td>
<td>206</td>
<td>237</td>
<td>244</td>
</tr>
<tr>
<td>Inland navigation</td>
<td>21</td>
<td>16</td>
<td>16</td>
<td>17</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>810</strong></td>
<td><strong>988</strong></td>
<td><strong>1110</strong></td>
<td><strong>1213</strong></td>
<td><strong>1260</strong></td>
<td><strong>1299</strong></td>
</tr>
</tbody>
</table>

Figures from the EEA (2008), illustrate the recent growth in GHG emissions from international aviation, as they estimate that these increased in the EU by 90% (60 Mt CO₂e) between 1990 and 2005; international aviation emissions will thus become an even more significant contributor to transport's GHG emissions if current trends continue. Furthermore, the IPCC has estimated that the total impact of aviation on climate change is currently at least twice as high as that from CO₂ emissions alone, notably due to aircrafts' emissions of nitrogen oxides (NOₓ) and water vapour in their condensation trails. However, it should be noted that there is significant scientific uncertainty with regard to these estimates, and research is ongoing in this area.


The principal source of transport's GHG emissions is the combustion of fossil fuels. Currently, petrol (motor spirit), which is mainly used in road transport (e.g. in passenger cars and some light commercial vehicles in some countries), and diesel, which is used by other modes (e.g. heavy duty road vehicles, some railways, inland waterways and maritime vessels) in various forms, are the most common fuels in the transport sector (see Figure 4). Additionally, liquid petroleum gas (LPG) supplies around 2% of the fuels for the European passenger car fuel market (AEGPL, 20096), while the main source of energy for railways in Europe is electricity, neither of which are included in Figure 4. While, alternative fuels are anticipated to play a larger role in providing the transport sector's energy in the future, currently they only contribute 1.1% of the sector's liquid fuel use.

1.2 Background to project and its objectives

The context of the EU Transport GHG: Routes to 2050 is the Commission’s long-term objective for tackling climate change, which entails limiting global warming to 2°C and includes the definition of a strategic target for 2050. The Commission’s President Barosso recently underlined the importance of the transport sector in this respect be noting that the next Commission “needs to maintain the momentum towards a low carbon economy, and in particular towards decarbonising our electricity supply and the transport sector”7. There are various recent 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. Hence, the project’s objectives are defined as to:

- Begin to consider the long-term transport policy framework in context of need to reduce greenhouse gas (GHG) emissions economy-wide.
- Deal with medium- to longer-term (post 2020; to 2050), i.e. moving beyond recent focus on short-term policy measures.
- Identify what we know about reducing transport’s GHG emissions; and what we do not.
- Identify by when we need to take action and what this action should be.

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5 Graph based on figures in DG TREN (2008), page 206
Given the timescales being considered, the project will take a qualitative and, where possible, a quantitative approach. The project has three Parts, as follows:

- Part I (“Review of the available information”) has collated the relevant evidence for options to reduce transport’s GHG emissions, which was presented in a series of Papers (1 to 5), and is in the process of developing four policy papers (Papers 6 to 9) that outline the evidence for these instruments to stimulate the application and uptake of the options.
- Part II (“In depth assessment and creation of framework for policy making”) involves bringing the work of Part I together to develop a long-term policy framework for reducing transport’s GHG emissions.
- Part III (“Ongoing tasks”) covers the stakeholder engagement and the development of additional papers on subjects not covered elsewhere in the project.

As noted under Part III, stakeholder engagement is an important element of the project. The following meetings were held:

- A large stakeholder meeting was held in March 2009 at which the project was introduced to stakeholders.
- A series of stakeholder meetings (or Technical Focus Groups) on the technical and non-technical options for reducing transport’s GHG emissions. These were held in July 2009.
- A series of Technical Focus Groups on the policy instruments that could be used to stimulate the application of the options for reducing transport’s GHG emissions. These were held in September/October 2009.
- Two additional large stakeholder meetings at which the findings of the project were discussed.

As part of the project a number of papers have been produced, all of which can be found on the project’s website, as can all of the presentations from the project’s meetings.

### 1.3 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
Drivers of transport demand trends

EU Transport GHG: Routes to 2050?

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Contract ENV.C.3/SER/2008/0053

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.

1.4 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), the ITF Preliminary report on Greenhouse Gas Reduction Strategies in the Transport Sector (ITF/OECD, 2008) and the ITF International Forum on Intermodal Transport and Supply Chains (Leipzig, 26 May 2009).
- 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, globalisation, 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.
- The Annex 1 provides detailed references on the literature review of transport scenarios
- The Annexes 2 and 3 inform about the list of transport drivers identified in the TRANSvisions study (Annex 2) and the TRANS-TOOLS model key assumptions
- The Annex 4 focuses on freight transport scenarios to 2050
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 TRANSvisions 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 other important sources for the analysis have been the ITF/OECD papers and reports; in particular:

- the review of main trends and projections behind the CO₂ emission from transport (ITF/OECD, 2008)
- the background material of the ITF International Forum on Intermodal Transport and Supply Chains (Leipzig, 26 May 2009), of particular interest as far as the analysis of the impacts of globalization on future transport demand is concerned.
3 Review of EU transport demand trends

The graphs below show the past trends in EU 27 transport demand from 1995 to 2007. The transport demand is measured in terms of activity, i.e. passenger kilometres for passenger transport and tonnes kilometer for freight transport, by transport mode.

Table 2: Freight transport in the EU-27 by mode

<table>
<thead>
<tr>
<th>Year</th>
<th>Road</th>
<th>Rail</th>
<th>Inland Waterways</th>
<th>Pipelines</th>
<th>Sea</th>
<th>Air</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>1,289</td>
<td>386</td>
<td>122</td>
<td>115</td>
<td>1,150</td>
<td>2.0</td>
<td>3,064</td>
</tr>
<tr>
<td>1996</td>
<td>1,303</td>
<td>392</td>
<td>120</td>
<td>119</td>
<td>1,162</td>
<td>2.1</td>
<td>3,098</td>
</tr>
<tr>
<td>1997</td>
<td>1,352</td>
<td>410</td>
<td>128</td>
<td>118</td>
<td>1,205</td>
<td>2.2</td>
<td>3,215</td>
</tr>
<tr>
<td>1998</td>
<td>1,414</td>
<td>393</td>
<td>121</td>
<td>125</td>
<td>1,243</td>
<td>2.4</td>
<td>3,300</td>
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<tr>
<td>1999</td>
<td>1,470</td>
<td>384</td>
<td>129</td>
<td>124</td>
<td>1,288</td>
<td>2.5</td>
<td>3,387</td>
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<tr>
<td>2000</td>
<td>1,519</td>
<td>404</td>
<td>134</td>
<td>127</td>
<td>1,348</td>
<td>2.7</td>
<td>3,534</td>
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<tr>
<td>2001</td>
<td>1,556</td>
<td>386</td>
<td>133</td>
<td>132</td>
<td>1,400</td>
<td>2.7</td>
<td>3,670</td>
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<tr>
<td>2002</td>
<td>1,606</td>
<td>384</td>
<td>132</td>
<td>128</td>
<td>1,415</td>
<td>2.6</td>
<td>3,668</td>
</tr>
<tr>
<td>2003</td>
<td>1,625</td>
<td>392</td>
<td>124</td>
<td>130</td>
<td>1,444</td>
<td>2.6</td>
<td>3,718</td>
</tr>
<tr>
<td>2004</td>
<td>1,747</td>
<td>416</td>
<td>137</td>
<td>132</td>
<td>1,485</td>
<td>2.8</td>
<td>3,920</td>
</tr>
<tr>
<td>2005</td>
<td>1,800</td>
<td>414</td>
<td>139</td>
<td>136</td>
<td>1,520</td>
<td>2.9</td>
<td>4,012</td>
</tr>
<tr>
<td>2006</td>
<td>1,855</td>
<td>440</td>
<td>139</td>
<td>135</td>
<td>1,548</td>
<td>3.0</td>
<td>4,129</td>
</tr>
<tr>
<td>2007</td>
<td>1,927</td>
<td>452</td>
<td>141</td>
<td>129</td>
<td>1,575</td>
<td>3.1</td>
<td>4,228</td>
</tr>
</tbody>
</table>

1995-2007 per year: 49.6% 17.1% 15.6% 12.1% 37.0% 55.0% 38.0%
2006-2007 per year: 3.9% 2.7% 1.9% -4.7% 17.6% 3.3% 2.6%

Source: DG TREN (2009a)

Table 3: Passenger transport in the EU 27 by mode

<table>
<thead>
<tr>
<th>Year</th>
<th>Passenger Cars P2W</th>
<th>Bus and Coach</th>
<th>Railway</th>
<th>Tram and Metro</th>
<th>Air</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>3,863</td>
<td>123</td>
<td>504</td>
<td>351</td>
<td>71</td>
<td>335</td>
</tr>
<tr>
<td>1996</td>
<td>3,931</td>
<td>125</td>
<td>508</td>
<td>349</td>
<td>72</td>
<td>352</td>
</tr>
<tr>
<td>1997</td>
<td>4,010</td>
<td>127</td>
<td>506</td>
<td>351</td>
<td>73</td>
<td>385</td>
</tr>
<tr>
<td>1998</td>
<td>4,108</td>
<td>130</td>
<td>515</td>
<td>351</td>
<td>73</td>
<td>410</td>
</tr>
<tr>
<td>1999</td>
<td>4,212</td>
<td>134</td>
<td>515</td>
<td>359</td>
<td>75</td>
<td>424</td>
</tr>
<tr>
<td>2000</td>
<td>4,292</td>
<td>136</td>
<td>518</td>
<td>371</td>
<td>77</td>
<td>456</td>
</tr>
<tr>
<td>2001</td>
<td>4,376</td>
<td>139</td>
<td>519</td>
<td>373</td>
<td>78</td>
<td>453</td>
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<tr>
<td>2002</td>
<td>4,452</td>
<td>139</td>
<td>518</td>
<td>366</td>
<td>79</td>
<td>445</td>
</tr>
<tr>
<td>2003</td>
<td>4,480</td>
<td>144</td>
<td>519</td>
<td>362</td>
<td>79</td>
<td>463</td>
</tr>
<tr>
<td>2004</td>
<td>4,543</td>
<td>147</td>
<td>525</td>
<td>368</td>
<td>82</td>
<td>493</td>
</tr>
<tr>
<td>2005</td>
<td>4,536</td>
<td>150</td>
<td>526</td>
<td>379</td>
<td>82</td>
<td>527</td>
</tr>
<tr>
<td>2006</td>
<td>4,656</td>
<td>154</td>
<td>526</td>
<td>390</td>
<td>84</td>
<td>549</td>
</tr>
<tr>
<td>2007</td>
<td>4,608</td>
<td>154</td>
<td>539</td>
<td>395</td>
<td>85</td>
<td>571</td>
</tr>
</tbody>
</table>

%5/07  21.4% 24.8%  6.9% 12.7% 20.1% 70.4% -7.7% 22.3%
/year  1.6%  1.9%  0.6%  1.0% 1.5% 4.5% -0.7%  1.7%
%5G/07 0.7%  0.1%  2.4%  1.4% 1.8% 4.0%  2.5%  1.2%

Source: DG TREN (2009a)
The graphs show the following trends:

- Concerning freight transport, road (national and international haulage) and sea (only domestic and intra EU 27 flows, provisional estimates) modes account for the higher shares of demand; on average respectively about 44% and 37% in terms of tkm; quite stable over the time span considered.
- Concerning passenger transport, road transport (cars and coaches) is the most important mode for meeting transport demand, on average respectively by 72% (stable) and 9% (decreasing trend) 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.

Table 4: Short and long distance transport volume by mode

<table>
<thead>
<tr>
<th>Mode</th>
<th>Billion pkm per year</th>
<th>Billion trips per year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;100km %</td>
<td>&gt;100km %</td>
</tr>
<tr>
<td>Air</td>
<td>0.0</td>
<td>560.0</td>
</tr>
<tr>
<td>Bus/Coach</td>
<td>249.0</td>
<td>37.6</td>
</tr>
<tr>
<td>Car driver</td>
<td>1443.4</td>
<td>59.4</td>
</tr>
<tr>
<td>Car passenger</td>
<td>809.6</td>
<td>53.8</td>
</tr>
<tr>
<td>Rail</td>
<td>64.8</td>
<td>22.5</td>
</tr>
<tr>
<td>Total</td>
<td>2566.8</td>
<td>47.1</td>
</tr>
</tbody>
</table>

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

Concerning the regional distribution, the TRANSvisions study (2009a) 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 macro zone: South (Portugal, Italy, Greece, Spain), North-Centre (rest of EU - 15), East (rest of EU - 27). This classification allows the analysis of the transport volumes trends in three differentiated zones of Europe: a) the North-Centre most developed industrial areas, b) the historical less developed southern areas and c) the new eastern areas (New Member States). However, it should be stressed from the point of view of traffic volumes the three areas are not fully homogenous, e.g. apart from the cases of Spain and Portugal, the three southern European peninsulas have no land connections. This could in some way underestimate the Intra-zone trips in the South zone, which could therefore be lower than in the other zones
- InterZone: trips with origin and destination in different macro zones
- ExtraEU: trips with origin or destination outside EU - 27, in one of the neighbouring countries (EFTA, the Balkans, Russia, Byelorussia, Ukraine and Turkey)

The following graph shows the freight traffic distribution (only inland modes) at 2005.
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 ton km). This confirms the importance and the weight of the industrial centre-European structure in determining freight transport flows. The analysis of the freight composition in the zone (both Intrazone and domestic) shows in fact the importance of two industry related sectors: Machinery & other manufacturing; and Building minerals & material.

**Figure 5:** 2005 Freight Ton-km geographic distribution (only inland traffic)

**Source:** TRANSvisions (2009a)

**Figure 6:** 2005 Freight Ton-km volume of short and mid-distance trips (only inland traffic)

**Source:** TRANSvisions (2009a)
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%).

**Figure 7:** 2005 Shares of freight Ton-km distribution of short and mid-distance trips in Europe (only inland traffic)

![Graph showing shares of freight Ton-km distribution](image)

*Source: TRANSvisions (2009a)*

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

**Figure 8:** 2005 Passenger Pax-km geographic distribution (all modes)

![Graph showing passenger Pax-km distribution](image)

*Source: TRANSvisions (2009a)*

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):
Drivers of transport demand trends

EU Transport GHG: Routes to 2050?

Figure 9: 2005 Passenger Pax-km volume of short and mid distance trips in Europe (all modes)

![Figure 9: 2005 Passenger Pax-km volume of short and mid distance trips in Europe (all modes)](image)

Source: TRANSvisions (2009a)

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).

Figure 10: 2030 Baseline Freight Ton-km distribution (only inland traffic)

![Figure 10: 2030 Baseline Freight Ton-km distribution (only inland traffic)](image)

Source: TRANSvisions (2009a)

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 show a significant growth compared to the 2005 level in the east zone, in particular the intra zone trips, due to the consolidation of the internal market.
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.

Figure 12: Pax-km 2005-2030 Baseline variation by trip length in Europe

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

- Over the past decades, intra-EU freight transport demand, measured in tonne kilometres, has increased by 2.8% per year on average. The corresponding growth rate for passenger transport demand has been 1.7% (in passenger km). Road and sea transport
modes have accounted for the higher shares (freight transport) in satisfying the transport demand. Concerning passenger transport, road transport modes (car and coaches) have basically proved to be the most important modes for meeting the demand.

- About the future trends in Europe, they have been estimated through the TRANS-TOOLS model (at 2030). This is a 4-step transport equilibrium model (version November 2008, developed by DTU and others in TEN-CONNECT), calibrated against 2005 data (see the Annex 3 for an overview on the model assumptions).

- **Freight trips** by 2030 will likely become longer as the share of intra European and extraEU27 increases compared to regional and domestic movements. Economic integration of Eastern European countries and the globalisation process (increase on imports and exports for overseas) may act as a causal factor. As an effect of the consolidation of the internal market in the east zone, the increase in intra zone trips by 2030 is due to growth.

- 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. This will happen in particular in the East zone. Intrazone trips, due to the consolidation of the internal market, whose pkm variation compared to 2005 level will be 1.6%, against 1.1% in North-Centre zone and 1.3 in the South zone.
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, globalisation)
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 results of the DELPHI 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. 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 globalisation 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
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.

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.

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8 Available on line at [http://www.isis-it.net/survey4/Login.asp](http://www.isis-it.net/survey4/Login.asp); Username and Password: guest
9 39 indicators representative of the following five key transport drivers have been considered: society, economy, energy, technology, and environment
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. As stated in the TRANSvision study (2009b, page 56) “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 per cent of today’s population is aged 60 years or over and by 2050 that proportion is projected to be 32 per cent. 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 per cent in 2005 to close to 20 per cent 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”:

Table 5: 2050 older people shares (all regions of the globe)

<table>
<thead>
<tr>
<th>Major area</th>
<th>Percentage distribution in 2005</th>
<th>Percentage distribution in 2050</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0-14</td>
<td>15-59</td>
</tr>
<tr>
<td>World</td>
<td>28.3</td>
<td>61.4</td>
</tr>
<tr>
<td>More developed regions</td>
<td>17.0</td>
<td>62.9</td>
</tr>
<tr>
<td>Less developed regions</td>
<td>30.9</td>
<td>61.0</td>
</tr>
<tr>
<td>Least developed countries</td>
<td>41.5</td>
<td>53.4</td>
</tr>
<tr>
<td>Other less developed countries</td>
<td>29.1</td>
<td>62.3</td>
</tr>
<tr>
<td>Africa</td>
<td>41.4</td>
<td>53.4</td>
</tr>
<tr>
<td>Asia</td>
<td>28.0</td>
<td>62.7</td>
</tr>
<tr>
<td>Europe</td>
<td>15.9</td>
<td>63.5</td>
</tr>
<tr>
<td>Latin America and the Caribbean</td>
<td>29.8</td>
<td>61.2</td>
</tr>
<tr>
<td>Northern America</td>
<td>20.5</td>
<td>62.7</td>
</tr>
<tr>
<td>Oceania</td>
<td>24.9</td>
<td>61.0</td>
</tr>
</tbody>
</table>


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 Table 6. 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.
Table 6: 2050 population ageing in Europe (EU 25)

<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0-14</td>
<td>15-64</td>
</tr>
<tr>
<td>EU-15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Variant</td>
<td>0.16</td>
<td>0.67</td>
</tr>
<tr>
<td>Medium Variant</td>
<td>0.16</td>
<td>0.67</td>
</tr>
<tr>
<td>High Variant</td>
<td>0.16</td>
<td>0.67</td>
</tr>
<tr>
<td>NMS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Variant</td>
<td>0.16</td>
<td>0.70</td>
</tr>
<tr>
<td>Medium Variant</td>
<td>0.16</td>
<td>0.70</td>
</tr>
<tr>
<td>High Variant</td>
<td>0.16</td>
<td>0.70</td>
</tr>
<tr>
<td>EU-25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Variant</td>
<td>0.16</td>
<td>0.67</td>
</tr>
<tr>
<td>Medium Variant</td>
<td>0.16</td>
<td>0.67</td>
</tr>
<tr>
<td>High Variant</td>
<td>0.16</td>
<td>0.67</td>
</tr>
</tbody>
</table>

Source: World Population Prospect. 2004 Revision

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.

The complex and mutually reinforcing relationships between the growing need for transport mobility and ageing, better conditions of life and changes in labour market composition, have been also stressed in the OECD study (OECD, 2002), in which, in the overall conclusions, were:

1. “the next generation of elderly will be used to high mobility (travelling whenever they want and travelling longer distances) and they will be determined to maintain this level of mobility. They will also be likely to have the financial capacities to do so.”
2. Elderly people will, on average, enjoy better health and physical condition than in the past, since living standards are improving. This means that the future elderly are likely to remain active for a longer time than before. Some people continue working for a few days a week after reaching the age of 65, or they start doing volunteer work.

3. Older people often choose to live away from inner urban areas, among others because of the higher crime rate and the higher costs of living within these areas. The need for mobility is greater in low-density areas than in urban areas.

4. Last, nowadays older people live independently, instead of in institutions, for a longer period than previously. “Ageing in place” is highly valued: older people don’t want to change where they live. This is partly a result of government policy, which encourages people to live on their own for as long as possible. Also, in the distant past it was usual for people to move in with their children when getting older. This is no longer the case. Living alone for a longer period requires more travelling to do shopping, visit health services, etc.”

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 and car, to the extent that older people will be placed away from the inner urban areas.

4.2 Impacts of migration

Concerning migration flows, as outlined in the TRANSvision study (2009b, page 58) “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:

Table 7: Migration scenarios (2050) in Europe (EU 25)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>EU-15</th>
<th>NMS</th>
<th>EU-25</th>
</tr>
</thead>
<tbody>
<tr>
<td>808</td>
<td>45</td>
<td>853</td>
<td></td>
</tr>
</tbody>
</table>

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.”
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.

To the extent that migration flows will be directed towards the outskirts of agglomerations, 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, and living in urban areas (particularly suburban areas). The likely improvement in the quality of life and income level of the first generations of immigrants may at the same time increase motorization levels, spurring the future transport demand by individual means (cars, motorbikes, etc).

4.3 Impacts of urbanization

In Europe the proportion of the population residing in urban areas is expected to rise from 72 per cent in 2005 to 78 per cent 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 Table 8. 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).

The BAU forecasts in the TRANSvisions DELPHI survey are taken from statistics and research projects reflecting “do nothing” scenarios.
Table 8: Urbanization trend in Europe (EU 25) to 2030

<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th>2010</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU-15</td>
<td>73.8%</td>
<td>74.8%</td>
<td>76.0%</td>
<td>77.3%</td>
<td>78.7%</td>
<td>80.2%</td>
</tr>
<tr>
<td>NMS</td>
<td>63.0%</td>
<td>63.6%</td>
<td>64.4%</td>
<td>65.5%</td>
<td>66.8%</td>
<td>68.1%</td>
</tr>
<tr>
<td>EU-25</td>
<td>72.1%</td>
<td>73.0%</td>
<td>74.1%</td>
<td>75.4%</td>
<td>76.9%</td>
<td>78.4%</td>
</tr>
</tbody>
</table>

Source: World Urbanization Prospect, the 2005 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, 90% of the respondents range between +10% from the BAU trend" (TRANSvision study, 2009b, page 188).

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.

If the malls are located away from populated areas, e.g. in rural areas nearby highway connections, it is unlikely that public transport links can be provided at a reasonable cost. Presently, in the majority of cases, these centres are largely accessed by car and have limited public transport options for reaching them. Often the farther the malls are in the countryside, the bigger they are – because they serve a large catchment area and are built upon cheaper rural land – and the bigger their car parks. In this case dual mode vehicles which can leave people at the mall entrance and go to park themselves are bound to be favoured. At any rate, if the current trends in the increase of peripheral retail centres continue, a growing transport demand by car is expected.
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 more true 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" (TRANSvision, 2009b, pages 128-129).

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

It is generally acknowledged that the cost of travel, that may be broken down into a fixed (vehicle purchase, maintenance, etc) and a variable part (taxes, fuel price, etc), plays an important role in determining the future passenger transport demand.

As shows in the IEA report (2007), fuel prices vary considerably across IEA countries. Three groups of countries can be identified: a) the United States, with the lowest prices (and the lowest tax levels); b) the European countries, with generally high prices (and high taxes); and, in the middle, other IEA countries such as Australia, Canada, Japan and New Zealand. The evolution of oil prices is one of the key element underlying the variation in car fuel prices over time. Taking account of the different tax regimes, the evolution of the gasoline prices in real terms has followed strictly the evolution of crude oil prices: substantially unchanged during the 90’s, after the peak in the early 1980s, starting to raise after the Asian crisis and OPEC production curbs from late 90’s onward, as showed in the figure below:

**Figure 14:** Trends in retail gasoline prices in real terms in Europe and other OECD countries

The passenger travel per capita (in vkm) and the average fuel price (2004), as showed in the next figure, appear to follow the same trends, even if there are some exceptions, shedding lights on the complex relationships between fuel prices and passenger car demand.
Figure 15: Passenger travel volume and fuel price (2004)

Source: IEA, 2007

The figure shows that countries with lower fuel prices (US, Australia, Canada) tend to have higher per capita passenger travel (in 000vkm). But, on the other hand, Japan shows lower passenger per capita volumes despite low fuel price, due to the combined effects of small geographical density and public transport supply.

Generally, it can be said that high fuel costs and high fuel taxes are correlated with lower transport demand by car (and CO₂ emissions), but other explanatory factors as population density and the availability of alternatives to car must be taken into account (ITF, 2008).

Kennet Small and Kurt Van Dender in their regression analysis on the sensitivity of transport demand (vkm per adult) in the US, based on a sample of 39 years cross-sectional time series (ITF, 2007), found lower elasticity of the vehicle-mile travelled to higher fuel price in presence of increasing income (in the long term) and higher elasticity in the short term period.

The implication is that in the long term, due to increased income level, the transport demand may became less price-elastic to increase in fuel prices; despite a short-term higher elasticity. On the other hand, the good news is that the “rebound effect” (the increased driving resulting from more efficient fuel economy) may be limited in the long run.

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.

In general, for passenger transport the types of responses they may include are illustrated in the figure below (TRANSvisions study, 2009b, page 130). “They provide a simple behavioural framework though which the effects of higher oil prices may be interpreted.

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11 A typical example of the rebound effect is the case of dieselisation in some European countries. In France, the reaction to higher gasoline prices has been to increase the car travel (km driven) and emissions through new diesel cars. “On average, switching from a gasoline to diesel car led to 27% more distance driven, 20% more energy consumed and a decrease of 21% in fuel expenditures” (ITF/OECD, 2008)
In the freight transport sector, commercial travel demands are expected to be less sensitive to oil prices than light passenger travel demands (taking into account the differentiation in short and long-term effect). 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 Figure 17. This is similar to that previously considered for passenger transport.

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. For a general overview of the macroeconomic impacts of persistent high oil prices in Europe, see also the HOP research project (2008).

As outlined in the TRANSvisions study (2009b) page 133, "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” (TRANSvisions study (2009b, page 135). 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.

However, 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) (TRANSvisions, 2009b, page 136).

**Figure 18: Decoupling GDP and transport growth (2030)**

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“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” (TRANSvisions, 2009b, page 137). Considering 2050, the TRANSvisions forecasts show that the decoupling between traffic within the EU-27 and GDP is still consistent with the maintenance of historical mobility patterns, namely the decoupling in passenger traffic and to lesser extent in freight transport compared to GDP growth.

**Figure 19: Decoupling GDP and transport growth (2050)**
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.

Figure 20: GDP growth and maritime transport

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, which are 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.

With a view to 2050, the experts’ evaluations provided in the TRANSvisions DELPHI survey 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 to 2050 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" (TRANSvisions, 2009b, page 188).

4.6 Impacts of globalisation

In the context of this paper, globalisation is defined as an increasingly integrated world economy. Therefore, an important feature of globalisation is 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.

However, against this trend, the recent economic downturn and financial crisis has undermined the pace of globalization. An interesting paper issued by ITF (2009) sets out the relationships between the recent economic downturn, with its negative impact in terms of globalization and international trade, and the future demand for road, aviation and maritime transport.

The contraction of trade volumes resulting from the financial and economic crisis in 2008 has in fact been larger than of GDP. Furthermore, current global imbalances and potential shortage of public and private funds for transport investments, may tend to conclude that the future global economic development will be less trade-intensive than the past.

What could be the impacts on transport demand of such moderate expectations in globalization trends?

In the road sector, a reduction in the new-vehicle sales may be expected (LGV and HGV). This may lead to a reduction freight transport demand, as outlined in the previous chapter, but not in the GHG emission trends, due to the assumption that the intensity of vehicle use is not dependent on GDP levels. Furthermore, the reduction in new-vehicle sales may weaken the environmental performances. The order of magnitude of the reduction of new-vehicle sales (LGV) at 2050 is about 40 millions.

The sensitiveness of air transport demand to globalization can be assessed in the order of magnitude of 2.5% annual (measured in terms of revenues pkm), assuming in such a case the elasticity of aviation demand with respect to GDP equal to one.

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12 Resulting from the application of the Adjustment scenario, characterised by a moderate economic growth compared to the Global economy scenarios, in which no economic crisis is foreseen (outcomes of the IEA MoMo economic Model (ITF, 2009). In Italy, in 2009, due to the effect of the economic crisis, the reduction of HGV new vehicle sales has been in the order of 50%, compared to the same period in 2008.
Concerning maritime forecasts, the previous chapter has shown that the long-run elasticity of maritime transport to GDD growth in higher than 1, i.e. 3.6% of GDP growth against 4.3% per annum of maritime transport. The impact assessment of a reduced globalization on maritime transport (ocean-going shipping) at 2050 has been carried out comparing two scenarios including greater globalization (A1F and A1T) and two scenarios roughly assuming a moderate growth and a consequent reduction of globalization (the A2 scenario).

![Globalisation and aviation demand](image1)

**Source:** Adaptation from ITF (2009)

**Figure 21: Globalisation and aviation demand**

Concerning maritime forecasts, the previous chapter has shown that the long-run elasticity of maritime transport to GDD growth in higher than 1, i.e. 3.6% of GDP growth against 4.3% per annum of maritime transport. The impact assessment of a reduced globalization on maritime transport (ocean-going shipping) at 2050 has been carried out comparing two scenarios including greater globalization (A1F and A1T) and two scenarios roughly assuming a moderate growth and a consequent reduction of globalization (the A2 scenario).

![Globalisation and maritime demand](image2)

**Source:** ITF (2009)

**Figure 22: Globalisation and maritime demand**
The above scenarios are based on the IPCC SRES scenarios, in which the A1 scenarios describe a future world of very rapid economic growth (the A1F, based on fossil and the A1T on increased energy end-use efficiency); the A2 scenarios a situation in which per capita economic growth and technological change are more fragmented and slower than in other scenarios, the B1 and B2 scenarios, with various accents, describe a world of lower economic growth.

It is likely to be expected that the future maritime transport growth will result in between the more optimistic globalization scenarios (A1F/A1T) and the regional scenarios (A2). This may lead approximately to a transport growth reduction more than half of what might have been according to the past trends, corresponding respectively to a rate of 2% per annum until 2050 (ocean-going shipping) and 12% per annum (t/miles for container shipping).

In conclusion, the long term impacts in terms of transport demand are likely to be the following:

- The current globalisation 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.

- However, in presence of a reduced pace in globalization, due to the current economic crisis and rebalancing of international trade flows, a limited growth rate of transport demand may be envisaged.

- In particular, maritime transport (ocean going shipping and container shipping) and aviation (passenger) may be the sectors for which a reduced globalization exerts the most significant impacts, reducing the expected growth up to half (maritime) and in line with GDP growth (aviation).

- Concerning road, a limited globalization rate, by the way of reduced GDP, may reduce the renewal of vehicle stock, but not the intensity of vehicle use, with negative impacts in terms of emissions level.

### 4.7 Impacts of ICT

The use of information and communication technology (ICT) is deemed to have a considerable influence on the demand for transportation, even if the assessment of the right direction is not easy to grasp. Mokhtarian, for instance, (G.Draijer, T. Van der Hoorn, 1998) draws a distinction between the following effects:

1. Substitution effects (ICT reduces traffic).
2. Generation effects (ICT directly creates new travel needs).
3. Operational efficiency (ICT encourages travel by allowing transportation systems to work more efficiently).
4. Indirect, long-term effects (ICT can affect the location of the places people travel between, which then affects travel patterns).

It can be seen that the implications of new developments in ICT influence society in may ways, particularly in the fields of living, working and producing. The JRC/IPTS report (2003) has provided an interesting framework on the ICT implications for transport demand in each of the three mentioned fields.

The main impacts of ICTs in the socio-economic sphere of living can be summarised as follows (adapted from JRC/IPTS tables):

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13 The IPCC SRES scenarios are duly described in the IPCC report “Special Report on Emissions Scenarios”, 2000
EU Transport demand: Trends and drivers

EU Transport GHG: Routes to 2050?

AEA/ED45405/Task 3 Paper

Contract ENV.C.3/SER/2008/0053

### Living

<table>
<thead>
<tr>
<th>Application</th>
<th>Role of ICT</th>
<th>Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public transport planning</td>
<td>Integrated public transport planning</td>
<td>Modal shift in favour of public transport</td>
</tr>
<tr>
<td>Private transport planning</td>
<td>Real-time route guidance and planning</td>
<td>Savings in congestion and travel time but perhaps major distance travelled</td>
</tr>
<tr>
<td>Road pricing and user charging</td>
<td>Widespread technology for vehicle recognition and revenue collection</td>
<td>Reduction in travel distance, modal shift to public transport</td>
</tr>
<tr>
<td>Improvement in e-shopping, medicine, banking, ticketing</td>
<td>Internet, sms, etc</td>
<td>Contrasting effects: reducing the need for individual trips, but leading to new journeys to replace the old ones</td>
</tr>
</tbody>
</table>

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.

### Working

<table>
<thead>
<tr>
<th>Application</th>
<th>Role of ICT</th>
<th>Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-office, Teleworking</td>
<td>Internet, email, mobile telecommunications</td>
<td>The impact may be in possible reduction of travel frequency, but also additional travel/activities due to the time saving from teleworking</td>
</tr>
<tr>
<td>E-meeting</td>
<td>Videoconferencing</td>
<td>Potential reduction in travel distance</td>
</tr>
<tr>
<td>E-information</td>
<td>E-mail, ftp, extranet</td>
<td>Possible reduction of the need of meetings to exchange information</td>
</tr>
</tbody>
</table>

The implications for travel from ICT in working domain are complex, due to the fact that E-commerce and teleworking may reduce the need to move, but, at the same time, there is still a limited application of the phenomenon. In general, much of the evidence is limited, and there needs to be more systematic collection of standard information across Europe, both at key points in time and over time.

### Production

<table>
<thead>
<tr>
<th>Application</th>
<th>Role of ICT</th>
<th>Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-commerce</td>
<td>Internet, sms, email</td>
<td>May reduce the need to travel, but this trend is counterbalanced by more frequent deliveries: smaller loads, faster delivery and more air movements</td>
</tr>
<tr>
<td>Just in time production</td>
<td>Technology application for lean production, etc</td>
<td>More frequent deliveries</td>
</tr>
<tr>
<td>Logistic and freight distribution</td>
<td>Real-time route guidance, track and trace technology – optimising delivery vehicles and routes</td>
<td>Improve reliability of trips, but may increase the average distance</td>
</tr>
<tr>
<td>E-marketing and publicity</td>
<td>Internet, sms, email</td>
<td>Possible reduction in related trips, e.g. marketing/publicity material production and distribution</td>
</tr>
</tbody>
</table>
As far as production and logistic is concerned, ICT is one of the main means by which productivity has been improved and it has also resulted in substantial cost savings for transport. In terms of transport demand impacts, this has led to long supply chains, increasing the average distance of trips. The same can be said considering the impacts of satellite technologies, that allow larger units to be transported along the main routes at a higher frequency, but distances are increased.

In general, the technological opportunities provided by the development of ICT can influence transport demand in several directions, depending on the directions that society takes. Assuming the continuation in the long term scenario of the trend emerging over the past years, e.g. reducing but stable economic growth, sustained international trade, urbanization, etc, 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, due to the globalisation trends) 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 optimising 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 issue is relevant, due to the fact that the new vehicles will mainly affect the efficiency and energy consumption of transport operations, 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 trans-national 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.

| Table 9: Scenarios to 2030: changes in transport volumes by mode |
|---|---|---|---|---|
| Mode | 2005 | 2020 | 2030 | Relative change |
| Car driver | 240,385 | 283,055 | 315,500 | 18,0% | 31,2% |
| Car passenger | 137,550 | 166,051 | 184,388 | 20,7% | 34,0% |
| Bus | 37,110 | 35,904 | 34,950 | -3,1% | -5,8% |
| Train | 6,362 | 6,408 | 8,378 | 0,7% | 0,3% |
| Airplane | 0,483 | 0,578 | 0,650 | 19,5% | 34,6% |
| Total | 421,900 | 492,656 | 541,866 | 16,8% | 28,4% |
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.

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).

The TRANS-TOOLS forecasts at 2030 have been extrapolated to 2050 through the METAMODEL approach, in the context of the TRANSvision study (2009a). 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.

Table 10: 2050 forecasts of traffic variation

2005 Baseline-2050 % variation

| Annual EU27 intra-NUTS3 passenger traffic variation | Road passenger | 0.9% |
| Annual EU27 inter-NUTS3 traffic variation | Rail passenger | 0.9% |
| Annual Extra EU27 passenger traffic variation | Road passenger | 0.6% |
| Annual EU27 intra-NUTS2 freight traffic variation | Rail passenger | 2.7% |
| Annual EU27 inter-NUTS2 traffic variation | Road freight | 0.4% |
| Annual Extra EU27 freight traffic variation | Rail freight | 1.3% |
| Annual Extra EU27 freight traffic variation | Sea freight | 2.3% |
| Annual Extra EU27 freight traffic variation | Sea freight outside EU | 1.5% |
| EU27 traffic variation 2005/2050 | Pkm | 44.7% |
| | Tkm | 89.6% |
| Annual EU27 traffic variation | Passenger | 0.8% |
| | Freight | 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 is also driven by the growth in availability of low cost air transport, even if, to a certain degree, it should be considered that the presence of low cost carriers do not add in itself major demand, rather, it may gain market shares from other airlines (Civil Aviation Authority 2006).

Tourism is estimated to account for about 60% of the demand for aviation (ITF, 2009a), which is growing rapidly. The air sector has been moving passengers over longer distances for shorter and more frequent holidays with negative environmental impacts per trip compared with tourism by road and rail, depending in particular on the loading factor/occupancy rate and the average distance of the trip. The CO2 intensity per passenger km in the air sector is in fact higher for air short haul trips compared to a two-occupants small car and passenger trains (DG TREN, 2009).

As stated in the TRANSvisions study (2009b, page 66) “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% (it was 4% between 1995 and 2000 in Europe). This represents 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 increased demand for foreign travel.

Concerning the Intra Europe traffic, the forecasts available at 2027 for passenger traffic (ITF, 2009a) indicate a general reduction of the transport growth rates compared to the past trends. However, it should be considered that a substantial portion of the relatively high increase in traffic in the last seven years comes from the explosive growth of low cost carriers, and the creation of single aviation market which later included Eastern European countries.

<table>
<thead>
<tr>
<th>Year</th>
<th>Intra-Europe</th>
<th>Asia Pacific-Europe</th>
<th>Europe-North America</th>
<th>World total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ave 1990-2007</td>
<td>5.4%</td>
<td>6.2%</td>
<td>3.6%</td>
<td>4.4%</td>
</tr>
<tr>
<td>Ave. 2007-2027</td>
<td>3.5%</td>
<td>5.7%</td>
<td>4.7%</td>
<td>5.0%</td>
</tr>
</tbody>
</table>

The importance of the Eastern European countries in passenger transport has been also confirmed by the following graph, showing 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

As stated in the TRANSvisions study (2009b, page 146) “The impact of an emerging “sustainable consumption” culture on transport could be important. In general terms, the definition of sustainable consumption can be the following (from the UNESCO Teaching and Learning for a Sustainable Future web site) “Sustainable consumption asks us to consider issues that go beyond the individual when we shop. These include not only the ecological impacts of what we buy but also the equity, human rights and political dimensions of sustainability in the production and consumption process. These aspects of sustainable consumption provide guidelines on how to reduce the social and ecological impacts of what we consume”.

In a radical change in cultural attitudes, for example, 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 CO₂ 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 Conclusions

The table below 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 an increase in emissions, "-" indicating reduced emissions); and the regional or geographical area interested.

Table 11: Summary table of impacts on transport demand and GHG emissions relevance

<table>
<thead>
<tr>
<th>Drivers</th>
<th>Impacts on Transport demand</th>
<th>GHG Relevance</th>
<th>Geographical area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Population ageing</td>
<td>Increase in medium/long distance trips by car/air</td>
<td>High: +</td>
<td>European wide area</td>
</tr>
<tr>
<td></td>
<td>Increase in short distance trips by public transport</td>
<td>Low: -</td>
<td>Urban/Metropolitan</td>
</tr>
<tr>
<td>Migration</td>
<td>Increase in short distance trips by car/public transport</td>
<td>Medium +</td>
<td>Urban/Metropolitan</td>
</tr>
<tr>
<td>Urbanization</td>
<td>Short distance trips by car/public transport</td>
<td>Medium +</td>
<td>Urban/Metropolitan</td>
</tr>
<tr>
<td></td>
<td>Short/medium distance trips by car (commuting)</td>
<td>High: +</td>
<td>Urban/Metropolitan</td>
</tr>
<tr>
<td>Energy prices</td>
<td>Modal shift from car towards short/medium distance trips by walking/cycling /public transport</td>
<td>Reduction of long distance trips by road/air</td>
<td>High: -</td>
</tr>
<tr>
<td>(persistently high)</td>
<td>But in the long term, increased income may reduce the elasticity</td>
<td>Increased of regional trade by rail</td>
<td>High: -</td>
</tr>
<tr>
<td>GDP growth</td>
<td>Increase in long distance trips by air/ship (leisure)</td>
<td>High: +</td>
<td>Regional (EU New Member States) due to the development of the single market</td>
</tr>
<tr>
<td></td>
<td>Increase in short distance trips by car</td>
<td>High: +</td>
<td>European wide area</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High: +</td>
<td>Regional (EU New Member States) due to the catching up of the GDP per capita level with the EU 10 club</td>
</tr>
</tbody>
</table>
### Drivers of transport demand trends

<table>
<thead>
<tr>
<th>Drivers</th>
<th>Impacts on Transport demand</th>
<th>GHG Relevance</th>
<th>Geographical area</th>
</tr>
</thead>
<tbody>
<tr>
<td>More Globalisation</td>
<td>Increase in long distance trips by air</td>
<td>High: +</td>
<td>European wide area</td>
</tr>
<tr>
<td></td>
<td>Increase in long distance trips by road/air/ships</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less Globalization</td>
<td>Reduction in long distance trips by air</td>
<td>High: -</td>
<td>European wide area</td>
</tr>
<tr>
<td></td>
<td>Reduction in long distance trips by road/air/ships</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICT</td>
<td>Increase in long distance trips by air/ships/rail</td>
<td>High: +</td>
<td>European wide area</td>
</tr>
<tr>
<td></td>
<td>Increase in short/medium trips by public transport</td>
<td>Low: -</td>
<td>Urban/metropolitan</td>
</tr>
<tr>
<td>New infrastructures</td>
<td>Increase in long distance trips by rail</td>
<td>High: -</td>
<td>Regional, the EU Member States interested by the TEN-T projects (mainly the New Member States)</td>
</tr>
<tr>
<td></td>
<td>Increase in long/medium distance trips by rail</td>
<td>High: -</td>
<td></td>
</tr>
<tr>
<td>Tourism</td>
<td>Increase in long distance trips by air</td>
<td>High: +</td>
<td>Regional, the EU Member States interested</td>
</tr>
<tr>
<td>Lifestyle</td>
<td>Increase in short distance trips by public transport, walking and cycling</td>
<td>High: -</td>
<td>Urban/metropolitan</td>
</tr>
</tbody>
</table>

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, globalisation trends, energy prices), while fewer 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 due 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. ICT development will cause contrasting effects on transport demand; on the one hand they can substitute short term and commuting trips, on the other, they may favour rapid and more efficient deliveries in urban areas by car, associated to the reduction of transport costs favouring long distance trips. **Globalization** is an important factor in raising demand for maritime and air transport (passenger and freight); however, the impacts on the current economic crisis and trade imbalances may reduce its influence on transport demand. Furthermore, a reduced globalization may hamper the fleet renewal in the short term, leading to higher emissions. However, air transport demand (passenger) is expected to increase at widespread levels across Europe, spurred by tourism and income growth.

All these trends will have relevant GHG emissions effects. Generally, a minus sign in the above table means that the impacts on GHG will be positive, as these will decrease, due to the likely overall reduction that may result. This happens when public transport (rail, buses) is involved, particularly in presence of the underlying substitution effect with the use of cars and airplanes. An example is the provision of new infrastructures (TEN-T priority projects), that are deemed to increase the use of long distance trips by rail, or the emerging safer lifestyle in urban areas, shifting the use of cars towards the use of walking, cycling and public transport in short distance trips.
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ITF (2009a) Tae Hoon OUM, University of BC, Canada, Xiaowen FU, Hong Kong Polytechnic University, Anming ZHANG, University of BC, Canada. “Air Transport Liberalization and its impacts on Airline Competition and air passenger traffic”, Background Paper


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Annex 1: Literature review

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

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

<table>
<thead>
<tr>
<th>Topic</th>
<th>Issuing Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>A sustainable energy system in 2050: promise or possibility?</td>
<td>ECN – Energy research Centre of the Netherlands</td>
</tr>
<tr>
<td>Foresight Intelligent Infrastructure Futures The Scenarios – Towards 2055</td>
<td>Department for Transport (UK), Office of Science and Technology</td>
</tr>
<tr>
<td>UK Air Passenger Demand and CO2 Forecasts</td>
<td>Department of Transport (UK)</td>
</tr>
<tr>
<td>Long range Transportation Plan – 2050 -</td>
<td>Conseil Général des Ponts et Chaussées</td>
</tr>
<tr>
<td>Four futures for Europe</td>
<td>CPB Centraal Planbureau</td>
</tr>
<tr>
<td>Perspectives énergétiques de la France à l’horizon 2020-2050</td>
<td>Centre d’Analyse Stratégique</td>
</tr>
</tbody>
</table>

### 1.6 Relevant foresight studies produced by business and other stakeholders

<table>
<thead>
<tr>
<th>Topic</th>
<th>Issuing Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pathways to 2050: Energy and Climate Change</td>
<td>WBCSD</td>
</tr>
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</table>

### 1.7 Relevant foresight studies produced by business and other stakeholders

<table>
<thead>
<tr>
<th>Topic</th>
<th>Issuing Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shell energy scenarios to 2050</td>
<td>Shell International BV</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Topic</th>
<th>Issuing Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 International and EU policy outlooks</td>
<td></td>
</tr>
<tr>
<td>ESPON Programme</td>
<td>European Union</td>
</tr>
<tr>
<td>2.2 International and EU climate change and energy outlooks</td>
<td></td>
</tr>
<tr>
<td>Global Climate Policy Scenarios for 2030 and beyond</td>
<td>JRC-IPTS</td>
</tr>
<tr>
<td>VIEWLPS project “Clear Views on Clean Fuels”</td>
<td>ED DG TREN</td>
</tr>
<tr>
<td>EurEnDel - Technology and Social Visions for Europe’s Energy Future, European Energy Delphi</td>
<td>EC DG Research</td>
</tr>
<tr>
<td>Climate change and a European low-carbon energy system</td>
<td>European Energy Agency (EEA)</td>
</tr>
<tr>
<td>World Energy Outlook 2006</td>
<td>International Energy Agency (IEA)</td>
</tr>
<tr>
<td>Transport strategies under the scarcity of energy supply</td>
<td>EC DG Research</td>
</tr>
<tr>
<td>Topic</td>
<td>Issuing Institution</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>European Energy and Transport Trends to 2030 – Update 2007</td>
<td>DG TREN</td>
</tr>
<tr>
<td>**2.3 Relevant foresight studies produced by business and other</td>
<td></td>
</tr>
<tr>
<td>stakeholders**</td>
<td></td>
</tr>
<tr>
<td>The Vision 2030 Project – Final Report</td>
<td>UK Highways Agency</td>
</tr>
<tr>
<td>Mobility 2030: Meeting the challenges to sustainability The</td>
<td>World Business Council for Sustainable Development</td>
</tr>
<tr>
<td>Sustainable Mobility Project – Overview 2004</td>
<td></td>
</tr>
</tbody>
</table>
Annex 2: TRANSvision list of transport drivers

1. SOCIETY
   1. Population growth and ageing
   2. Migration
   3. Urbanization
   4. Work-time regimes (tele-working)
   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 m. in 2020, 495 m. 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 measuresd are summarized in the table below.

<table>
<thead>
<tr>
<th>Policy issue</th>
<th>Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective charging for transport</td>
<td>The existing charging regime is maintained. Where charges apply they are based on cost recovery.</td>
</tr>
<tr>
<td>Promoting freight transport corridors</td>
<td>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,</td>
</tr>
<tr>
<td>Promote the use of intelligent transport systems</td>
<td>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 %.</td>
</tr>
<tr>
<td>Advance the technological change in transport</td>
<td>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.</td>
</tr>
<tr>
<td>Support the development of freight logistics</td>
<td>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.</td>
</tr>
<tr>
<td>Improve interoperability in the rail transport sector</td>
<td>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.</td>
</tr>
</tbody>
</table>
Annex 4: Freight trends and forecasts

The freight trends and forecasts outlined in this paper derive basically from the most likely continuation of existing trends, relying on the BAU scenarios sketching out by the application of the TRANS-TOOLS model to 2030\textsuperscript{14}, projecting to 2050 the main trends under an "other things being equal" assumption.

Therefore, the freight forecasts provided in this paper do not take into account for extreme scenarios concerning economic development, world trade pace, population growth and other social/political background scenarios, e.g. insurgency or terrorism, lack of security, etc.

The structure of this annex is the following:

- A brief outlines the background assumptions behind the BAU scenario in the TRANS-TOOLS model and its main results
- The overview of future freight trends by transport mode, on the basis of the background conditions described before
- The conclusions, in terms of where, what type of goods and which transport means will characterize the long term freight transport flows

The BAU scenario in the TRANS-TOOLS assumptions

The review of drivers affecting volume and composition of transport demand carried out in the Task III Paper has identified a wide range of factors belonging to several interlinked domains: economy, energy, technology and society. With reference to the freight transport, the review has stressed that economic growth (including the pace of globalization and the related intensity of global trade), and fuel price, assumed as one of the main components of the transport costs, are important drivers behind freight transport growth.

The TRANS-TOOLS Baseline scenario looks at the above key drivers as follows:

**Economic growth.** The baseline scenario of economic development in Europe 27 to 2030 is based on the DG-ECFIN Note 253 of June 2006. The pattern suggests a fastest growth in the eastern part of Europe compared to the western part. There are in fact significant regional differences in the forecasts of GDP growth rates in Europe, to the extent that in the old member states (Germany, the Netherlands, Italy) the growth rates are slower compared to the Eastern European countries. The graph below shows that this pattern is going to continue up to 2050, in which for many countries the potential annual growth rates will drop to close to, or below, 1\% during the period 2030 to 2050. Only a few small countries (LU, LV, CY, IE, LT, and EE) are projected to benefit of an average growth rate higher than 2.5\%.

\textsuperscript{14} The TRANS-TOOLS transport forecasts to 2030 have been analysed in the TEN CONNECT study (2009), elaborated and projected to 2050 in the TRANSvision study (2009). The TRANS-TOOLS forecasts have also been used in the FREIGHTVISION project (2009)
Oil price. In the TRANS-TOOLS baseline scenario (2005-2030), the oil price in 2030 is 20% higher than in 2005 in real prices. Price per barrel of oil, expressed in 2006 US$ per barrel will be about 80€ on average from 2005 - 2030. However, a peak in oil price after 2025 is expected due to the increasing resource scarcity. In fact, according to the WETO –H2 Reference scenario (2006), oil price per barrel could reach 110 $ (100 $ per barrel for gas) in 2050, as shown in the following picture.
Despite the likely increase of oil price in the long term horizon, the impacts on freight transport costs and the related negative implications for freight transport demand are considered mild. This could happen for several reasons, generally depending on technological developments:

- Concerning **truck**, it should be considered that about 2/3 of the costs are time related and the rest can be considered as distance related. Considering the distance related costs, fuel costs make up about 1/3 to ½ of the distance based costs (TEN CONNECT, 2009). Therefore, also assuming an improvement of technological development and improved efficiency both in terms of better utilisation of the trucks and more efficient load planning, it can be concluded that distance costs for trucks will increase with 4% up to 2030 measured in fixed prices and something more up to 2050, due to higher oil prices, but not up to a level reducing dramatically freight transport demand by truck.

- The same technological development will act positively for freight transport by **air**. It is expected in fact that efficiency improvements, as well as consolidation of the air transport business and introduction of less fuel consuming aircrafts could result in the same air fares in 2030 as in 2005, measured in real prices.

- Concerning **maritime** transport, not modelled as such in TRANS-TOOLS (freight flow between Europe and the rest of the world are estimated but not allocated to specific transport modes, even if it can be guessed that the vast majority of them is carried by ship), it can be assumed in the long term that maritime transport will be not the most sensitive transport mean to higher energy costs, given that it only uses 5% of the oil consumed by transport sector (ITF, 2009).

- **Inland Waterways** operating costs are considered in the long run to be not heavily affected by fuel prices increase.

**Globalization** and the economic integration have an enormous effect on freight transport. The main paper has provided estimates of how the reduction of international trade due to the present economic downturn may affect freight demand, in particular for maritime transport. **However, the TRANS-TOOLS scenario to 2030 and the projection to 2050 assume that the globalization process in the long term perspective will not be arrested**: the decline in customs duties, containerisation and more reliable transport, the Internet, information and communication technologies will continue to exert their impact toward a general reduction of transport costs. Moreover, the reorganization of the global industrial landscape from the International Division of Labour to the International Division of Production Processes (ITF, 2009) will continue, implying the development of modular products, which can be broken down into independently constructed sub-assemblies, paving the way for the reorganisation of production processes on a global scale.

This process will also change the commodity structure and commodity composition of the European trade. A growing **value-to-weight** ratio and evolution compared to GDP growth in the European import and export external trade has already been recorded over the past 10 years, as showed in the figure below (TRANSvisions, 2009):
Figure 28: Value to weight evolution of EU 27 Import external trade

![Graph showing the value to weight evolution of EU 27 Import external trade.](image)

Figure 29: Value to weight evolution of EU 27 Export external trade

![Graph showing the value to weight evolution of EU 27 Export external trade.](image)

Source: TRANSvisions (2009)

The growing value-to-weight ratio in freight transport leads to the consequence of a reduced importance of transport costs of the delivered price of goods (low price elasticity), leading to increasing switching to air cargo and maritime transport in a long term perspective.

Summing up, the TRANS-TOOLS baseline scenario assumes that freight transport in Europe will be spurred by globalization and new international production patterns (vertical integration and increase of value-to-weight ratios of traded goods), stressing the emergence of a global economy in which in the long run the notion of distance and nation could be not so important. In such a context, there will be a European moderate economic growth on average (GDP at 2%), but with higher levels in the Eastern countries.
Results

The resulting trends (2005-2050) of freight transport (including short sea shipping) by geographic distribution are the following (all transport modes included):

Figure 30: Freight geographic distribution EU 27 (2005-2050)

The geographical distribution allows to identify two type of traffic:

1. **Short distance freight traffic**, classified in a) Domestic freight traffic: trips with origin and destination inside the same country b) Regional freight traffic occurring inside the NUTS2 area; c) Intra Intra-Zone freight traffic: trips with origin and destination inside the same macro zone: South (Portugal, Italy, Greece, Spain), North/Centre (rest of the EU-15), East (rest of the EU-27).

2. **Long distance freight traffic**, concerning: a) ExtraZone traffic, involving trips with origin and destination in different macro zones and b) Cross-border freight traffic, i.e. Extra-EU: trips with origin or destination outside the EU-27, in one of the neighbouring countries (EFTA, the Balkans, Russia, Byelorussia, Ukraine and Turkey).

The figure shows a growing trend of long distance trips, in particular overseas freight traffic, while the short distance trips, in particular domestic trips show a significant decreasing trend. The next chapter reviews how the different transport modes behave in such a context.

**Freight scenarios by transport modes**

**Road transport**

Road freight traffic by truck will not lose its importance. As shown in the table below, in terms of tonne km, the TRANS-TOOL forecasts to 2030 and the projections to 2050 show a limited reduction in the share of road freight transport at EU 27 level: from 46.5% to 40.3%.
Table 12: Shares by transport mode in billion tonne km (2005-2050) EU 27

<table>
<thead>
<tr>
<th>Mode</th>
<th>Bill tkm 2005</th>
<th>Bill tkm 2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road Intra NUTS</td>
<td>395</td>
<td>465</td>
</tr>
<tr>
<td>Road Inter NUTS</td>
<td>1316</td>
<td>2347</td>
</tr>
<tr>
<td>Rail</td>
<td>447</td>
<td>1222</td>
</tr>
<tr>
<td>Maritime</td>
<td>1525</td>
<td>2949</td>
</tr>
<tr>
<td>Total</td>
<td>3683</td>
<td>6983</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Percentage</th>
<th>2005</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Road</td>
<td>46.5%</td>
<td>40.3%</td>
</tr>
<tr>
<td>% Rail</td>
<td>12.1%</td>
<td>17.5%</td>
</tr>
<tr>
<td>% Maritime</td>
<td>41.4%</td>
<td>42.2%</td>
</tr>
<tr>
<td>Total</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Source: TRANSvisions (2009)

Furthermore, in terms of freight tonne-lifted, the truck mode accounts nowadays for about 73% of all freight transport movements, and despite its decreasing trend (it will be 67% in 2030), it is likely to be expected that road freight transport will be still relevant to 2050. The lifted tonnes, the so-called handling factor (McKinnon, 2006), can be considered a crude measure of the number of links in a supply chain. The important role of truck stresses the limited degree of substitution with other modes, also in consideration of the fact that 85% of road transport is less than 150km, with no viable alternative (J. Lacny, 2009).

By type of commodity, mineral and solid fuels will be the most important items carried by road (domestic market). The geographical growth strongly depends on the GDP forecast. Future developments in tonne-km are in fact correlated with the GDP growth. This explains the higher truck transport growth projected in the Eastern European countries: Romania, Latvia, Poland, Bulgaria and the Slovak republic. Where the domestic freight transport is projected to fall, as in Denmark and Germany, a reduction in tonne km by road is likely to happen.

In fact, according to the TRANS-TOOLS projections in the European central and northern regions, domestic freight traffic will remain stable, decoupled from economic growth, while traffic originated or having a destination outside the EU-27 is projected to grow faster than the economy.

**Rail transport**

The TRANS-TOOLS projections for rail freight transport are positive. Rail freight transport in fact increases its share from 12% in 2005 to 14% in 2030 to 17% in 2050. The growth in long distance transport is the key factor behind the good performance of rail freight.

The TRANS-TOOLS projections points out that in the long term, rail freight may grow because of the high growth of goods imported and exported overseas. Rail is in fact expected to be competitive for overseas traffic moving from/to large ports and main consumption centres.

In terms of geographical distribution, Bulgaria and Romania are estimated to show an increase more than 200% in 2030.
By type of commodity, bulk products, building material, chemicals and metal product will be the type of goods showing the higher increase by rail. Furthermore, in 2030 the rail freight transport to and from Russia is expected to grow by 135%. Similar high growth rates are expected in the Baltic countries.

**Maritime transport**

Maritime and Short Sea Shipping freight transport are projected to grow at high rates in Europe. The TRANS-TOOLS forecasts to 2030 and the projections to 2050 show a growth rate in billion tonne km by about 100% for SSS (compared to the 2005 level) and about 150% for overseas transport, as shown in the table below.

<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th>2020</th>
<th>2030</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea freight including SSS</td>
<td>1525</td>
<td>2223</td>
<td>2645</td>
<td>2949</td>
</tr>
<tr>
<td>% var.</td>
<td>100</td>
<td>45.8%</td>
<td>73.4%</td>
<td>93.4%</td>
</tr>
<tr>
<td>Sea freight outside Europe</td>
<td>52022</td>
<td>75309</td>
<td>91820</td>
<td>129104</td>
</tr>
<tr>
<td>% var</td>
<td>100</td>
<td>44.8%</td>
<td>76.5%</td>
<td>148.2%</td>
</tr>
</tbody>
</table>

The reasons behind the high growth rates are manifold:
- technological reasons: it is supposed that short-sea shipping and feedering will become increasingly efficient as inland transport becomes more congested, or there is no alternative dedicated rail service available
economic reasons: as stressed by Hummels (2009), the growth of the ratio value-to-weight of the goods transport, i.e. the unit of the value of the goods transport is increasing, makes the transportation costs by maritime (and air) less important in terms of impacts on the final good delivered to the consumers.

globalization trends, which rely essentially on maritime transport and that, in particular for the Centre-North Europe, will determine the increase of the average distance against the domestic traffic (the opposite will happen in the European South–East countries), meaning an increase in overseas imports and exports.

Furthermore, the projected growth rates are going to be supplied by massive infrastructure investments, as stressed in the TEN CONNECT (2009), for which “massive container terminal extension plans will add additional capacity of 43 million TEU in the North Range, 31 million TEU in the Mediterranean and the Black Sea and another 9 million TEU in the UK until 2020”. This will make the capacity of the EU containers Ports sufficient to meet the demand.

### Air transport

Air freight transport demand at world level has been growing at an average annual rate by 5.8% since 1978 (Boeing, 2008). In a future scenario characterised by a moderate economic growth and the continuation of the current globalization trends, a 5.4 percent average annual growth in air cargo traffic may be estimated in the long term. This would imply that air traffic will double in 15 years, and more than triple in 25 years (Tae Hoon OUM, et al, 2009).

In Europe, the analysis carried out by Hummels (2009) based on past trends over the 2000-2007 period of the shows that in 2007, airborne EU 27 imports from other countries non EU (in value) were 18.1 percent of the total, compared to 25.1 percent in 2000. In contrast, seaborne imports were 50.3 percent of the import value, with a growing trend compared to 2000 (41.5). This means that in this period airborne imports rose only slightly while seaborne import values rose 75 percent. Data show that there is a great variance across countries in their reliance on air-borne v. ocean-borne shipments, for example, as landlocked countries heavily use airborne shipments. A similar trend is shown for export value. Exports are less likely to use air (25.1 percent in 2007; against 31 percent in 2000).

However, data show that airborne exports are especially important for the UK and Ireland. This likely reflects the commodity composition (e.g. the prevalence of electronics and pharmaceuticals in Irish exports). This can lead to the interesting conclusion that richer countries are also more likely to use airborne shipments.

The future growth of air freight transport will be determined by:

- Positively: economic growth rate and growing globalization rates (the reduction in weight/value ratio make convenient to shift to air shipping)
- Negatively: Oil rising prices (past trends show that the elasticity of transportation costs to rising oil price is higher for air than for maritime shipping)

### Inland waterways transport

The TRANS-TOOLS growth rates of inland waterways are slightly below the truck growth rates (in tonn km): 27% between 2005 and 2020 and 39% between 2005 and 2030, corresponding to an annual growth rate of 1.5%.

Belgium, France, Germany and the Netherlands show continuous grow rates, following the general increase of freight transport.
The type of commodity involved are metal product and solid fuels (domestic market) and metal product and manufactured articles (international trade).

**Conclusions**

The long term trends shaping the TRANS-TOOLS forecasts and projections to 2050 at EU 27 level are the following:

**Moderate economic growth**: The average annual GDP growth rate by 2% at EU 27 level is assumed. However, significant differences at regional and national level are expected, with relative higher growth rates in Eastern and Baltic countries. Due to the strong relationships between GDP growth and road freight transport, e corresponding higher growth rates in these countries is to be expected.

**Oil price will continue to rise**: However, the growing trend of oil prices, in particular over the 2030-2050 period is not going to reduce significantly the freight transport growth. This is due mainly to technological improvements: the energy consumption by road oil-based transport will drop by 19% to 2050, in addition to load factors improvements due to the application of new technologies in freight logistic, allowing the reduction of the impacts of higher oil prices on transport costs. Maritime transport has shown a low elasticity of traffic growth to higher oil prices, while rising fuel prices could undermine the relative price of air cargo.

**Globalization and international trade will not be subjected to radical changes.** It is likely to be expected that China will rely less on export-led growth patterns, while, at the same time, US trade deficits could be adjusted in the long term. However, the integration of the world economy should not been undermined and the European international trade should continue to growth at higher rates compared to the intra European transport.

The implications of these trends in terms of where freight transport will be directed, what type of goods will be involved and how they will be carried, are the following:

**Where**

The evolution of freight demand will be different geographically. In the EU central and northern regions, domestic freight traffic will remain stable, decoupled from economic growth, while traffic originating or having a destination outside the EU-27 will grow faster than the economy. Besides, if measured in value instead of weight, foreign trade is increasing in terms of value, and the proportion of international traffic will be higher in the European North/Centre zones.

To 2030, the European Eastern countries are expected to have the biggest increase of freight transport (4.3% ton-km per year), while the South will grow less (1.58% per year) and the North/Centre even loses some traffic, -0.3% per year. Freight transport between the zones increases most from/to the eastern countries to the rest, with the East-South exchanges growing at 4.1% per year and East-North/Centre growing at 3.3% per year. The South-North/Centre relation grows at a more modest rate of 1.1% per year. Freight traffic with neighbouring countries grows most in the eastern countries at a rate of 4.1% per year. In the South this rate is 2.7% and in the North/Centre 2.3%. To 2050, the projections of the above trends should continue, even if with higher uncertainties.

**What**

While freight transport for shorter distances will be dominated by minerals and building material, for longer distances, it will be more mixed with machinery and other manufacturing, especially for the more industrialised zones. Crude oil, oil derivatives and to a lesser extent solid mineral fuels will be also important in the long distances.

Total motorised freight transport with origin or destination in the EU-27 (measured in ton-kilometres) will keep growing, following previous patterns, but the elasticity to GDP will change
largely in relation to the type of products and the type of movement considered. When only considering freight with origin and destination within EU-27 territory, the growth rate could be very low in average for all products, less than 1.2% per year. The addition of freight with origin or destination in EU-27 neighbouring countries (except northern Africa) increases the growth rate to 2.25% per year, mainly due to the great amount of oil, coal and other fuels moved by sea mode coming from Norway and Russia.

How

The following table summarises the long term projections by transport mode:

| Table 14: Projections of freight transport annual variation growth rates by mode (2005-2050) |
|--------------------------------------------------|--------------------------------------------------|--------------------------------------------------|--------------------------------------------------|
| P.a % Freight traffic                            | 2005                                            | 2020                                            | 2030                                            | 2050                                            |
| -                                                | 2.0%                                            | 1.9%                                            | 1.4%                                            |
| P.a % Road Freight traffic IntraNUTS2             | -                                               | 0.2%                                            | 0.6%                                            | 0.4%                                            |
| P.a % Road Freight traffic InterNUTS2             | -                                               | 1.5%                                            | 1.7%                                            | 1.3%                                            |
| P.a % Rail Freight traffic InterNUTS2             | -                                               | 2.5%                                            | 2.3%                                            | 2.3%                                            |
| P.a % Maritime Freight traffic EU 27              | -                                               | 2.5%                                            | 2.2%                                            | 1.5%                                            |
| P.a % Maritime Freight traffic overseas           | -                                               | 2.5%                                            | 2.2%                                            | 2.0%                                            |
| Freight rail share long distance                  | 25.3%                                           | 28.0%                                           | 28.6%                                           | 34.2%                                           |

Source: TRANSvisions (2009)

The table shows that in the long term, rail freight and maritime transport are expected to grow at higher rates than road transport, due to the high growth of goods imported and exported overseas and among the European Inter zones traffic. External trade is expected to increase significantly, so there is a good chance for rail as the loads will tend to concentrate in ever fewer points, such as main ports, to gain share by connecting these freight terminals. In congested corridors linked to large industrial centres and ports, freight train services will also tend to be provided through dedicated lines in the long term. The picture should be completed with airborne cargo forecasts, projected to grow at higher rates.