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Towards a resource-efficient transport system

TERM 2009: indicators tracking transport and environment in the European Union

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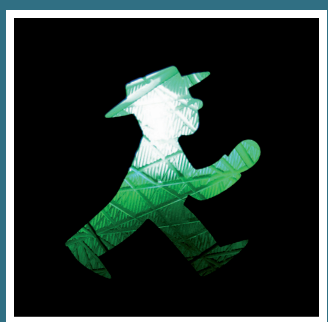

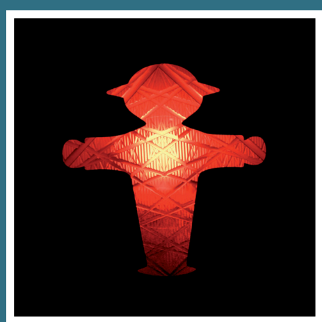

European Environment Agency

Towards a resource-efficient transport system

TERM 2009: indicators tracking transport and environment in the European Union

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Foreword — Professor Jacqueline McGlade

In 2000, EEA published its first Transport and Environment Reporting Mechanism (TERM) report. It was drafted in response to a request from the 'Cardiff Council' in 1998, at which EU Member States recognised the need for policy integration and posed the question: 'How do we better integrate the environmental perspective into transport policy?' In the decade since, we have seen major progress in some areas such as emissions of regulated pollutants. In others, such as emission of greenhouse gases, little or no improvement has been seen.

EEA has published TERM reports annually since 2000 with the aim of highlighting transport's impact on the environment and developments with respect to specific issues. For example, in 2002 the report focused on the differences between the acceding countries (later to become the new 'EU-10' Member States) and existing Member States.

One issue that has appeared in all publications is greenhouse gas mitigation. Ten years ago it was an issue of some importance, albeit just one among many. Today it has grown to become a core issue. During recent years it has played a key role in the TERM assessment and in day-to-day policy transport and energy policymaking. Thus, to put the last ten yeas of reporting in perspective one can say that we have moved from *integration* to *mitigation*.

Many of the key messages from this year's report will be familiar as the transport sector does not change rapidly.

Chapter 1 reviews the Common Transport Policy. Addressing the environmental aspects of transport policy effectively requires a vision for the transport system by the mid-21st century. The process of establishing a new Common Transport Policy is essentially about creating this vision and then designing policies to achieve it.

Chapter 2 addresses freight transport. Freight transport continues to grow slightly faster than the economy. Road and air freight transport, and the resulting CO_2 emissions, show the largest increase. Although the recent economic downturn has had a short-term impact on growth rates, the overall trend suggests that the least energy-efficient modes of travel will continue to increase in the long term.

Chapter 3 addresses passenger transport. Passenger transport by car continues to grow, albeit slower than the economy. During the recent recession passenger transport volume appears to have contracted at rates similar to the economy.

Chapter 4 addresses greenhouse gas emissions. Greenhouse gas emissions from transport continue to rise steadily and now account for 19.3 % of EEA member country emissions. If international bunker emissions are added to this figure, then more than a quarter of emissions are transport related. If the emissions tied to providing transport infrastructure, producing vehicles, exploration of oil and gas etc., are also added, then the figure reaches almost one-third of all emissions.

Chapter 5 addresses emissions of regulated pollutants. Emissions of local air-quality pollutants continue to decline across EEA member countries. However, the national nitrogen oxides (NO_X) emissions ceilings and ambient nitrogen dioxide (NO_2) limit values set for 2010 by EU regulation remain hard to achieve. There is therefore a need for members to consider additional measures such as low emission zones.

Chapter 6 addresses transport fuels. Ensuring a fuel shift in the transport system requires a long-time perspective because of the large capital invested in the existing system. Volatile fuel prices may at times favour a shift but may equally well make alternatives difficult to justify economically. Shifting fuels requires stable financial conditions because new market actors are typically less well consolidated.

Chapter 7 addresses transport noise. A large number of people are exposed to transport noise levels that affect the quality of their life and health, notably in large agglomerations. Road traffic is by far the dominant source of exposure to transport noise. A significant though lower number of people are also exposed to railway and airport noise levels that affect their health and quality of life. The number of people exposed to damaging levels of transport noise, particularly at night, could increase if there is no further development of effective policies on noise and if action plans against noise are not fully implemented.

Chapter 8 addresses greenhouse gas mitigation potential. None of the scenarios considered in this report would realise the 80 % cut in CO_2 emissions by 2050 from 1990 levels regarded as necessary to keep global temperature increase below 2 °C. However, the greatest savings potential arises from a combined package, in which technological improvements that reduce fuel consumption are used alongside measures to shift journeys to lower emission modes and to avoid the need to travel altogether. Achieving the desired reductions requires that we implement a package of policy measures that does not rely solely upon technology. This includes measures such as high density, mixed use land planning, whose impacts may not be felt in the short term. Indeed, because such effects are so distant in time, we need a common vision for sustainable transport and mobility to guide planning.

Introduction

This report presents a summary of selected issues from the European Environment Agency Transport and Environment Reporting Mechanism (EEA TERM) set of transport and environment integration indicators. It is not simply a replication of indicators but rather an attempt to put insights from the indicators into the context of efforts to develop European policy towards achieving a low-carbon transport system.

The objective of this report is to indicate some of the main challenges to reducing the environmental impacts of transport and to make suggestions to improve the environmental performance of the transport system as a whole. The report examines issues centred around transport and climate change, which need to be addressed in the coming years. These issues are derived partly from the policy questions that form the backbone of TERM and partly from other ongoing work at EEA. As with previous TERM reports, this report evaluates the indicator trends measuring progress towards existing objectives and targets from EU policy documents and various transport and environmental directives.

The selection does not represent a full inventory of conclusions that can be extracted from TERM but rather a selection that tries to give deeper insight into the link between transport development and climate change. Readers are therefore encouraged to seek further information in the TERM fact sheets themselves (see link below), as well as in other sources referred to in the text.

TERM: a two-layered information system

TERM reports have been published since 2000 as an official indicator-based reporting mechanism. The present report is thus the tenth anniversary edition. As one of the environmental assessment tools of the Common Transport Policy, TERM offers important insights that can help in developing EU policies. With this report, the EEA aims to show the main developments over the past decade and the challenges that lie ahead, thereby also making it a comment on contemporary EU transport policy.

Currently, TERM consists of 40 indicators (see the overview in Annex 2), structured around seven policy questions (see box page 7). It addresses various target groups, ranging from high-level policymakers to technical policy experts. It is therefore set up as a two-layered information system, with different degrees of analytical detail.

This report summarises the key messages from the indicators. Indicator fact sheets constitute a more detailed information layer. The fact sheets provide an in-depth assessment for each indicator, including an overview of the main policy context and existing EU policy targets related to the indicator; an analysis of data quality and shortcomings; a description of metadata; and recommendations for future improvement of the indicator and data. The TERM indicator fact sheets form the reference information system of this report and can be downloaded from the EEA website at: www.eea.europa.eu/themes/transport.

Scope of the report

The report aims to cover all 32 EEA member countries. These are the 27 EU Member States, one candidate country (Turkey), and Iceland, Liechtenstein, Norway and Switzerland. Switzerland only recently became an EEA member and has not provided data for all TERM indicators. Where data are not complete, this is generally noted in the metadata section, where different country groupings are also described.

In terms of time coverage, most indicators cover the last 10 years subject to data availability. There are cases, however, where data for some Member States have only become available recently, or where the transition from a centrally planned to market economy has led to such big changes that comparisons over time become irrelevant.

Unless other sources are given, all assessments including in this report are taken from TERM fact sheets and are based on data from Eurostat.

The underlying fact sheets used for this report were developed by the European Topic Centre for Air and Climate Change and a consortium led by TRL of the United Kingdom.

The project was managed and the final version of the text written by Peder Jensen, EEA. Substantial input and review was also provided by Anke Lükewille, Cinzia Pastorello, Colin Nugent, Martin Adams, Peder Gabrielsen, Ricardo Fernandez, Valentin Leonard Foltescu, all from EEA. In addition, comments were received from other EEA staff, several EEA member countries and the European Commission.

TERM policy context, process and concept

The Amsterdam Treaty identifies integration of environmental and sectoral policies as the way to deliver sustainable development. The European Council, at its summit in Cardiff in 1998, requested the Commission and transport ministers to focus their efforts on developing integrated transport and environment strategies. At the same time, and following initial work by the EEA on transport and environment indicators, the joint Transport and Environment Council invited the Commission and the EEA to set up a transport and environment reporting mechanism (TERM), which should enable policymakers to gauge the progress of their integration policies. The Sixth Environment Action Programme and the EU Strategy for Sustainable Development re-emphasise the need for integration strategies and for monitoring environmental themes, as well as sectoral integration.

The main aim of TERM is to monitor the progress and effectiveness of transport and environment integration strategies on the basis of a core set of indicators. The TERM indicators were selected and grouped to address seven key questions:

1. Is the environmental performance of the transport sector improving?
2. Are we getting better at managing transport demand and at improving the modal split?
3. Are spatial and transport planning becoming better coordinated so as to match transport demand to the need for access?
4. Are we optimising the use of existing transport infrastructure capacity and moving towards a better balanced intermodal transport system?
5. Are we moving towards a fairer and more efficient pricing system, which ensures that external costs are internalised?
6. How rapidly are cleaner technologies being implemented and how efficiently are vehicles being used?
7. How effectively are environmental management and monitoring tools being used to support policymaking and decision-making?

The TERM indicator list covers the most important aspects of the transport and environment system (driving forces, pressures, state of the environment, impacts and societal responses — the so-called DPSIR framework). It represents a long-term vision of the indicators that are ideally needed to answer the above questions.

The TERM process is steered jointly by the European Commission (Directorate General for Environment, Directorate General for Energy and Transport, Eurostat) and the EEA. The steering structure will be updated in 2010 to take into account the creation of Directorate General for Climate (DG CLIMA) and Directorate General for Mobility (DG MOVE). The EEA member countries and other international organisations provide input and are consulted on a regular basis.

1 Transport in perspective

When historians look back on 2009, they may possibly come to judge that it was the year when we started to see developments change direction in the transport sector, particularly transport policy. The signs are not always obvious when we look at them without the benefit of hindsight; they only stand out when seen across decades. Yet although signs may be deceiving when interpreted too early, we should try to indentify them or risk missing important opportunities to reinforce a development in sustainable directions.

On the policy scene the United Nations climate convention summit, COP15, was the biggest event of 2009 and indeed the biggest global policy event in a long time. Results did not match the very high expectations voiced by many parties, be they policymakers, industrialists, green groups or any other participant in the public debate. Nevertheless, despite being a non-binding declaration, the Copenhagen Accord did stress the need to keep average global atmospheric temperature increases below 2 °C. Moreover, the debate did show that practically all countries recognise that transport emissions must be addressed as part of the broader efforts to mitigate the climate challenge. No agreement on how to deal with the emissions from international maritime transport and aviation was reached, but the need for an agreement was recognised. The Kyoto Protocol excluded the maritime and aviation sectors because of lack of agreement on the allocation of emission to parties. In Copenhagen, the two UN bodies responsible — International Maritime Organization (IMO) and International Civil Aviation Organization (ICAO) — were asked to work towards an agreement on emission reduction for the sectors.

In the EU context, Commission President Barroso's political guidelines for the new Commission made it clear that maintaining momentum towards a low-carbon, resource-efficient economy, particularly towards de-carbonising the transport sector, would be one of the priorities of his second term. During her hearing in the European Parliament, the new Commissioner for Climate Action, Ms. Connie Hedegaard, stressed work on a low-carbon strategy for transport as a core task. Likewise the Commissioner for Environment, Mr. Janez Potočnik, has in several speeches made it clear that resource efficiency, which covers both efficient use of carbon as well as broader material and nature resource use, is core to his work program. Climate mitigation — including in the transport sector — has thus moved to the heart of transport policy, and indeed to the heart of EU policy.

Scientists talks of the need for a 50 % reduction in global emissions by 2050, equating to 80–95 % reductions for developed countries. Transport will certainly have to contribute. Today transport, including the international aviation and maritime transport, accounts for around one-quarter of all EU emissions. Therefore we can only meet these long-term targets by also addressing emissions in the transport sector.

Some issues have already been addressed via the Climate Action and Renewable Energy Package such as putting new passenger cars on a trajectory towards reducing emissions to 95 g CO_2/km by 2020 (see Chapter 4), which is close to half of 1990 levels. Unfortunately, traffic levels are growing at around the same rate as we see average fleet emissions declining, meaning the net effect may still be far from what we want. There are initiatives to include vans and, with a longer time perspective, trucks into emissions regulations. But without complementary measures there is still a risk that some of the improvements will be balanced by the growth in traffic.

More efficient vehicles using less fuel may in the long run be cheaper to operate and thus lower the general transport costs. This in turn leads to more transport (known as the rebound effect) because tasks that were earlier to costly to undertake can now be done at a reasonable price. While this entails added choice for consumers and thus added welfare, it also means that significant parts of the environmental benefits disappear in growing transport volumes. Similar processes are apparent elsewhere in the economy. Half a century ago few could afford a week's vacation in Thailand but now it is available to a broad segment of society (see Chapters 2 and 3).

The Climate Action and Renewable Energy Package also establishes a broader framework for biofuels policy up to 2020 (Chapter 6). It includes a requirement that the sustainability of biofuels be certified. The majority of existing biofuels will meet these criteria with the possible exception of some imported fuels, which may have indirect influence on land use in third countries. The regulation on assessing these indirect land use effects is still under development. As the required reduction in greenhouse emissions from different fuels is raised in the coming years, there is a risk that it may become more difficult to find sufficient biofuels to meet the targets. Thus the benefits of this policy may also be limited.

The recent financial crisis and recession had a significant negative effect on automobile manufacturers. Many governments used scrappage schemes of different sorts as an instrument to maintain and stimulate market demand for new passenger cars. In some cases, countries presented the packages as environmentally focused, whereas in others they were simply presented as rescue measures. The packages did result in renewal of part of the fleet and on average this should indicate that older more polluting cars have been replaced with newer cleaner cars.

Certainly, new car purchases have reduced regulated pollutant emissions and there is also some evidence that the cars are in many cases smaller and more efficient. The question is whether the driving force behind purchases was the scrappage schemes or high fuel prices shortly before the recession hit. It can additionally be argued that the same amount of money invested in other kinds of sustainable transport could have generated larger environmental benefits. Because the economic situation has changed dramatically over the past couple of years, and because car purchases are driven by many factors, it will be almost impossible to establish the exact environmental effect of the schemes.

Around 40 % of EU greenhouse gas emissions are covered by emission trading. Trading ensures that emissions are reduced as long as allocation plans are made properly, the market is transparent, and monitoring, reporting and verification works properly. At the same time, however, it is also based on a principle that over-achievements in one year can be banked and used in another year. This way it allows for proper planning and predictability but at the same time makes over-achievements less likely. Flexibility on emission reduction achievements thus arises mainly from sectors not covered by emission trading. With transport being one of the biggest sectors not covered by trading this means that transport represents, if not a 'low hanging fruit', at least one that may have to be picked.

While the outlook for decarbonising transport outlined above is somewhat uncertain, there were clear signs of change in 2009 compared to earlier years. Several Directorates General are running scenario projects to look at what a more sustainable transport system could look like. While Chapter 8 of this report cannot be called a scenarios exercise, it does look at how to combine different policies into a comprehensive mitigation policy. What emerges from this as well as many other studies is that policymakers are faced with a slightly unusual situation. Normally studies outline a range of options between which policymakers can choose. In this case, however, the message to policymakers and those currently reviewing the Common Transport Policy is: 'choose all the described measures and invent a few more'.

Addressing the environmental aspects of transport policy effectively requires a vision for what the transport system should be like by the mid-21st century. The process of establishing a new Common Transport Policy is essentially about creating this vision and then designing policies to achieve it.

2 Freight transport and modal split

Freight transport continues to grow slightly faster than the economy. Road and air freight transport, and the resulting CO_2 emissions, show the largest increase. Although the recent economic downturn has had a short-term impact on growth rates, the overall trend suggests that the least energy efficient modes of travel will continue to increase in the long term.

Over the past decade the amount of freight transported grew rapidly. This was particularly striking up until the end of 2007 when the downturn in economic growth started to curtail the demand for freight movement. Overall tonne-kilometres increased in EEA member countries (excluding Cyprus, Liechtenstein and Malta) by 34 % between 1997 and 2007. Over the period, road and air freight increased faster (43 % and 35 % respectively), thereby increasing their market share. Maritime transport grew by 31 %, thus almost maintaining its market share. However, volumes transported by rail freight and on inland waterways increased by only 10 % during this period thereby reducing their market share. A more recent analysis of road freight activity based on a smaller dataset illustrate the impact of the financial crisis. Figure 2.3 presents those findings, illustrating trends from the fourth quarter of 2007 to the second quarter of 2009 for 25 EU Member States.

Improved logistical performance is one of the tools to mitigate greenhouse gases emissions from freight transport (further measures are discussed in Chapter 8). CO_2 emissions can be reduced from freight transport by reducing average haul lengths, improved vehicle utilisation, reconfiguring production and distribution systems and shortening routes between collection and delivery points. The reorganisation of distribution systems is complex and unlikely to arise in the short term because relocation of production to places where labour costs are cheaper often results in goods being transported over greater distances to markets.

Freight consolidation centres are one way to promote more efficient delivery and may eliminate intermediate locations within a supply chain (McKinnon, 2007). However, it is important to note that there are limitations and barriers to use of consolidation points such as proximity to railway lines or main roads, as well as economic costs including insurance which will be more expensive the more times goods are handled on a journey.

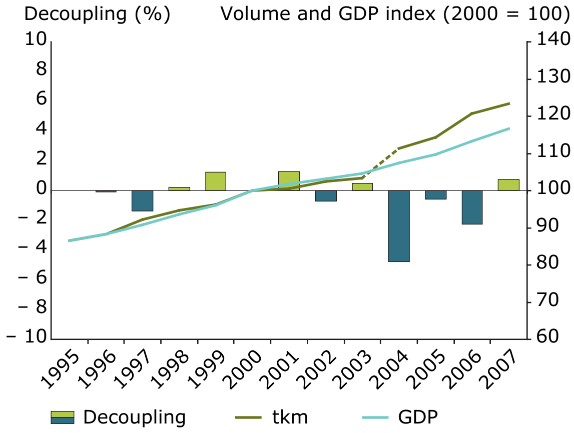
The impact of freight on urban areas has been researched by the European Commission. The project, 'Best Urban Freight Solutions' (BESTUFS, 2006), examined a variety of national programmes across Europe with a view to establishing more efficient and environmentally friendly transportation of road freight in urban areas. Recommendations included higher cubic capacity vans, an increase in the share of alternative fuels and further research into the instruments required to promote the use of environmentally friendly vehicle technologies, such as incentives and compensation measures granted to those transport operators who decide to employ alternative propulsion, active support for demonstration activities in the urban freight domains.

The integration of different freight transport modes is of particular importance if an increase in the market share of rail and maritime freight is to be achieved. A publication entitled 'A sustainable future for transport' discusses the importance of an intelligent and integrated logistics system to coordinate the development of ports and intermodal terminals to transport freight (EC, 2009a). Its focus is the role of technology in promoting a sustainable transport system. Technology-led solutions are fundamental to reducing CO_2 emissions from freight movements but must be implemented in conjunction with organisational reforms to the sector. For example, changes to current cabotage arrangements and continued investment in port and railway infrastructure will be essential.

Figure 2.1 Freight transport volumes grow alongside GDP

Freight transport activity has grown at a faster rate than the economy during the last decade. However, freight activity returned to grow in parallel with the economy during 2007.

Transport growth can be attributed to the improvement in transport efficiency, enabled in part by the removal of intra-EU transport barriers, which has encouraged investment and stimulated trade. However, factors such as rising fuel prices and the economic slowdown may have a significant impact on freight transport growth in the future.

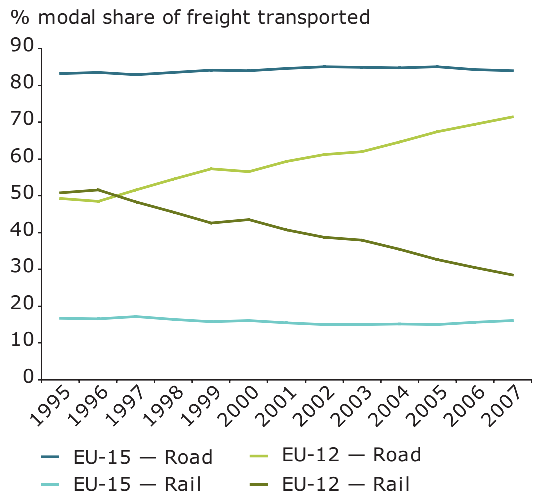


Note: The two curves show the development in GDP and freight transport volumes, while the columns show the level of annual decoupling. Green indicates faster growth in GDP than in freight transport while blue indicates stronger growth in freight transport than in GDP. The large change in 2004 is tied to a change in methodology but no correction figure exists (see metadata for more details).

Source: Eurostat, 2009.

Figure 2.2 Road transport's market share increases strongly in EU-12

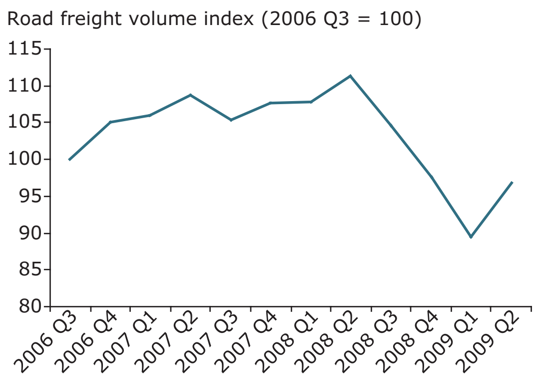
The figure compares rail and road transport trends (shares of transport volume in million tonne-km) in two regions (EU-15 and EU-12) over the last decade. The modal split between road and rail freight in the EU-15 stayed relatively constant over the decade with a slight shift towards rail in the second half of the period. In the EU-12, however, the share of freight moved by road has increased from around 50 % to over 70 %. A change in the geographic orientation of the markets for the EU-12 (from east to west) has contributed to the shift because the new markets are not well connected by rail infrastructure and offer the much more adaptive road transport as an alternative. In addition EU-12-based companies are increasingly carrying out transport services in the EU-15.



Source: Eurostat, 2009.

Figure 2.3 Impacts of the recession on road freight transport in selected countries

Recent data from Eurostat provide an indication of the recession's impact on road freight activity in 25 EEA member countries. At the individual country level there is great variation but the overall picture is one of stagnating growth until the summer of 2008 and a sharp decline thereafter (15 % over just a year). Over shorter periods the decline is even larger but this is partly explained by seasonal variations.



Note: Summary of quarterly road freight transport by type of operation and type of transport (mio tkm).

Source: Eurostat, 2009.

3 Passenger transport and modal split

Passenger transport by car continues to grow, albeit slower than the economy. During the recent recession passenger transport volume appears to have contracted at rates similar to the economy.

The number of kilometres travelled by passengers in EEA member countries grew by 1.5 % in 2007 compared to 2006, and by 1.2 % in the EU-27. This is slightly below annual average growth over the past decade. Intra-EU air passenger travel remained the fastest growing area, with a growth of 48 % between 1997 and 2007. Intra-EU sea travel declined, however, by almost 6 % during this period.

Car journeys comprised 72 % of all passenger-kilometres in the EU-27 in 2007 (excluding Cyprus and Malta). The percentage share has remained similar since 1995 and it therefore remains the dominant mode of transport. Intra-EU bus and coach travel has decreased from a share of over 9 % in the mid-1990s to 8 % in 2007, while air travel's share of total passenger-kilometres has increased from 6 % to nearly 9 % during this period. Figure 3.3 shows rail passenger transport data from the fourth quarter of 2007 to the second quarter of 2009 for 18 EU Member States. It illustrates significant growth during the economic recession.

The increasing volume of travel by CO_2-emitting modes such as private cars, buses, trains and air transport has both direct and indirect impacts on the environment. Noise, air pollution and habitat fragmentation are some of the direct impacts. Indirect effects include congestion and safety. Policies that support a modal shift can reduce congestion and encourage reduced car use and ownership, as discussed in more depth in Chapter 8. Efficient bus operations and improvements in technology to incorporate integrated ticketing systems can result in increased occupancy rates and hence a reduction in emissions per bus journey, even if service provision increases (DfT, 2008).

Environmental benefits through efficiency improvements in private motor vehicles are seen by governments as an indirect effect of car scrappage schemes recently promoted across Europe. A number of governments provide or have recently provided a subsidy to replace older vehicles with new more efficient models. The aim has been to re-stimulate the new car market in addition to reducing CO_2 emissions but the long term effectiveness of these schemes is uncertain. Car sales in Europe rose 11.2 % in October 2009 against the previous months' figures as manufacturers and dealers cashed in on scrappage schemes. EU-15 Member States such as France, Germany and Italy all reported increases in vehicle registrations between January 2009 and October 2009 whereas in the EU-12 registrations fell by 37 % (Motor Trader, 2009).

In 2009, the EC issued an Action Plan on Urban Mobility (COM(2009)490/5), which develops measures identified in the European's Green Paper on Urban Transport (EU, 2007). It highlights the responsibility of local, regional and national authorities in developing urban mobility policies, which are fundamental in promoting sustainable transport. The six themes —promoting integrated policies, focusing on citizens, greening urban transport, strengthening funding, sharing experience, and optimising urban mobility — form the framework of a number of actions to be carried out up to 2012. The optimisation of urban mobility describes the importance of affordable and family friendly public transport solutions to promote reduced car-dependence. The uptake of sustainable urban mobility plans is central to the success of modal shift but also requires the support of citizens.

Figure 3.1 Trends in passenger transport demand and GDP

Passenger transport volumes continue to grow, but slower than the economy. In some of the EU-15 Member States, transport volumes experienced a slight decrease of passenger transport in 2007. These include Austria, Belgium, France, the Netherlands, Spain and the United Kingdom.

Note: The two curves show the development in GDP and passenger transport volumes, while the columns show the level of annual decoupling. Green indicates faster growth in GDP than in transport while blue indicates stronger growth in transport than in GDP. The data refer to road, rail and bus modes of passenger transport.

Source: Eurostat, 2009.

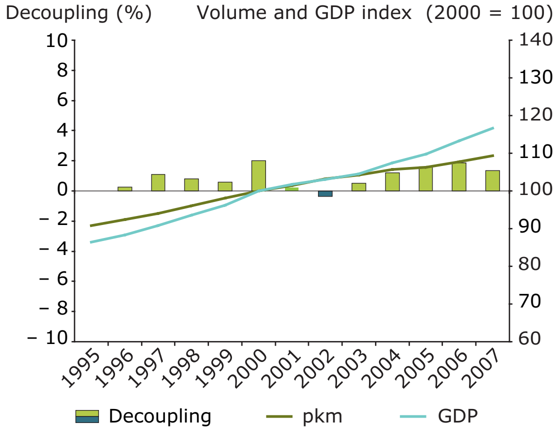
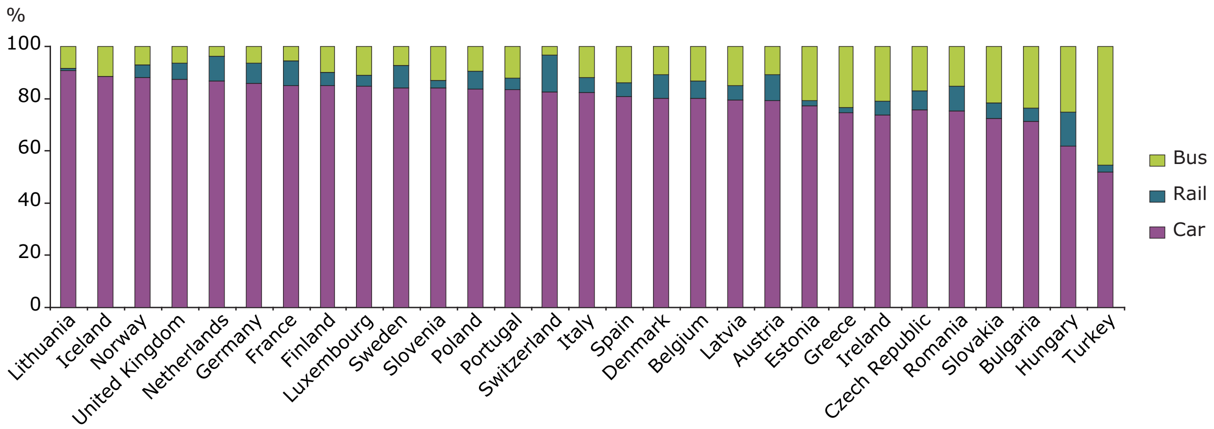


Figure 3.2 Passenger transport modal split (without sea and aviation, 2007)

The modal split for inland passenger transport was dominated by the private car in all EEA member countries. Bus travel had the second-largest modal share in all but six European countries (France, Germany, the Netherlands, Sweden, Switzerland and the United Kingdom).

During the last ten years (1997–2007), demand for rail remained fairly steady, or increased, in all EU-15 Member States but one (Portugal). However, for the EU-12, rail transport declined considerably in most countries. Three countries (Estonia, Hungary and Slovenia) have experienced a slight improvement in rail demand since 1997. Lithuania, however, did not increase its rail use to 2006, reaching a record low of 11 % of the 1990 level.

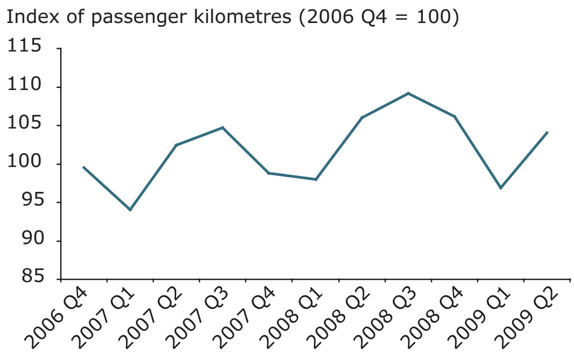


Note: The Switzerland data are for 2005.

Source: Eurostat, 2009.

Figure 3.3 Impacts of the recession on rail transport in selected countries

Rail passenger transport do not appear to be negatively affected by the recession. Recent data from Eurostat provides an indication of the development in transport volume via data from 18 EU Member States. There is great seasonal variation, but overall transport volumens are growing.



Note: Summary of quarterly rail passenger transport.

Soruce: Eurostat, 2010

4 Greenhouse gas emissions from the transport sector

Greenhouse gas emissions from transport continue to rise steadily and now account for 19.3 % of EEA member country emissions. If international bunker emissions are added to this figure then more than a quarter of emissions are transport related. If the emissions tied to providing transport infrastructure, producing vehicles, exploration of oil and gas etc., are also added, then the figure reaches almost one-third of all emissions.

Greenhouse gas emissions from the transport sector continue to grow (see Figures 4.1 and 4.2) in contrast to other sectors such as industry, housing and energy production. In the EEA-32, emissions of greenhouse gases (GHGs) from transport (excluding international aviation and maritime transport) increased by 28 % between 1990 and 2007 and now account for just under 19.3 % of total emissions. Under Kyoto Protocol reporting requirements, emissions from international aviation and maritime transport (known as international bunker fuel emissions) are excluded from national totals and reported separately as a memo item. International bunkers add around one-third to reported EU transport emissions.

Year-on-year increases in emissions from international maritime and aviation are showing signs of slowing with only 2.6 % and 0.9 % increases in emissions between 2006 and 2007, compared with 5.3 % and 6.4 % increases from 2005 to 2006. This trend of contracting emissions growth looks set to continue in the short term for aviation. In the long term, however, continued expansion is expected because of the close link to economic development. The EU agreed in July 2008 that it will bring the aviation sector into the EU Emissions Trading Scheme (ETS) system from 2012 (Directive 2008/101/EC) to help address the dramatic increase in emissions and hopes for a broader global agreement in the context of continuing climate change talks.

The latest data on energy efficiency of new cars show that the rate of improvement has increased. In 2008 the average emissions of new cars were 154 g CO_2/km. This is significantly above the target of 140 g CO_2/km but on the other hand a strong improvement over 2007 (159 g CO_2/km) (EC, 2009c). The lack of progress seen in the previous years motivated the EU to introduce Directive 2009/443/EC, which regulates the average emissions of new cars sold in the EU from 2010 to 2020. The requirements will gradually be tightened and reach 95 g CO_2/km by 2020. Exceedances will result in fines based on the level of exceedance and the number of cars sold.

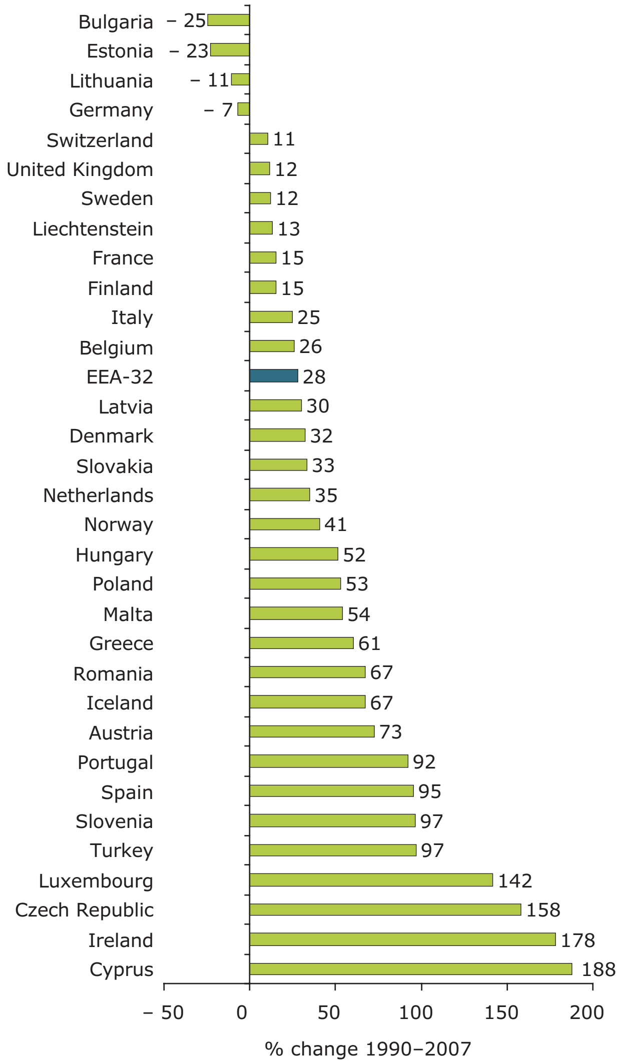
A further follow up to this regulation is proposed in the form of a parallel regulation for light commercial vehicles (vans) starting with a target of 175 g CO_2/km in 2014 gradually tightening to 135 g CO_2/km by 2020. Additionally, work is starting on establishing harmonised testing methods that can be applied to a similar regulation for heavy duty vehicles. The timeline for the latter regulation is less certain, however.

The emissions reductions required by Directive 2009/443/EC are significantly faster than the growth in traffic seen over recent decades. If, therefore, these technology improvements continue then emissions would gradually be reduced. Since full fleet penetrations of new technologies take 15–20 years, however, and that further improvements to technology will be increasingly expensive, overall improvements will be less dramatic. It should not be assumed, therefore, that there will be no need for further developments towards near-zero emission vehicles, such as electric or hydrogen fuel-cell vehicles supplied by renewable energy sources.

Figure 4.1 Trends in transport greenhouse gas emissions by country 1990–2007

Transport sector greenhouse gas emissions increased by 28 % over the period 1990–2007. This compares with a reduction of 5 % in emissions across all sectors and a reduction of 11 % from the non-transport sectors. The increase has occurred even though fleets have improved their energy efficiency and therefore reflects increases in transport volumes. Preliminary numbers for 2008, where the financial crisis starts to have an impact show an overall decline in emissions of around 2 % compared to 2007.

The majority of EEA member countries (except for Bulgaria, Estonia, Lithuania and Germany) show an increase in transport emissions between 1990 and 2007 principally due to increased transport movements. Most countries continue to increase their emissions between 2006 and 2007 illustrating the continued difficulties in reducing transport emissions in the EEA countries. Only very few countries (Bulgaria, France, Germany, Luxembourg, the Netherlands and Portugal) show a decrease of emissions from 2006 to 2007.

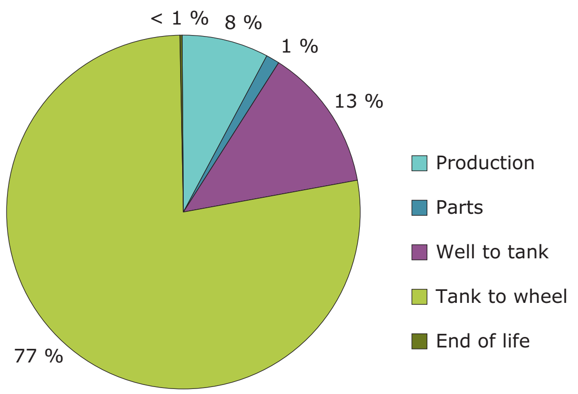


Note: Excluding international aviation and maritime transport (according to Kyoto).

Source: European Topic Centre for Air and Climate Change, 2009.

Figure 4.2 Life-cycle analysis of passenger cars

The direct emissions from transport fuel combustion are not the only impacts on greenhouse gas emissions or other environmental issues. Life-cycle analysis of passenger cars completed in 2008 and based on 2005 data showed that a total of 777 Mt CO_2-equivalents were attributable to passenger cars in the EU-25 in 2005. Of this, 77 % were from the combustion of fuels in the vehicle operation ('tank to wheel'). The 'use-phase' is the dominant in the life cycle, however as Figure 4.2 illustrates; production of fuels and vehicles and disposal of used vehicles account for 23 % of emissions.



Source: IMPRO-car, 2008.

5 Local emissions and air quality

Emissions of local air quality pollutants continue to decline across EEA member countries. However, the national nitrogen oxides (NO_X) emissions ceilings and ambient nitrogen dioxide (NO_2) limit values set for 2010 by EU regulation remain hard to achieve. There is therefore a need for members to consider additional measures such as low emission zones.

Since 1990, Europe has made much progress in reducing emissions of the main air pollutants. Despite these emission reductions, several Member States anticipate that they will miss their 2010 national emission ceilings for one or more pollutants (EEA, 2009a). In spite of significant past emission reductions the contribution of the road transport sector to total European emissions remains significant:

- in 2007, road transport was the largest contributor to NO_X emissions in the EEA member countries, and the second largest contributor to pollutants forming particulate matter (PM);
- passenger cars are among the top six individual polluting sources for two important local air quality pollutants NO_X and particulate matter (PM_{10}, $PM_{2.5}$), as well as carbon monoxide (CO) and non methane volatile organic compounds (NMVOC) emissions;
- heavy duty vehicles were the most important source of NO_X emissions and are a key source of CO, $PM_{2.5}$, PM_{10} and NMVOC (EEA, 2009b).

Several EU transport emission-related policy measures, such as fuel quality and ever tighter vehicle emission 'Euro' standards for certain new vehicles, have significantly reduced emissions from the transport sector. In the future, as exhaust emissions of air pollutants decline, growing numbers of vehicles will mean that non-exhaust PM emissions arising from sources such as tyre and brake wear, road surface abrasion and re-suspension of road dust, may become proportionally more important.

Despite significant past reductions in air pollutant emissions, measured ambient levels of NO_2 and PM_{10} mass concentrations have in general not significantly changed across EEA member countries since 1997 (ETC/ACC, 2009a).

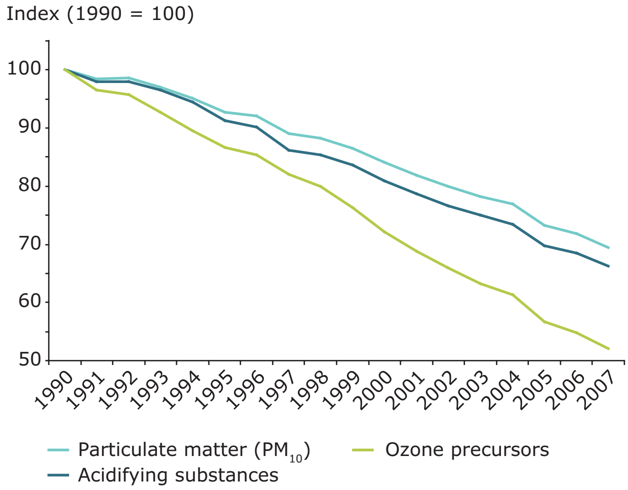
Most EU Member States still do not comply with the PM_{10} limit values (for which the attainment year was 2005 according to Directive 1999/30/EC). Especially in urban areas, the exceedance of the daily mean PM_{10} limit value is not only a compliance problem but also has important potential adverse effects on human health. For NO_2 limit values, 2010 is the attainment year (Directive 1999/30/EC). The most critical issue for NO_2 compliance in European countries is the exceedance of the annual NO_2 limit value in urban areas, particularly at measurement stations close to streets (ETC/ACC, 2009a).

According to the revised Air Quality Directive (2008/50/EC), Member States may notify the European Commission if, in their opinion, certain conditions are met in a zone or agglomeration that justify an exemption from the PM_{10} and NO_2 limit values (until 2011 and 2015, respectively). These conditions include that:

- all appropriate measures to meet the deadline for the limit value have been taken at national, regional and local level (see examples in Box 5.1);
- quantitative source apportionments are provided reflecting regional, urban and local contributions within the Member State but also transboundary contributions;
- a further split on the urban and local scale is given in order to identify any significant sources, including, for example, transport (DG ENV, 2010).

Figure 5.1 Transport emissions of regulated air pollutants in EEA member countries

Between 1990 and 2007 there was a significant reduction of transport-related emissions of particulate matter (30 %), acidifying substances (34 %) and ozone precursors (48 %) across the 32 EEA member countries. The introduction of catalytic converters and reduced sulphur content in fuels has contributed substantially to the reduction of these pollutants, offsetting the pressure from increased road traffic.



Source: EEA, 2009b.

Box 5.1 Air quality at the local level: management plans and programmes

Present European air quality legislation is based around the principle that EU Member States divide their territories into a number of air quality management zones and agglomerations (the latter are for example big cities). In these defined areas, countries are then required to assess air quality using measurements, modelling or other empirical techniques (e.g. ETC/ACC, 2009b; FAIRMODE, 2010).

To comply with EU air quality legislation, Member States have to establish national air quality plans and programmes including abatement measures from the national to the local scale. The plans and programmes must specify how the measures are bringing concentrations below respective limit or target values in a zone or agglomeration by the attainment date. Authorities can choose from a range of abatement options. Low emission zones (in combination with retrofit initiatives), traffic planning, and measures aiming at a shift of motor vehicle mileage to other transport modes, are all examples of important management elements to reduce air pollutant concentrations. A ban of studded tires (as used in certain Scandinavian countries during winter) is an example of an effective measure to help abate non-exhaust PM pollution.

Furthermore, there are many means by which authorities can address and involve citizens, for example promoting cycling, collective transport and walking. Authorities can also have a role in informing and warning particularly sensitive population groups regarding poor air quality episodes by applying near real-time air quality forecast and scenario tools.

6 Transport fuel developments

Ensuring a fuel shift in the transport system requires a long time perspective because of the large capital invested in the existing system. Volatile fuel prices may at times favour a shift but may equally well make alternatives difficult to justify economically. Shifting fuels requires stable financial conditions because new market actors are typically less well consolidated.

Oil prices remain volatile, rising towards the end of 2009 after a sharp fall from the peak in July 2008. The World Economic Outlook projects that the average price of oil will be USD 62.50 per barrel in 2010 (roughly equal to the actual price in 2009), and will remain unchanged in real terms over the medium term (WEO, 2009). Global oil demand fell by 0.4 million barrels per day (mbd) in 2008 due to sharply decelerating demand in advanced economies (particularly Japan and USA), and is forecast to decline by about 2.4 mbd in 2009 (WEO, 2009).

Allowing for inflation, however, the real price (including taxes) of road transport fuel in September 2009 is close to the average real price since 1980. There have been significant fluctuations but over the span of three decades the fuel price has changed rather little.

Despite the general trend in global oil demand, it appears that Europe is facing an increasing deficit of diesel fuel but a surplus of gasoline by 2015 (Wood-MacKenzie, 2008) because of the vehicle fleet's growing reliance on diesel. Such a deficit will eventually drive up road transport and aviation costs, and ultimately affect the competitiveness of global business operations. In addition it makes it profitable to employ more energy-consuming chemical processes at refineries in order to increase the share of diesel refined out of each barrel of oil. This will increase the up-stream greenhouse gas emission of fuel production and lower the benefit of shifting from gasoline to diesel. According to the latest figures for European Organisation for Economic Co-operation and Development members (IEA, 2009) diesel imports in January–June 2009 were higher than for the same period in the previous three years, with much of this fuel coming from Russia (Wood-MacKenzie, 2008).

The EU has a target to increase the share of renewables in energy use to 20 % by 2020. The Climate Action and Renewable Energy Package include a series of measures, with the EU Emissions Trading System (EU ETS) being a central component. Emissions from sectors not included in the EU ETS, including land transport, are to be cut by 10 % from 2005 levels by 2020 (EC, 2009b). The introduction of mandatory blending of sustainably produced biofuels in road transport fuel is another part of this strategy. The provisions of the Renewable Energy Directive and Fuel Quality Directive as parts of the package are important steps towards a low-carbon transport sector.

Not only have high oil prices made biofuels more economically attractive, they have also led to increased viability of oil sands and synthetic fuels based on coal and natural gas. Until recently, oil sands we re not considered a viable petroleum source because of extraction costs but higher oil prices now make oil sand processing economically viable when supplies of petroleum products are tight and crude oil prices are high (Greenergy, 2009). The costs in terms of CO_2 emissions are also higher than for conventional crude oil. For example, the CO_2 emissions to extract and refine conventional crude oil are 28.6 kg per barrel of oil but this increases to 85.5 kg per barrel for oil sand (Woynillowicz *et al.*, 2005). As demand goes up, oil sands are the marginal source of additional product supply to meet demand. In this respect every tonne of biofuel produced reduces demand for petroleum products and results in less need to resort to expensive and polluting oils sands to make up the deficit.

Figure 6.1 Road transport fuel prices (including taxes) in EU Member States

While nominal prices of transport fuels have increased considerably, the real (inflation corrected with HICP, reference year 2005) price of road fuel in the EU has remained relatively stable during the last three decades, apart from short periods of price instabilities. Over the same period real disposable income has increased significantly, effectively making transport fuels cheaper.

Note: All prices are in 'unleaded petrol equivalent litres'.

Source: TERM fact sheet 21 based on DG MOVE.

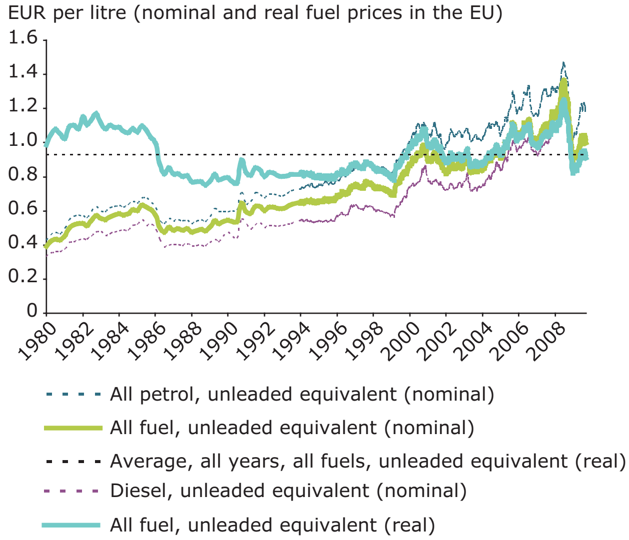
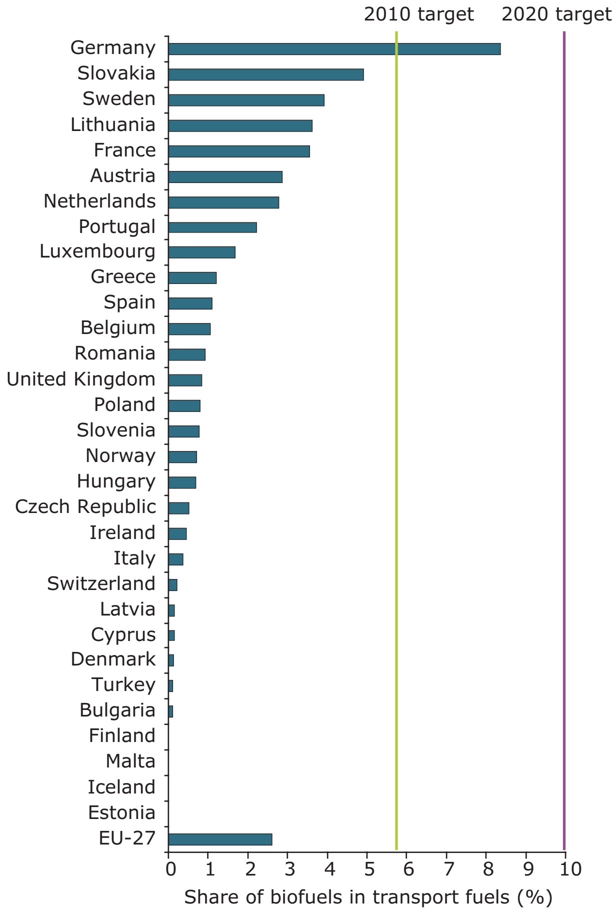


Figure 6.2 Few countries on track to meet biofuels targets

Data for 2007 show that only a few countries are on track to meet the 2010 indicative targets for biofuels use. With the implementation of the Climate Action and Renewable Energy Package there will be further requirements of 10 % renewable fuel by 2020. In addition there is a requirement that biofuels should meet sustainability standards, thus potentially restricting the supply if sustainability cannot be documented.

Source: Eurostat, 2009.



Box 6.1 Electric cars and renewable energy

ETC/ACC (2009c) has conducted a review of the environmental impacts of the large-scale introduction of electric cars. The review highlights the importance of a 'well to wheel' analysis, assessing the total greenhouse gas emissions from electric vehicles determined by the power plant or power plant mix supplying electricity. One key findings is that in order for electric cars to maximise their greenhouse gas emission reduction potential and provide environmental benefits, a charging strategy that is adapted (as far as possible) to the fluctuations in production of renewable electricity must be developed.

7 Transport noise

A large number of people are exposed to transport noise levels that affect the quality of their life and health, notably in large agglomerations. Road traffic is by far the dominant source of exposure to transport noise. A significant though lower number of people are also exposed to railway and airport noise levels that affect their health and quality of life. The number of people exposed to damaging levels of transport noise, particularly at night, could increase if there is no further development of effective policies on noise and if action plans against noise are not fully implemented.

The Environmental Noise Directive requires that two common noise indictors are used to derive the strategic noise maps. The first is known as L_{den}, which is a long-term noise level averaged over one year and based upon an average day within that year. As such it combines the L_{day}, $L_{evening}$ and L_{night} levels. Within L_{den}, the $L_{evening}$ and L_{night} components are weighted by adding 5 decibels (dB) and 10 dB respectively. This enables the indicator to be used to assess the overall annoyance as experienced by a known population.

The second common indicator is L_{night}. This is the annual long-term average noise level during an eight hour night time period which is commonly taken to be from 23.00 hours until 07.00 hours. This enables the indictor to be used for assessing the scale of sleep disturbance in a given population.

L_{day} and $L_{evening}$ are the annual long-term average noise levels during the day (commonly 07.00–19.00 hours) and evening (commonly 19.00–23.00 hours) periods.

The directive requires that these indictors are used to calculate the numbers of people exposed to noise from the aforementioned sources in 5 dB bandings beginning with 50 dB for L_{night} and beginning with 55 dB for L_{den}.

To date, these indicators have been reported separately for road, railway and aircraft noise sources. This enables identification of which transport modes are mainly responsible for exposure to noise but it is not possible to aggregate the data to determine the global exposure from multiple sources in a given area, for example, in a single agglomeration or country.

EEA has established the Noise Observation and Information Service for Europe (NOISE) which is a web-based database of noise exposure in Europe. Using the quality-checked data reported in accordance with the directive, it represents the first step towards a truly pan-European assessment of environmental noise impacts. NOISE may be viewed at http://NOISE.eionet.europa.eu.

Currently, only five countries have provided all the reports required by the directive. The rest have provided more or less incomplete datasets. In the first reporting round data were expected from 164 *agglomerations* but the first reporting round only reported as follows:

- 102 reported on exposure to road noise;
- 93 on exposure to railway noise;
- 76 on exposure to air noise;
- 94 on exposure to industry noise.

Data were expected for 82 576 km of *major roads* but were only reported for 24 310 km.

Data were expected for 12 315 km of *major railways* but were only reported for 5 310 km.

Data were expected for 78 *major airports* but only reported for 66.

Table 7.1 presents the key figures.

Table 7.1 Noise exposure reported by 26 EEA member countries

The overall exposure data as reported by 26 EEA member countries are summarised below. The total population in EU-27 is around 500 million people.

Total population exposed				
		Major roads	**Major railways**	**Major airports**
> 55 dB L_{den}		59 107 300	12 458 000	6 888 100
Population in agglomerations exposed				
	Roads	**Railways**	**Airports**	**Industry**
> 55 dB L_{den}	41 198 400	3 684 900	1 782 331	761 700
> 50 dB L_{night}	27 802 500	2 516 700	1 081 100	390 700

Note: Population exposed based on quality-checked round-one noise maps up to February 2009.

Box 7.1 WHO Night Noise Guidelines

The World Health Organization Night Noise Guidelines for Europe, published in October 2009, provide considerable detail on the relationship between noise, sleep quality and health. The recommendations are expressed in terms of L_{night} (night noise indicator described in the Environmental Noise Directive), although the report also describes a number of exposure-response relationships for instantaneous reaction to noise. Sleep disturbance can also result from exposure to long-term average noise levels at night of greater than 40 decibels (dB).

In the Guidelines, WHO observes that at this level of noise exposure *'adverse health effects are observed among the exposed population'*. On this basis, WHO has declared that people should not be exposed to night noise levels greater than 40 dB $L_{night,outside}$ during the part of the night when most people are in bed. This is a challenging target for any authority charged with preventing increasing levels of transport noise so an Interim Target (IT) of 55 dB $L_{night,outside}$ is recommended in situations where 40 dB $L_{night,outside}$ is not feasible in the short term. The IT is not a health-based limit value and vulnerable groups cannot be protected at such a level. Therefore, the IT should be considered as a feasibility-based intermediate target only and used solely in exceptional situations.

Box 7.2 Environmental Noise Directive

Directive 2002/49/EC relating to the assessment and management of environmental noise, more commonly referred to as the Environmental Noise Directive (END), introduced obligations on EU Member States to produce strategic noise maps designed for the global assessment of noise exposure due to different sources in given areas and for overall predictions of such areas. This includes reporting the numbers of people exposed to certain levels of noise from some of the busiest transport sources and in the largest of Europe's cities.

The directive required that this strategic noise mapping should take place in two separate rounds. The first noise maps were due to have been reported by 30 December 2007 and related to major roads with more than 6 million vehicles per year, major railways with more than 60 000 trains per year, major airports with more than 50 000 air traffic movements per year and large cities, or agglomerations, with a population of more than 250 000 people. The noise maps for agglomerations were to include assessments for roads, railways, airports and industry.

The second round of noise mapping is due for completion in 2012 and broadens the scope of the strategic noise mapping to also include major roads with more than 3 million vehicles per year, major railways with more than 30 000 trains per year and agglomerations with more than 100 000 inhabitants. Thereafter, the strategic noise maps for all of these sources must be revised every five years.

This is the first TERM report for which a truly comprehensive dataset from the first round of noise maps has been available. As such, the figures reported are strictly those stated by EEA member countries and have not been extrapolated in any way.

8 Transport greenhouse gas mitigation options

There are many different policies that can reduce the greenhouse emission from the transport sector but if ambitious targets are to be achieved the policymaker will need to employ all measures rather than just 'picking the best ones.'

The transport sector continues to increase its emissions of greenhouse gases, posing a key challenge in creating a low-carbon future and resource efficient. Economic development has brought with it an expanding transport network, with a modal share dominated by increased individual motor transport, as reported in TERM reports over the past decade. This shift has been attributed to social changes linked to the growth in affluence in Europe, an enhanced ease of mobility, suburbanisation and falling land use densities in urban areas. In turn these have led to increasing trip number and lengths, and more widespread car ownership, while reducing the financial viability of public transport and non-motorised transport.

Numerous scenarios studies under way across Europe are evaluating the options available to reduce carbon emissions. The European Commission study, 'Routes to 2050', is just one example. It centres on developing visions of the future, setting a baseline and targets upon which reductions can be monitored, with an exploration of the options available to meet those targets (DG ENV, 2009).

The aim of the present chapter is to provide an overview, based on a wide range of different sources, of the main mitigation options available to reduce greenhouse gas emissions from the transport sector in Europe, and to assess the potential of policy pathways to achieve this through a review of existing literature. In order to provide a meaningful analysis, the focus is on travel by road and rail and includes both passenger and freight transport. The literature examined predominantly focuses on CO_2 reductions, which account for the vast majority of greenhouse gas emissions. As such, the discussions in this chapter centre on potential savings in CO_2.

Baseline data and future CO_2 emission reductions target

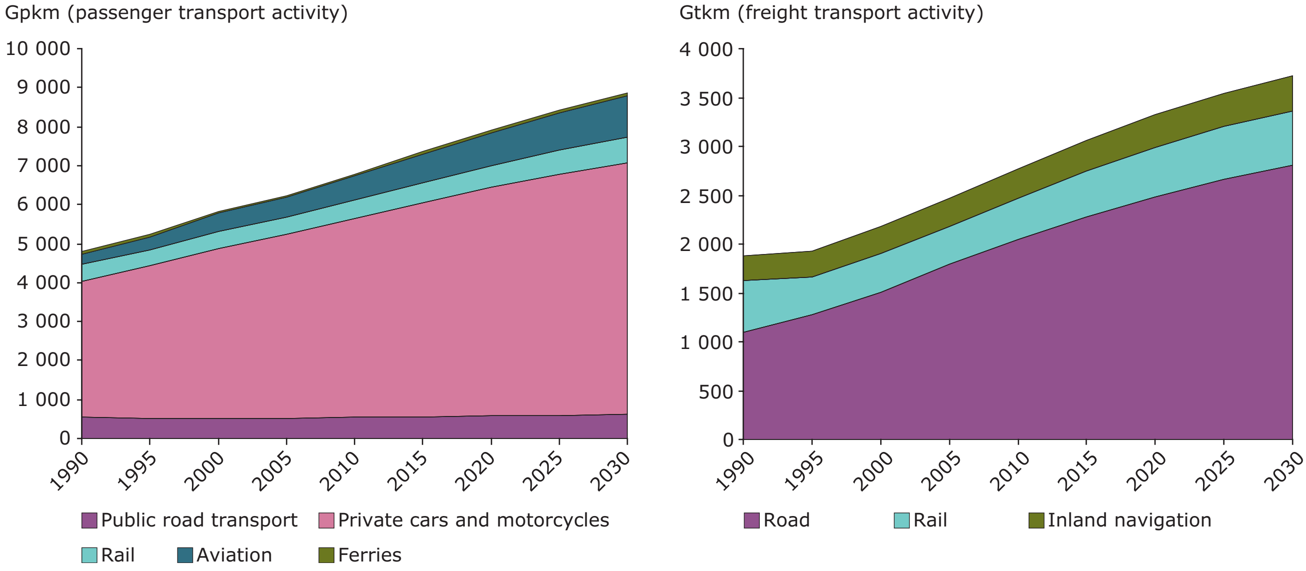
Projections for passenger transport activity in Gpkm (billion passenger-km), and for freight in Gtkm (billion tonne-km), are intended to present an indication of how continuing growth is likely to occur if business-as-usual persists and no additional measures are implemented (see Figure 8.1). It is clear that passenger and freight transport by road will remain the principal mode of travel with the greatest market share if present trends continue and no action is taken to reduce emissions.

For the purposes of this chapter, the Intergovernmental Panel on Climate Change target for developed countries to reduce CO_2 emissions by 80 % from 1990 levels by 2050 is applied when considering policy packages (IPCC, 2007). The aspirational global target applicable to all sectors is used for illustrative purposes. Business-as-usual projections are based on transport demand in Europe and all three projections consider an 80 % cut in the 1990 European baseline figures for passenger and freight activity. The objective is therefore to achieve an 80 % reduction in the 1990 baseline figures by 2050. Although burden-sharing discussions could conclude that transport should contribute less than other sectors due to the difficulties of reducing emissions, other recent discussions in the international community have suggested that a 95 % reduction in developed countries emissions is required by 2050. Therefore it is felt that an 80 % reduction in the transport sector is a reasonably illustrative target to assess.

Framework for analysis

The framework set out in Figure 8.2 is used to examine mitigation options, which include both

Figure 8.1 Passenger and freight demand projections for the EU-25



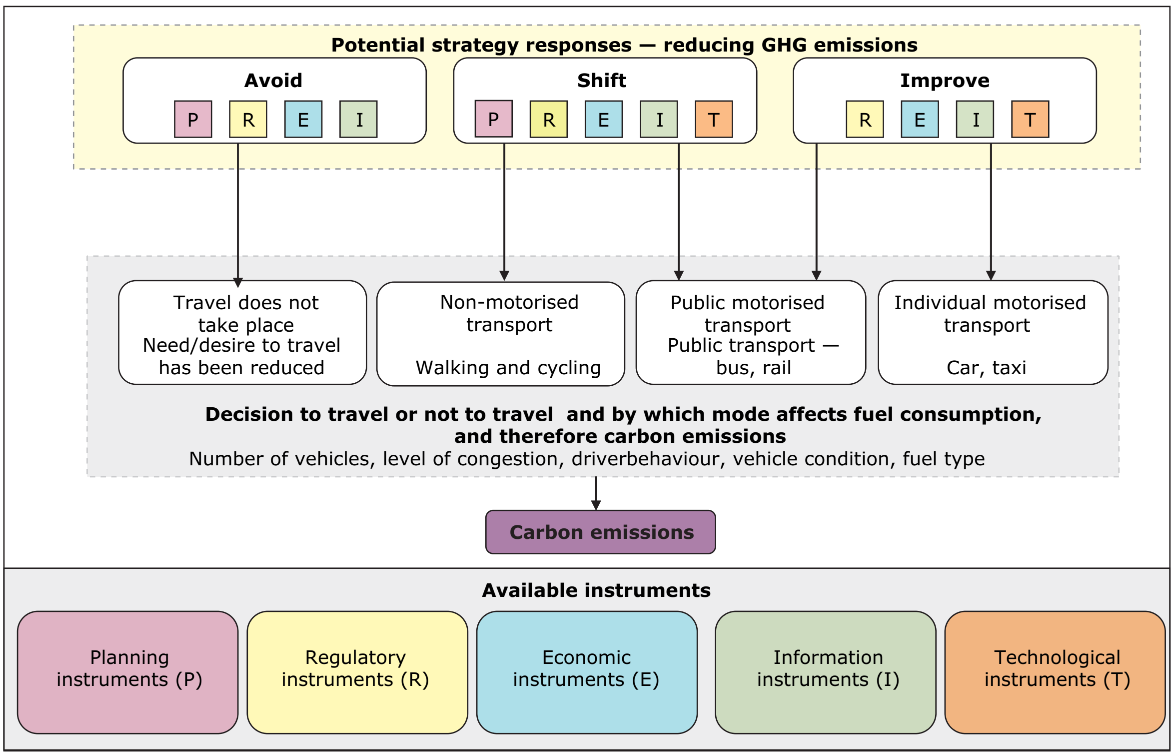
Source: EC, 2007.

technical and non-technical options. As outlined in Dalkmann and Brannigan (2007) a combination of three different approaches — 'avoid', 'shift' and 'improve' (ASI) — each including specific policy measures, can be used to reduce CO_2 emissions from transport.

Policy analysis

The ASI approach is compatible with a broad range of measures, which in combination are more effective at reducing total journey numbers and duration, and promoting more fuel-efficient modes of transport.

Figure 8.2 Potential strategies for reducing GHG emissions — 'avoid', 'shift' and 'improve'



Source: Dalkmann and Brannigan, 2007.

Box 8.1 Policy instrument categories

Planning (P)	Planning instruments comprise all measures that concentrate on planning infrastructure. It includes planning for non-motorised travel and public transport, as well as land-use planning.
Regulatory (R)	Public administrations and political bodies can implement regulatory instruments that influence demand for travel, as well as setting standards for emissions and fuel efficiency.
Economic (E)	Economic instruments can be used to internalise the external costs of transport, such as greenhouse gases impacts. They can be used to shift the economic burden from ownership (fixed cost) to use (variable cost), and charges and taxes can be administered to encourage more energy efficient vehicles, reduce demand for transport and encourage modal shift.
Information (I)	Public awareness campaigns are an example of information instruments that can be developed to stimulate the use of alternative means of travel.
Technological (T)	Technology options focus on fuels, propulsion technology, other vehicle attributes and communications and information media.

The three strategies to reduce emissions and five policy instruments used to implement measures can be combined to create a matrix of 15 core categories, as presented in Table 8.1. The table identifies overlaps between strategies and policy instruments.

Combinations of specific measures

A selection of policy instruments are examined in more depth below to identify positive and negative impacts, uncertainties and the potential mitigation range of each measure, based on current knowledge. The list presented in Table 8.2 is not exhaustive but provides an overview of the main policy measures. The effects refer to the sources where policy measures are described. In many cases it is difficult to give very concrete estimates as the effect can be very sensitive to implementation conditions.

Policy packages

Three policy packages have been created to provide an 'improve' perspective, an 'avoid and shift' package, and a combination of both. They are intended to illustrate the effectiveness of measures to reduce carbon emissions using both realistic and optimistic scenarios. Realistic scenarios consider what is achievable or possible, based on existing knowledge whereas optimistic scenarios take a more hopeful and positive view of future outcomes from the policy measures. Since the level and intensity of each intervention differs from instrument to instrument so too will the extent and timescale of their impacts.

'Improve' package

The 'improve' package comprises a co-existence of technologies applicable to cars, light goods vehicles, HGVs, buses and trains over the next 40 years.

- Immediate impacts are factored in from improved vehicle and engine design supported through legislation on new car standards and improved freight movements.
- Hybrid vehicles can play a role from 2020, delivering a significant impact on emissions from cars, light goods vehicles and buses.
- The use of low-carbon fuels, including biofuels, is assumed to be cost-effective and sustainable in terms of land take, however, a 2050 outlook does not assume a significant greenhouse gas emission reduction from this source.
- Electric vehicles are widely predicted to be one of the most effective measures to reduce CO_2 emissions. The 'improve' package anticipates an uptake rate of 50–80 % in 2050. A 35 % reduction in CO_2 for electric cars by 2050 is projected on the basis of a mix of renewable and non-renewable energy sources.
- Rebound effects are significant for the 'improve' package because improved fuel efficiency reduces the cost of car travel, leading to further growth in total traffic.
- There are uncertainties with regard to pressure on land from other uses affecting fuel supplies for biofuels and regarding the adequacy of power generation and distribution networks for electric vehicles, which are unlikely to be sourced entirely from renewable energy.

'Avoid and shift' package

The 'avoid and shift' package contains complementary measures available to encourage the use of fuel efficient modes and zero emissions travel.

Table 8.1 Policy instruments to 'avoid', 'shift' and 'improve' transport emissions

<table>
<tr><td></td><td colspan="5">Strategy responses</td></tr>
<tr><td>Policy instrument</td><td colspan="2">Avoid</td><td>Shift</td><td colspan="2">Improve</td></tr>
<tr><td>Planning</td><td>High density mixed land-use development.
Restrictive parking standards.
Car-free settlements.</td><td rowspan="2">Planning and regulatory cross-cutting instruments through planning legislation and infrastructure provision. Development of freight hubs/ consolidation points.</td><td>Integrated public transport.
High density mixed use land to be achieved through spatial planning. Investment in passenger transport through land use planning. Infrastructure for NMT.
Road freight to rail and sea.
Travel planning through planning process.</td><td colspan="2">n/a</td></tr>
<tr><td rowspan="2">Regulatory</td><td>Parking restrictions and availability.
Vehicle access restrictions.</td><td>Traffic management measures including: parking restrictions, access restrictions on the type of vehicles that can be used.
Regulation of transport providers.</td><td colspan="2" rowspan="2">Vehicle emissions and fuel efficiency standards.
Set and enforce speed limits.
Restrictions based upon emissions e.g. low-emission zones.</td></tr>
<tr><td colspan="3">Parking restrictions can be used to 'avoid' and 'shift'</td></tr>
<tr><td rowspan="2">Economic</td><td colspan="2">Fuel taxes, vehicle taxes.
Road user charges, parking charges, emission trading.</td><td>Subsidise alternative modes.
Fuel taxes, vehicle taxes, emissions trading, congestion charging.
Low emission zones.</td><td colspan="2">Use of pricing instruments to encourage investment in more carbon efficient energy and vehicles.</td></tr>
<tr><td colspan="5">Fuel pricing discourages travel, encourages modal shift and encourages improved fuel efficiency</td></tr>
<tr><td>Information</td><td colspan="2">Promotion of alternatives to travel.</td><td>Travel awareness campaigns.
Personalised travel planning.
Public transport information.
Increase awareness of alternatives.
Mobility management and marketing.
Co-operative schemes.
Travel planning.</td><td>Improve driver behaviour (eco-driving schemes).</td><td rowspan="2">Public awareness campaigns aimed at informing consumers about vehicle efficiency.</td></tr>
<tr><td>Technology</td><td colspan="2">Enable virtual interactions: virtual — conferencing, remote working.
Travel plans introduced through planning instruments include remote working and teleconferencing.</td><td>Improvements in the efficiency and quality of passenger transport.</td><td>Vehicle efficiency improvements.
Regenerative breaking, biofuel.
Hybrid electric vehicles, plug-in hybrid electric vehicles, and electric vehicles. Hydrogen vehicles.
Rail electrification.</td></tr>
<tr><td></td><td colspan="2"></td><td colspan="3">Traffic management is both a 'shift' and 'improve' policy measure.</td></tr>
</table>

Table 8.2 Overview of policy instruments

	Instrument	Evidence to support benefits	Effects: positive (+), negative (–) and uncertainties (?)
Planning	Land use planning; high density mixed use developments	Comparative data analysis across many international cities has shown that higher densities are generally associated with lower transport energy consumption and CO_2 emissions (CfIT, 2009). The most energy-efficient settlement, in terms of transport, is one with a resident population of 25 000–100 000 or greater than 250 000 (Banister, 1997).	+ Strong emission reduction potential in the longer term + Improved accessibility + Reduction in journey distances and trips + More opportunities for non-motorised transport + Improved public transport + Less urban sprawl and protection of open space – Reduction of green space in urban areas – Public dislike for intensive development ? More guidance required at national level to evaluate options for future large-scale developments
Planning	Travel planning	A travel plan is a package of measures to influence travel behaviour towards more sustainable options. Travel planning also encompasses personalised travel plans, car sharing, and teleworking. CfIT (2009) estimate a total reduction of 11 % of vehicle km in urban areas through smarter choices, which equates to 1.3 Mt C annually by 2020.	+ More opportunities for non-motorised transport, with associated health benefits + Greater travel choices and heightened public awareness + More public transport use + Reduced car trip frequencies + Reduced congestion + Better air quality ? Need to maintain over longer term to sustain benefits ? Requires high-level support
Planning	Freight movements	An urban consolidation centre provides facilities whereby deliveries from a number of different suppliers can be consolidated for subsequent delivery to an urban area in a vehicle with high load utilisation. Urban delivery vehicles can be specially designed for low noise and emissions. Quantified impacts are reductions in vehicle trips, vehicle kilometres, total fuel consumed and vehicle emissions (DfT, 2005).	+ Fewer vehicles needed and reduced trips + Less congestion + Reduction in total emissions and noise + Local safety benefits from fewer heavy vehicle movements ? Depends on information sharing between freight operators to maximise benefits fully – Increased delivery costs, potentially putting urban centres at a disadvantage in competition with out-of-town sites
Regulatory	Traffic management measures including: parking restrictions; road space reallocation for public transport and non-motorised transport; restrictions on specific vehicle types	Traffic signals form the core of traffic management systems which are expected to become increasingly sophisticated in the future. Comparing traffic data in London in 2003 with those from 2002, the introduction of a congestion charge led directly to reductions of about 16 % in CO_2 emissions from traffic within the charging zone (UKERC, 2009).	+ Improved traffic flow + Priority for non-motorised transport + Faster more integrated and accessible public transport journeys – Reallocating road space away from cars can be controversial – Capacity freed up with improved traffic management will lead to further growth from suppressed demand unless benefits are locked in with other measures
Regulatory	Enforce and reduce speed limits	Using an emissions modelling tool, Carsten *et al.* (2008) assessed the effect of intelligent speed adaptation (ISA) on carbon emissions. They found that for all levels of ISA the impact on CO_2 per km travelled is variable and small for non-70 mph roads, while the changes predicted on 70 mph speed limit roads are significant, up to 5.8 % (with an uncertainty range of +/– 0.7 %) with a mandatory ISA system.	+ Besides lowering fuel consumption and emissions, reducing speeds on motorways (below 55km/h) improves air quality and safety, as well as having traffic management benefits ? Enforcement ? Eco-driving and Information Instruments overlap

Table 8.2 Overview of policy instruments (cont.)

	Instrument	Evidence to support benefits	Effects: positive (+), negative (–) and uncertainties (?)
Economic	Pricing instruments including: fuel taxes, vehicle taxes, parking pricing, congestion charging, low emission zones.	Parking pricing can reduce the demand for parking by 10–30 % in comparison with unpriced parking (VTPI, 2006). Possible 7 % annual saving in traffic CO_2 from 2010 to 2025 (UKERC, 2009). Pricing strategies at the national level have only a limited impact as price elasticities of demand are low and as the expected levels of increase in demand quickly outweigh reductions in use (Banister and Marshall, 2000). Theroretical studies show that a dedicated road pricing system can have substantial benefits (ECMT, 2003).	+ Reduced congestion + Revenue stream generated to invest in more fuel-efficient transport modes + Consumers can be incentivised to buy smaller and more fuel-efficient vehicles + Fuel taxation is an effective economic instrument in reducing transport activity most effective in combination with regulatory measures + Pricing mechanisms help lock in benefits from other measures – Risk of shifting traffic onto uncharged roads – Public antagonism — an important aspect for the successful implementation of pricing strategies is public acceptability
Information	Travel awareness campaigns.	Travel awareness campaigns help increase public awareness and better inform consumer behaviour. Successful implementation of policies is dependent upon public awareness and support, particularly when considering more radical policies (Banister, 1997).	+ Less congestion + Most effective when supported by other instruments + More informed customer behaviour ? Need to maintain over long term ? Resource intensive, only targets a small proportion of total travel
Technology	Teleworking, teleconferencing.	Vehicle use typically reduces by around 50–70 % on telecommuting days and telecommuting tends to be particularly attractive to longer-distance commuters (VTPI/TDM 2008).	+ Remove and reduce car trip frequencies + Less congestion + Reduction in energy consumption – Potentially shifts energy consumption to the home, with greater demand for heating and lighting – Rebound effects: home workers may chose to live further from their place of work, offsetting total savings
	Eco-driving schemes	Training 1 % of all drivers are to eco-drive annually would result in a 3 % reduction in fuel consumption and 0.3 Mt CO_2 by 2020 (CCC, 2009).	+ Reduced fuel consumption and costs + Reducing unnecessary loads + Reduced speeds + Improved vehicle maintenance
	Vehicle efficiency improvements	Implementation of the Regulation 443/2009 on new cars is expected to yield a 25 % reduction in CO_2 emissions from tailpipes by 2012–2015 (SMMT, 2009).	+ Improvements to the efficiency of current petrol and diesel vehicles, falling into two categories: non-engine improvements and engine improvements
	Biofuels	Future generations of biofuel feedstocks and production processes may be more sustainable and cost-effective and have the potential to meet 10–20 % of current transport energy demand (OECD/ITF, 2008).	+ Effective way to reduce the carbon intensity of transport fuels + Do not require costly new infrastructure + Required modification to new vehicles is of low cost ? Literature varies with regard to the cost effectiveness and potential of biofuels – One main disbenefits is competition for land use with biofuels, displacing food production and natural habitats – Biofuels grown on land previously cleared from rainforest increases total carbon

Table 8.2 Overview of policy instruments (cont.)

	Instrument	Evidence to support benefits	Effects: positive (+), negative (–) and uncertainties (?)
Technology	Biofuels	Future generations of biofuel feedstocks and production processes may be more sustainable and cost-effective and have the potential to meet 10–20 % of current transport energy demand (OECD/ITF, 2008).	+ Effective way to reduce the carbon intensity of transport fuels + Do not require costly new infrastructure + Required modification to new vehicles is of low cost ? Literature varies with regard to the cost effectiveness and potential of biofuels – One main disbenefits is competition for land use with biofuels, displacing food production and natural habitats – Biofuels grown on land previously cleared from rainforest increases total carbon
	Hybrid electric vehicles and plug-in hybrid electric vehicles	Sources suggest that plug-in hybrids will be available to the mass market by 2020 (ERTRAC, 2009). Fuel savings associated with a full hybrid are in the range 15–25 %, depending on the type of technology and driving conditions (IMPRO-car, 2008).	+ Strong emission reduction potential. Hybrid electric vehicles run off an electric motor at low speeds. The battery that runs the motor is charged by the vehicles engine when running at higher speeds. Plug-in hybrid vehicles combine the vehicle efficiency advantages of hybridisation with the opportunity to travel part-time on electricity provided by the grid, rather than through the vehicle's internal recharging system
	Electric vehicles	Electric vehicles with high tank-to-wheel energy efficiency have the potential to create energy efficiency improvements and thus CO_2 savings in the range 60–80 % (ETC/ACC, 2009).	+ Strong emission reduction potential if the primary source is renewable energy ? Electric vehicles require an extensive power generation and distribution network ? Major developments needed in battery technology – Can the grid mix support high levels of electric vehicles (EVs)?
	Hydrogen	Unless hydrogen is made from low CO_2 energy sources hydrogen has a significantly higher life cycle CO_2, compared with petrol and diesel (King, 2007).	+ Strong emission reduction potential – No natural sources of hydrogen – Production processes inherently energy intensive – Long-term timescale and large investment required to support this fuel

- A substantial emission reduction impact is obtained through land use planning by bringing people closer to services. This is of particular importance for urban areas, where approximately 80 % of the population are estimated to be living by 2050.

- Planning and regulatory measures are fully supported by society and key policymakers. Fiscal measures and significant investment in passenger transport ensure frequent and high quality services using highly developed information and communication technology innovation.

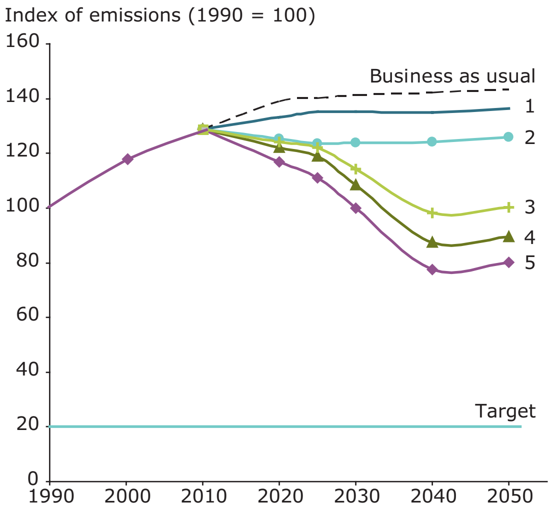
- The 'avoid and shift' package assumes that teleworking and virtual conferencing facilities are far advanced by 2050 and therefore a large majority of commuting trips are no longer made.

- Rebound effects are anticipated in respect of many of the improvements. In particular, traffic growth is likely to arise from reduced travel costs (caused by improved fuel efficiency) and the release of suppressed demand.

Combined package: 'avoid', 'shift' and 'improve'

The combined package includes the rapid deployment of all ASI strategies, each having

Figure 8.3 Effect of a combination of 'improve' measures



Each curve showes the additional effect of adding further instruments.

1 Improved engine design: includes engine combustion improvements, hybrid trains and cars; electrification of trains. Estimated to lead to a 9 % reduction in CO_2 emissions from cars in 2050.

2 Improved vehicle design: including reducing vehicle weight, reducing aerodynamic drag, automatic tyre pressure adjustments. Estimated to lead to an 8 % reduction CO_2 emissions from all vehicles in 2050.

3 Electric cars (lead to a 35 % reduction in transport CO_2 emissions in 2050).

4 Low-carbon fuels: lead to a 4 % reduction in CO_2 emissions from cars and 12 % from HGVs and buses in 2050.

5 Technologies encouraging behavioural change: including speed limit enforcements and vehicle platooning. Estimated to lead to a 9 % reduction in CO_2 emissions from cars and 4 % from HGVs and buses in 2050.

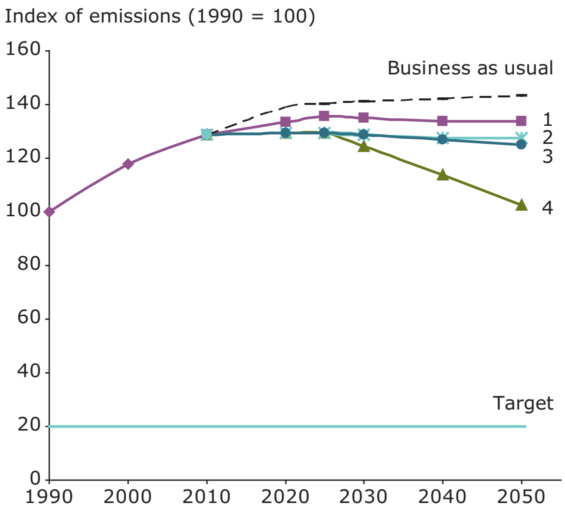
varying impacts and differing timescales based upon the literature reviewed in this chapter. A total reduction in emissions of 64 % is projected, comprising 44 % through 'improve' measures and 20 % as a result of 'avoid' and 'shift' measures. This assumes that policymakers implement measures to effect both technological and behavioural change. Even combined, however, the measures still fall short of achieving the 80 % target.

The potential for these policy pathways to offset the others through rebound effects has been taken into account. Rebounds effects include an increase in trips made and distances travelled because of improved fuel and vehicle efficiency.

Future savings will be influenced by the scale of national populations and economies. If these grow then vehicle ownership may increase, leading to more and longer journeys. In economies where vehicle ownership is at, or near, saturation level, the effect of future growth in demand is likely to be less than where ownership is currently low. When the 'combined scenario' takes into account both population and economic growth, the transport is projected not merely to fall short of the 80 % target by a significant margin but to start moving in the opposite direction before 2050.

Whilst none of the scenarios considered would deliver the desired 80 % cut in CO_2 emissions by

Figure 8.4 Effect of a combination of 'avoid' and 'shift' measures



Each curve showes the additional effect of adding further instruments.

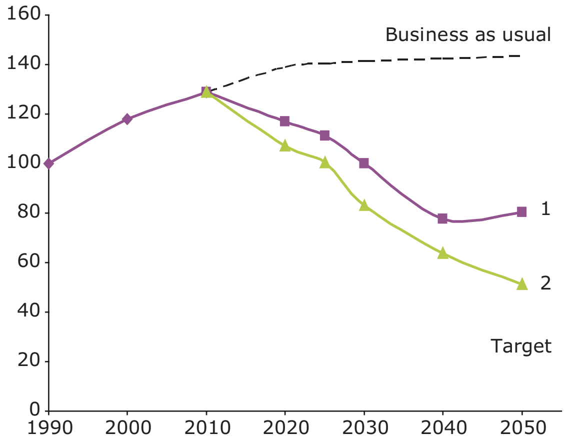
1 Shifting to public transport: includes school and personal travel planning, increasing bus frequencies, reducing walking distance to amenities. Estimated to lead to a 13 % reduction in CO_2 emissions in 2050.

2 Fuel efficient driving (5 % reduction in transport CO_2 emissions expected in 2050).

3 Pricing: national road pricing and increasing duty of fuels (3 % reduction expected in 2050).

4 Low mobility: includes increasing population density in cities, car clubs and HGV scheduling. Tele-working. Expected to lead to a 25 % reduction in car CO_2 emissions in 2050.

Figure 8.5 Effect of a combination of 'improve', 'avoid' and 'shift' measures



Each curve showes the additional effect of adding further instruments.

1 'Improve' package: improved engine and vehicle design, electric cars, low-carbon fuels and technologies encouraging behavioural change. These measures lead to a 44 % reduction in transport CO_2 emissions.

2 'Avoid and shift' package: road pricing, car clubs, increasing population density in cities, travel planning. These measures lead to a 20 % reduction in transport CO_2 emissions.

2050, the greatest savings potential arises from the combined package, in which technological improvements that reduce fuel consumption are used alongside measures to shift journeys to lower emission modes and to avoid the need to travel altogether. It is clear therefore that we need to implement a package of policy measures that do not rely solely upon technology. High density, mixed-use land planning impacts may not be felt in the short and medium term, which implies that the gains from these 'avoid' and 'shift' policies my be much greater after 2050. On the other hand, implementing such changes will require a paradigm shift in planning approaches.

The effectiveness of the ASI approach, which tackles all of the key drivers of greenhouse gas emissions from the transport sector, relies on the implementation of a package of policy measures, as outlined in this chapter. For the policymaker it is essential to understand that the benefits of policies can be optimised by:

- adopting an holistic approach that employs a combination of instruments with wider benefits to society than just their carbon savings;
- recognising the need for policy instruments that work beyond transport in areas that act as drivers of transport demand;
- coordinating measures to simultaneously discourage carbon-intensive travel behaviour, while introducing incentives to adopt more sustainable travel behaviour;
- invest in public transport to help overcome resistance to congestion charging;
- taking account of the economic and demographic context;
- understanding the interactions between different policy instruments and the rebound effects that may occur;
- reinforcing positive impacts and locking in benefits;
- considering long-term impacts and the constraints faced at a regional, national and local level;
- engaging with society and raising awareness of the impacts of increasing emissions.

Combined policy measures are likely to have the greatest impact. They help lock in benefits, minimise rebound effects, maximise wider societal benefits and optimise cost-effectiveness. Key stakeholders and institutional arrangements will determine the success of strategy implementation, which must be supported and influenced by the public. The analysis of policy pathways above highlights that realising potential emissions savings demands that policymakers take immediate action, and recognise and make full use of the interactions between policy instruments.

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Annex 1 Metadata and supplementary information

Throughout the report abbreviations are used to refer to specific country groupings. The following definitions are used:

- EU-15: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom.
- EU-10: Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia.
- EU-12: EU-10, Bulgaria and Romania.
- EFTA-4: Iceland, Liechtenstein, Norway and Switzerland.
- EU-25: EU-15 and EU-10.
- EU-27: EU-15 and EU-12.
- EEA-32: EU-27, EFTA-4 and Turkey.

Chapter		Supplementary information	
2	Freight transport and modal split	**Figure 2.1**	
		Note:	No data available for Malta and Liechtenstein. GDP is in euro at constant 2000 prices. Freight transport (tonne-kilometre) includes transport by road, rail and inland waterways. Short-sea shipping and oil pipelines are excluded due to lack of data. The two curves show the development in GDP and freight transport volumes, while the columns show the level of annual decoupling. Green indicates faster growth in GDP than in freight transport while red indicates stronger growth in freight transport than in GDP. The large change in 2004 is partly tied to a change in methodology but no correction figure exists. The change appears to affect in particular data from Spain, Italy, Portugal, Poland and Romania. In a number of other cases individual country data for specific years exhibit rather large changes that appear not to be rooted in actual transport volume developments, but it is not enough to change the over all trend.
		Source:	EEA core set indicator 036, to be published (based on Eurostat, 2009).
		Figure 2.2	
		Note:	No data available for Malta.
		Source:	EEA core set indicator 036, to be published (based on Eurostat, 2009).
		Figure 2.3	
		Note:	Index of road freight transport volume reported on a quarterly basis for 25 countries: All EEA countries except Greece, Iceland, Italy, Liechtenstein, Malta, Switzerland and United Kingdom.
		Source:	Eurostat, 2010.
3	Passenger transport and modal split	**Figure 3.1**	
		Note:	No data available for Cyprus, Malta, and Liechtenstein. GDP is in euro at constant 2000 prices. Passenger-kilometre includes transport by road, rail and bus.
		Source:	EEA core set indicator 035, to be published (based on Eurostat 2009).
		Figure 3.2	
		Note:	Data for 2007. Switzerland data are for 2005. No data available for Cyprus, Malta and Liechtenstein. There is no agreement among the EU Member States on how to attribute the passenger-kilometres of international intra-EU flights, therefore data for air passenger travels are deemed unreliable and not included.
		Source:	EEA core set indicator 035, to be published. Eurostat 2009.

Chapter		Supplementary information	
		Figure 3.3	
		Note:	Index of passenger rail transport volume reported on a quarterly basis for18 countries: Belgium, Czech Republic, Denmark, Germany, Estonia, Ireland, Spain, France, Latvia, Luxembourg, Hungary, Austria, Poland, Romania, Slovenia, Slovakia, Finland, Sweden.
		Source:	Eurostat, 2010.
4	Greenhouse gas emissions from the transport sector	**Figure 4.1**	
		Note:	Data are for 1990–2007.
		Source:	EEA, 2009. Data compiled by European Topic Centre for Air and Climate Change.
		Figure 4.2	
		Source:	Data taken from project IMPRO-car (see reference list).
5	Local emissions and air quality	**Figure 5.1**	
		Source:	EEA, 2009. Data compiled by European Topic Centre for Air and Climate Change.
6	Transport fuel developments	**Figure 6.1**	
		Note:	Quarterly data until 1.1.1994. Thereafter weekly data. Average calculated for EU Member States at any given point in time. Thus the number of countries increase with time.
		Source:	European Commission, DG TREN, Oil bulletin.
		Figure 6.2	
		Source:	Eurostat, renewable energy statistics.
7	Transport noise	**Table 7.1**	
		Source:	Data reported by 26 EU Member States as of February, 2009. Dava available at: http://NOISE.eionet.europa.eu.
8	Transport greenhouse gas mitigation options	**Figure 8.1**	
		Note:	Passenger and Freight demand projections for the EU-25
		Source:	EC, 2007.
		Figure 8.2	
		Note:	'Avoid', 'shift' and 'improve'.
		Source:	Dalkmann and Brannigan, 2007.
		Figure 8.3	
		Note:	Options towards achieving a low-carbon transport system ('improve' approach)
		Source:	The % reduction that can be achieved by implementing each measure has been obtained from the following literature sources: IMPRO-Car (JRC) March 2008, Report of the alternative fuels group of the cleaner vehicle task force (UK DTI) 2000, Well-to-wheel analysis of future automotive fuels and power trains in the European context (Concawe, 2004), Review and analysis of the reduction potential and costs of technological and other measures to reduce CO_2 emissions from passenger cars (TNO, IEEP, LAT) 2006, Evaluating the sustainability of passenger cars (TRL) 2009, Review of low-carbon technologies for HGVs (Riccardo) 2009, King Review of low-carbon cars 2007/2008. This information has then been combined with estimated uptake rates to derive an overall mitigation potential of each measure.
		Figure 8.4	
		Note:	Options towards achieving a low-carbon transport system ('avoid and shift' approach)
		Source:	The % reduction that can be achieved by implementing each measure has been obtained from the following literature sources: UK Climate Change Committee Report — building a low-carbon economy — Chapter 7 (2008), Making smarter choices work (report for UK DfT) 2004, King Review of low-carbon cars (2007/8), EU transport 2050 — Ian Skinner's presentation (2009), This information has then been combined with estimated uptake rates to derive an overall mitigation potential of each measure.
		Figure 8.5	
		Note:	Options towards achieving a low-carbon transport system ('avoid, shift and improve'). The data in Figures 8.3 and 8.4 have been combined to generate Figure 8.5.
		Source:	See the data source for Figures 8.3 and 8.4 outlined above.

Chapter	Supplementary information
Annex 3 Data	**Table A.1** **Note:** The dataset include a number of data breaks that appears to be tied to change in methodology but no correction figure exists. The change appears to affect in particular data from Spain, Italy, Portugal, Poland and Romania. In a number of other cases individual country data for specific years exhibit rather large changes that appear not to be rooted in actual transport volume developments, but it is not enough to change the over all trend. **Source:** Eurostat, 2010. **Table A.2** **Source:** Eurostat, 2010 **Table A.3** **Note:** The table displays the gross weight of seaborne goods handled in ports (goods unloaded from vessels plus goods loaded onto vessels). Data are collected according to Directive 95/64/EC of 8.12.1995. The Czech Republic, Luxembourg, Hungary, Austria and Slovakia, as well as Liechtenstein and Switzerland have no maritime ports. **Source:** Eurostat, 2010. **Table A.4** **Note:** There appear to be a databreak for Austria in 1995, but no correction factor exists. **Source:** Eurostat, 2009. **Table A.5** **Note:** This indicator is defined as the percentage share of each mode of transport in total inland transport, expressed in passenger-kilometres (pkm). It is based on transport by passenger cars, buses and coaches, and trains. All data should be based on movements on national territory, regardless of the nationality of the vehicle. However, the data collection methodology is not harmonised at the EU level. **Source:** Eurostat, 2009. **Table A.6** **Source:** DG TREN Pocketbook 2008–2009. **Table A.7** **Source:** DG TREN Pocketbook 2008–2009. **Table A.8** **Note:** All transport-related greenhouse gases — (CO_2-equivalent). **Source:** EEA Greenhouse gas data viewer 2010. **Table A.9** **Note:** Investment in infrastructure in selected countries. **Source:** OECD/ITF, 2009.

Annex 2 Overview of TERM fact sheets

TERM indicators have been published annually since 2000, subject to data availability. In 2000, the indicators appeared only in the annual TERM report but since then they have been published individually on the EEA website (www.eea.europa.eu/themes/transport/indicators). When the indicator set was defined it was foreseen that data, that were then limited would eventually become available. For that reason, not all indicators have been published every year. Indicator TERM 05 is marked with * to indicate that it is under development.

Indicator		2000–2004					2005–2009				
TERM 01	Transport final energy consumption by mode	+	+	+	+	+	+	+	+	+	+
TERM 02	Transport emissions of greenhouse gases		+	+	+	+	+	+	+	+	+
TERM 03	Transport emissions of air pollutants	+	+	+	+	+	+	+	+	+	+
TERM 04	Exceedances of air quality objectives due to traffic	+	+	+	+	+	+	+	+	+	+
TERM 05	Exposure to and annoyance by traffic noise	+	+								*
TERM 06	Fragmentation of ecosystems and habitats by transport infrastructure	+	+	+							
TERM 07	Proximity of transport infrastructure to designated areas		+	+							
TERM 08	Land take by transport infrastructure	+	+	+							
TERM 09	Transport accident fatalities	+	+	+	+	+	+		+		+
TERM 10	Accidental and illegal discharges of oil at sea		+	+		+					
TERM 11	Waste oil and tires from vehicles		+								
TERM 11a	Waste from road vehicles (ELV)	+	+	+							
TERM 12a/b	Passenger transport volume and modal split (CSI 035)	+	+	+	+	+	+	+	+	+	+
TERM 13a/b	Freight transport volume and modal split (CSI 036)	+	+	+	+	+	+	+	+	+	+
TERM 14	Access to basic services	+	+		+						
TERM 15	Regional accessibility of markets and cohesion		+		+						
TERM 16	Access to transport services	+	+								
TERM 18	Capacity of infrastructure networks	+	+	+	+	+	+				+
TERM 19	Infrastructure investments	+	+	+					+		+
TERM 20	Real change in transport prices by mode	+	+	+		+	+		+		+
TERM 21	Fuel prices and taxes	+	+	+	+	+	+	+	+	+	+
TERM 22	Transport taxes and charges			+	+	+	+		+	+	+
TERM 23	Subsidies						+				
TERM 24	Expenditure on personal mobility by income group				+	+		+		+	+
TERM 25	External costs of transport	+	+	+	+	+		+		+	+
TERM 26	Internalisation of external costs	+	+	+	+	+	+	+		+	
TERM 27	Energy efficiency and specific CO_2 emissions	+	+	+	+		+		+	+	+
TERM 28	Specific emissions	+	+		+		+		+	+	+
TERM 29	Occupancy rates of passenger vehicles	+	+	+		+	+			+	+
TERM 30	Load factors for freight transport		+	+		+	+			+	+
TERM 31	Uptake of cleaner and alternative fuels (CSI 037)	+	+	+	+	+	+	+	+	+	+
TERM 32	Size of the vehicle fleet	+	+	+	+	+		+		+	+
TERM 33	Average age of the vehicle fleet	+	+	+	+		+		+	+	+
TERM 34	Proportion of vehicle fleet meeting certain emission standards	+	+	+	+	+		+		+	+
TERM 35	Implementation of integrated strategies	+	+	+		+					
TERM 36	Institutional cooperation		+	+		+					
TERM 37	National monitoring systems	+	+	+		+					
TERM 38	Implementation of SEA	+	+	+		+					
TERM 39	Uptake of environmental mgt. systems by transport companies	+									
TERM 40	Public awareness	+	+			+					

Annex 3 Data

This annex provides an overview of key statistics that underpin the assessments in this report. It is generally based on data from sources such as Eurostat. For a full explanation of the data sources, see Annex 1 on metadata.

Table A.1: Freight transport volume by country (1995–2006).

Table A.2: Freight transport modal share (rail, road, inland waterways) by country (1997, 2002, 2006).

Table A.3: Total passenger transport demand by country (1995–2006).

Table A.4: Passenger transport by mode (car, bus/coach, rail) by country (1997, 2002, 2006).

Table A.5: Car ownership by country (1995–2006).

Table A.6: Air passenger transport in EU-25 (1995–2006).

Table A.7: Greenhouse gas emissions from transport by mode and by country (1990–2006).

Table A.8: Biofuels production (2002–2007) and consumption (1995 and 2006) by country.

Table A.9: Investment in infrastructure by mode (rail, road, inland waterways, seaports, airports) and country (1995, 2000, 2005)

Table A.1 Freight transport volume by country (1 000 million tonne-km)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Austria	27.2	27.4	26.7	26.9	28.9	41.8	43.2	44.9	47.2	51.3	54.2	57.0	58.5	58.7	59.7	58.2	62.0	61.4
Belgium	49.9	49.5	48.5	51.0	58.5	58.9	54.7	57.0	54.7	51.0	65.9	67.9	68.3	66.1	64.0	60.5	60.4	59.2
Bulgaria	22.1	16.1	15.0	14.6	14.5	15.5	14.5	14.4	13.1	11.9	12.3	13.4	14.0	15.4	17.9	20.3	19.9	20.9
Switzerland	19.1	19.5	19.8	20.2	20.6	21.0	20.8	21.1	22.3	22.9	24.7	25.4	25.3	25.6	27.0	27.5	28.7	29.7
Cyprus	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.4	1.1	1.4	1.2	1.2
Czech Republic	50.1	50.1	50.1	49.3	46.8	54.3	52.6	61.7	52.7	53.8	54.9	56.0	59.6	62.5	61.2	58.4	66.2	64.5
Germany	311.7	334.2	330.2	322.3	345.4	372.3	367.9	381.9	395.8	413.0	424.7	429.9	425.7	428.7	459.3	469.6	501.0	522.8
Denmark	19.9	20.4	21.3	21.8	23.7	24.4	23.1	23.5	23.5	25.2	26.1	24.1	24.5	25.0	25.4	25.3	23.1	22.7
Estonia	11.5	10.3	4.8	5.1	5.0	5.4	6.1	7.3	9.0	10.8	12.9	12.4	13.9	13.6	15.6	16.5	16.0	14.8
Spain	98.9	98.2	98.6	99.9	106.7	112.6	113.1	122.0	136.3	145.7	160.3	172.8	196.1	204.3	232.7	244.9	253.4	269.9
Finland	34.7	32.4	32.6	34.3	35.7	33.9	33.9	35.7	38.1	39.5	42.2	40.4	41.7	41.1	42.5	41.6	40.8	40.3
France	215.1	215.6	219.9	208.5	220.6	233.0	235.5	242.4	251.0	266.6	268.6	265.5	262.7	258.5	265.7	254.9	261.6	269.4
Greece	14.6	14.5	13.0	15.9	16.1	13.5	16.2	18.5	16.3	16.9	17.9	18.9	19.6	19.8	21.7	24.0	34.7	28.6
Hungary	32.8	26.8	23.7	21.1	21.6	23.7	23.4	24.4	28.4	27.3	28.1	27.5	27.3	27.8	31.3	36.4	42.6	48.2
Ireland	5.7	5.7	5.8	5.7	5.8	6.1	6.9	7.5	8.7	10.7	12.8	12.8	14.7	16.0	17.5	18.2	17.7	19.1
Iceland	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.8	0.9	0.8
Italy	154.2	154.8	161.5	152.5	160.0	184.9	196.5	196.8	207.3	199.0	207.6	208.7	213.1	194.4	219.2	234.6	244.7	217.3
Lithuania	26.8	24.9	16.4	16.9	12.6	12.4	12.3	13.8	13.9	15.6	16.7	16.0	20.5	22.9	23.9	28.4	31.0	34.7
Luxembourg	4.2	4.2	5.0	5.2	4.9	6.4	4.4	5.4	6.0	7.3	8.7	9.7	10.0	10.5	10.5	9.5	9.6	10.3
Latvia	24.4	21.6	12.6	11.1	10.9	11.6	14.6	17.3	17.1	16.4	18.1	19.5	21.2	24.8	26.0	28.2	27.6	31.5
Netherlands	95.8	94.9	97.3	96.8	102.7	105.6	108.1	115.0	123.0	129.0	125.4	124.6	122.3	123.5	138.0	138.2	131.8	127.0
Norway	10.8	10.8	10.8	11.4	12.1	12.4	15.3	17.1	17.7	17.8	18.1	18.1	18.1	19.2	20.3	21.4	22.7	22.8
Poland	122.8	105.4	100.4	104.6	110.9	120.3	124.8	132.3	131.5	126.4	128.0	126.4	129.2	136.4	155.5	162.1	182.2	205.4
Portugal	20.4	20.6	18.8	17.5	20.0	20.8	25.1	27.1	27.3	28.3	29.0	32.1	31.9	29.5	43.1	45.3	47.3	48.8
Romania	80.0	55.3	42.0	39.0	41.7	47.1	47.8	48.2	36.6	30.9	33.3	37.4	44.2	49.4	58.4	76.6	81.2	83.5
Sweden	45.6	44.2	43.5	44.5	46.1	51.0	52.2	54.2	52.5	52.3	55.7	53.7	55.8	56.8	57.8	60.3	62.2	63.8
Slovenia	9.1	7.5	7.2	6.9	7.6	8.8	8.5	8.9	9.2	9.3	9.5	9.9	9.7	10.3	12.2	14.3	15.5	17.3
Slovak Republic	21.7	21.7	21.7	21.9	25.0	41.7	29.5	29.2	30.9	30.0	27.0	25.8	25.4	27.0	28.3	32.1	32.3	37.8
Turkey	110.2	110.3	110.5	106.2	103.2	121.0	144.7	149.4	160.6	159.2	171.3	158.9	158.1	160.8	166.2	163.1	186.9	191.1
United Kingdom	155.2	154.5	151.3	158.2	168.6	175.0	181.5	186.3	189.5	184.6	183.9	182.9	182.9	186.1	190.7	190.1	199.7	198.0

Note: No data for Malta and Liechtenstein.

Table A.2 Modal split of freight transport (% in total inland freight tonne-km)

	Road				Rail				IWW			
	1996	**2000**	**2004**	**2007**	**1996**	**2000**	**2004**	**2007**	**1996**	**2000**	**2004**	**2007**
EU-27	n.a.	73.7s	76.0s	76.5s	n.a.	19.7s	18.1bs	17.9s	n.a.	6.6s	5.9bs	5.6s
Austria	64.3s	64.8	65.6b	60.9	30.8s	30.6	31.4b	34.8	4.9s	4.5	2.9b	4.2
Belgium	76.4	77.4	74.9	71.1	13.2	11.6	12	13.2	10.4	10.9	13.1	15.7
Bulgaria	n.a.	52.3	66.9	70	n.a.	45.2	29.2	25.1	n.a.	2.6	3.9	4.8
Cyprus	100	100	100	100	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Czech Republic	57.1	68	75.2	74.7	42.4	31.9	24.7	25.3	0.5	0.2	0.1	0.1
Denmark	92.3	92.1	91.5	92.2	7.7	7.9	8.5	7.8	N/A	N/A	N/A	N/A
Estonia	31.1	37.3	32.7	43.2	68.9	62.7	67.3	56.8	0	0	0	0
Finland	73.7	75.8	76.0	73.9	26.0	24 .0	23.8	25.9	0.3	0.3	0.3	0.3
France	76.4	76	79.9	81.4s	21.0	20.6	17 .0	15.2s	2.6	3.4	3.2	3.4s
Germany	64.3	65.3	66.1	65.7	19.0	19.2	20.0	21.9	16.7	15.5	13.9	12.4
Greece	97.8s	n.a.	n.a.	97.1	2.2s	n.a.	n.a.	2.9	N/A	N/A	N/A	N/A
Hungary	61.3e	68.1b	65.9	74.4	32.7e	28.8b	28.0	21.0	6.0e	3.1b	6.1	4.6
Ireland	91.7	96.2	97.7	99.3	8.3	3.8	2.3	0.7	N/A	N/A	N/A	N/A
Italy	89.2	89.0	89.8s	88.3s	10.8	11.0	10.1s	11.6s	0.1	0.1	0e	0e
Latvia	15.1	26.5	28.4	41.9	84.9	73.5	71.6	58.1	0	0	0	0
Lithuania	34.1	46.6	51.3	58.5	65.9	53.4	48.7	41.5	0.1	0	0	0
Luxembourg	79.7	87.8	91.2	92.5	13.0	7.9	5.3	4.1	7.3	4.4	3.5	3.3
Malta	100	100	100	100	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Netherlands	64.2	63.4	64.7	61.4	2.9	3.7	4.2	5.7	32.8	32.9	31.1	33.0
Poland	45.3	56.9	66.1b	73.5	54.0	42.2	33.7b	26.4	0.7	0.9	0.2b	0.1
Portugal	92.6	92.5	94.7b	94.7	7.4	7.5	5.3b	5.3	N/A	N/A	N/A	N/A
Romania	41.4	42.9	60.8b	71.3	50.7	49.1	27.8b	18.9	7.9	7.9	11.4b	9.8
Slovakia	53.8	53.0b	65.4	71.8	40.8	41.7b	34.3	25.5	5.4	5.3b	0.3	2.7
Slovenia	71.7e	71.9e	74.1	79.2	28.3e	28.1e	25.9	20.8	N/A	N/A	N/A	N/A
Spain	90.2s	92.8	95.1	96.1	9.8s	7.2	4.9	3.9	N/A	N/A	N/A	N/A
Sweden	63.9	63.9	63.9	63.6	36.1	36.1	36.1	36.4	N/A	N/A	N/A	N/A
United Kingdom	91.6	90.0	88.1s	86.6s	8.3	9.8	11.8s	13.3s	0.1	0.1	0.1	0.1
Iceland	100	100	100	100.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Norway	81.7	83.5	86.2	84.9	18.3	16.5	13.8	15.1	N/A	N/A	N/A	N/A
Turkey	93.8	94.3	94.4	94.9	6.2	5.7	5.6	5.1	N/A	N/A	N/A	N/A

Note: n.a. = not available; N/A = 'Not applicable' or 'Real zero' or 'Zero bydefault'; s = Eurostat estimate; b = Break in series; e = Estimated value.

Source: Eurostat.

Table A.3 Sea transport of goods (1 000 tonnes)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
EU-27	n.a.	n.a.	n.a.	n.a.	n.a.	3 334 802	3 452 336	3 570 238	3 718 675	3 835 939	3 937 489	3 918 647
Belgium	161 621	171 026	165 557	179 381	174 181	173 824	181 110	187 889	206 539	21 8941	236 320	243 819
Bulgaria	n.a.	n.a.	n.a.	n.a.	20 192	20 390	21 358	23 125	24 841	27 513	24 900	26 576
Cyprus	n.a.	n.a.	n.a.	n.a.	n.a.	7 220	7 258	6 837	7 290	7 645	7 476	7 939
Denmark	124 010	104 966	97 213	96 533	93 972	94 283	103 954	100 373	99 688	107 674	109 660	106 096
Estonia	n.a.	n.a.	n.a.	n.a.	40 383	44 682	47 048	44 808	46 546	49 998	44 964	36 191
Finland	75 314	76 562	77 467	80 681	96 150	99 099	104 439	106 524	99 577	110 536	114 819	114 725
France	305 079	319 000	315 153	325 789	318 188	319 032	330 135	334 035	341 470	350 334	346 825	351 976
Germany	213 318	217 388	221 623	242 535	246 050	246 353	254 834	271 869	284 865	302 789	315 051	320 636
Greece	101 311	110 546	112 549	127 750	122 171	147 692	162 534	157 892	151 250	159 425	164 300	152 498
Ireland	36 333	39 958	42 928	45 273	45 795	44 919	46 165	47 720	52 146	53 326	54 139	51 081
Italy	434 295	444 956	425 914	446 641	444 804	457 958	477 028	484 984	508 946	520 183	537 327	526 219
Latvia	n.a.	n.a.	n.a.	n.a.	56 827	51 978	54 652	54 829	59 698	56 861	61 083	61 430
Lithuania	n.a.	n.a.	n.a.	n.a.	20 953	24 405	30 242	25 842	26 146	27 235	29 253	36 379
Malta	n.a.	n.a.	n.a.	n.a.	n.a.	4 990	5 215	5 303	5 283	5 452	5 254	5 501
Netherlands	402 162	405 384	395 664	405 802	405 853	413 312	410 330	440 722	460 940	477 238	507 463	530 359
Poland	n.a.	n.a.	n.a.	n.a.	46 210	48 111	51 020	52 272	54 769	53 131	52 433	48 833
Portugal	54 734	57 619	58 794	56 404	56 164	55 599	57 470	59 071	65 301	66 861	68 229	65 275
Romania	n.a.	n.a.	n.a.	n.a.	27 619	32 698	35 925	40 594	47 694	46 709	48 928	50 458
Slovenia	n.a.	n.a.	n.a.	n.a.	9 146	9 305	10 788	12 063	12 625	15 483	15 853	16 554
Spain	270 634	280 254	295 715	234 913	315 120	326 001	343 716	373 065	400 019	414 378	426 648	416 158
Sweden	149 892	155 618	156 349	159 291	152 830	154 626	161 454	167 350	178 122	180 487	185 057	187 778
United Kingdom	558 530	568 502	565 614	573 050	566 366	558 325	555 662	573 070	584 919	583 739	581 504	562 166
Iceland	n.a.	4 728	5034	5 164	4 966	4 771	4 981	5 308	5 653	5 917	n.a.	n.a.
Norway	n.a.	n.a.	n.a.	n.a.	n.a.	190 034	186 781	198 199	201 678	196 818	198 507	193 368

Note: n.a. = not available.

Source: Eurostat.

Table A.4 Total passenger transport (1 000 mio pkm)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Austria	85.2	87.8	90.2	91.1	93.5	80.5	81.5	80.8	81.7	83.0	84.1	84.5	85.6	86.7	87.4	88.6	90.1	91.0
Belgium	106.6	110.9	112.2	112.9	115.8	117.3	118.1	119.6	123.6	125.8	127.2	129.5	132.2	134.3	137.3	134.9	137.0	140.5
Bulgaria	41.0	32.7	32.8	31.9	31.4	31.4	32.4	36.0	37.4	40.0	41.1	42.0	44.6	43.4	43.4	45.1	46.9	47.7
Cyprus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Czech Republic	75.9	74.3	72.8	71.2	72.6	74.3	82.6	82.3	83.2	84.8	87.4	88.3	88.4	90.3	89.4	91.8	92.1	94.6
Denmark	57.7	58.2	58.7	59.6	60.0	60.9	61.9	63.1	63.7	64.6	64.2	63.3	63.5	63.9	65.4	65.7	67.2	68.9
Estonia	15.9	15.0	13.8	13.2	12.8	12.4	12.3	12.4	12.4	12.4	12.8	12.6	12.4	12.4	12.6	13.1	13.1	13.0
Finland	63.0	61.9	61.6	60.7	60.6	61.2	61.7	63.3	64.5	65.9	66.8	68.0	69.3	70.6	71.9	72.9	73.6	75.1
France	690.9	704.3	721.1	730.4	752.8	737.3	751.3	763.1	785.2	807.5	812.2	840.1	848.9	853.1	855.3	848.1	848.7	856.9
Germany	799.8	827.3	846.6	863.4	940.8	954.8	956.1	957.5	968.9	990.2	975.7	997.1	1 001.9	9 96.6	1 009.6	998.9	1 014.2	1 015.5
Greece	48.7	50.0	51.6	53.6	56.0	58.8	59.2	62.6	65.8	70.1	76.6	80.8	85.3	88.5	93.0	96.8	100.5	104.3
Hungary	77.7	74.6	72.7	68.6	70.3	70.8	72.8	72.5	72.6	73.9	75.0	75.2	75.9	75.9	75.7	74.5	74.2	67.0
Iceland	3.0	3.0	3.1	3.2	3.3	3.4	3.6	3.8	4.0	4.2	4.7	5.1	5.2	5.4	5.5	6.1	6.4	5.7
Ireland	17.6	18.4	19.0	19.8	20.8	22.0	23.3	25.1	26.3	27.6	28.8	30.1	31.5	32.7	33.9	35.3	36.6	38.0
Italy	651.3	668.0	731.3	727.3	723.0	745.7	760.9	772.4	794.5	798.9	867.2	860.0	854.8	854.6	865.2	867.3	869.4	870.0
Latvia	17.4	15.4	12.4	10.2	9.7	9.4	8.9	9.0	9.1	9.5	9.2	9.2	9.3	11.4	13.7	15.9	16.8	17.6
Lithuania	21.3	20.8	18.9	17.0	16.0	15.1	15.2	15.6	16.2	16.8	17.6	18.5	19.5	22.9	30.0	38.9	38.9	38.8
Luxembourg	4.7	4.9	5.1	5.3	5.4	5.5	5.6	5.8	5.9	5.9	6.6	6.8	7.0	7.0	7.1	7.4	7.6	7.8
Malta	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Netherlands	163.6	146.0	152.2	148.5	149.7	152.4	153.7	158.7	159.8	163.8	164.0	164.7	166.9	167.4	168.0	170.0	169.9	171.6
Norway	48.4	47.8	47.8	48.3	49.9	49.7	51.7	51.6	52.6	53.2	53.7	54.8	55.9	56.9	57.8	58.5	58.5	60.3
Poland	164.8	158.5	156.7	162.3	164.1	171.4	175.4	185.1	195.7	197.8	205.5	211.2	217.4	222.0	230.0	244.5	265.6	286.1
Portugal	43.5	45.4	52.2	52.8	55.3	57.0	59.6	63.4	66.6	70.3	73.4	74.7	77.0	78.8	81.5	84.6	86.7	88.8
Romania	78.2	72.0	77.8	69.9	64.5	65.5	67.6	67.9	63.1	63.5	64.3	65.0	63.8	70.0	72.0	75.8	77.8	79.6
Slovakia	35.4	35.0	34.5	33.6	32.4	33.4	32.8	31.6	31.2	32.3	35.2	35.1	35.9	35.3	34.4	37.2	36.2	35.9
Slovenia	21.3	19.0	18.1	18.4	19.8	21.0	22.7	24.0	23.5	24.8	24.6	24.9	25.4	25.6	26.0	26.3	26.9	27.4
Spain	223.2	258.0	270.1	281.3	292.7	305.3	318.6	328.1	343.1	361.7	371.5	378.8	405.4	414.5	428.6	412.1	412.6	424.4
Sweden	101.0	100.9	101.8	100.4	100.0	102.1	102.8	103.1	104.1	107.2	108.9	109.6	112.2	114.5	114.6	115.0	115.3	118.4
Switzerland	91.9	91.9	91.9	91.9	91.9	91.1	91.3	92.3	93.4	94.9	95.7	97.2	98.8	99.9	100.9	104.3	106.4	107.0
Turkey	125.0	121.6	131.5	135.9	131.2	144.1	154.4	165.2	171.5	174.3	172.3	166.5	172.7	179.9	182.8	195.0	208.3	219.6
United Kingdom	667.6	659.9	659.1	658.8	687.3	692.6	698.6	711.2	717.5	726.7	725.4	740.3	763.9	766.2	770.3	770.4	773.0	788.9

Source: Eurostat.

Table A.5 Modal split of passenger transport; passenger cars % in total inland passenger-km

	Road				Bus				Rail			
	1996	2000	2004	2007	1996	2000	2004	2007	1996	2000	2004	2007
EU-27	n.a.	83.0	n.a.	83.4	n.a.	9.9	n.a.	9.5	n.a.	7.1	n.a.	7.1
Austria	77.4	79.2	79.2	79.2	10.7	11.0	11.0	10.8	11.9	9.8	9.5	10.1
Belgium	83.1	83.4	81.2	80.1	11.2	10.5	12.5	13.3	5.7	6.1	6.3	6.7
Bulgaria	n.a.	56.0	64.5	71.3	n.a.	35.5	30.0	23.6	n.a.	8.5	5.5	5.1
Cyprus	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	0	0	0	0
Czech Republic	70.1	73.2	75.6	75.7	20.1	18.5	17.0	17.0	9.8	8.3	7.4	7.3
Denmark	79.6	79.7	79.7	80.2	12.5	11.6	11.2	10.8	7.8	8.7	9.1	8.9
Estonia	n.a.	n.a.	n.a.	77.2	n.a.	n.a.	n.a.	20.7	n.a.	n.a.	n.a.	2.1
Finland	81.7	83.4	84.8	84.9	13.0	11.5	10.6	10.0	5.3	5.1	4.7	5.0
France	86.4	86.1	86.2	84.9	5.6	5.3	5.1	5.5	8	8.6	8.7	9.6
Germany	85.4	85.2	86.1	85.8	7.1	7.1	6.7	6.4	7.5	7.7	7.2	7.8
Greece	62.5	69.2	74.5	77.0	34.5	28.3	23.7	21.2	3.0	2.5	1.8	1.9
Hungary	63.2	62.1	61.9	61.8	25.0	25.0	24.7	25.2	11.8	12.9	13.4	13.1
Ireland	71.4	73.7	75.5	76.3	22.9	21.4	19.8	18.6	5.6	4.9	4.8	5.1
Italy	82.5	83.8	82.8	82.4	11.7	10.8	11.5	11.9	5.9	5.4	5.7	5.7
Latvia	n.a.	n.a.	n.a.	79.5	n.a.	n.a.	n.a.	15.0	n.a.	n.a.	n.a.	5.5
Lithuania	n.a.	n.a.	86.6	90.7	n.a.	n.a.	11.9	8.4	n.a.	n.a.	1.5	0.9
Luxembourg	85.2	85.5	85.6	84.9	9.8	9.5	10.8	11.1	5.0	5.1	3.6	4.1
Malta	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	0	0	0	0
Netherlands	86.3	86.0	87.9	86.7	5.1	4.6	3.9	3.8	8.5	9.4	8.4	9.5
Poland	69.3	72.8	78.9	83.6	19.4	15.4	13.1	9.6	11.3	11.7	8.0	6.8
Portugal	73.8	78.7	82.2	83.3	18.6	16.1	13.3	12.2	7.6	5.2	4.5	4.5
Romania	n.a.	69.9	74.9	75.3	n.a.	12.0	13.1	15.3	n.a.	18.1	12.0	9.4
Slovakia	54.8	67.9	70.6	72.4	33.8	23.9	22.9	21.6	11.4	8.1	6.5	6.0
Slovenia	78.4	82.9	84.7	85.1	18.9	14.3	12.4	11.9	2.7	2.9	2.9	3.0
Spain	81.3	81.5	81.7	80.9	13.8	13.5	13.2	13.9	4.9	5.0	5.0	5.2
Sweden	84.8	83.7	84.7	84.1	8.5	8.7	7.8	7.2	6.8	7.6	7.6	8.7
United Kingdom	89.0	88.2	88.1	87.3	6.3	6.4	6.2	6.3	4.6	5.3	5.6	6.4
Iceland	88.6	87.0	87.2	88.6	11.4	13.0	12.8	11.4	0	0	0	0
Norway	87.4	87.0	88.1	88.0	8.0	7.7	7.4	7.0	4.6	5.3	4.6	4.9
Turkey	37.2	45.9	53.2	51.9	59.4	50.7	43.9	45.5	3.4	3.4	2.9	2.5

Note: n.a = not available.

Source: Eurostat.

Table A.6 Air passenger transport in EU-27 (1 000 mio passenger-kilometres)

	1 000 mio passenger-kilometres
1995	335
1996	352
1997	385
1998	410
1999	424
2000	456
2001	453
2002	445
2003	462
2004	493
2005	526
2006	547
2007	571

Source: DG TREN.

Table A.7 Number of passenger cars per thousand inhabitants

	1990	1995	2000	2005	2006	2007	Change 2006–2007 %
Austria	388	452	511	503	507	510	0.6
Belgium	387	421	456	468	470	473	0.7
Bulgaria	152	196	245	329	230	272	18.4
Cyprus	304	335	384	463	479	521	8.7
Czech Republic	234	295	335	386	399	412	3.2
Denmark	309	320	347	362	371	378	1.9
Estonia	154	269	339	367	413	391	– 5.4
Finland	388	371	412	462	475	485	2.1
France	476	481	503	499	504	508	0.9
Germany	461	495	475	493	498	501	0.5
Greece	170	207	292	387	407	428	5.2
Hungary	187	218	232	287	293	300	2.2
Iceland	468	445	561	625	641	668	4.2
Ireland	228	276	348	400	418	434	3.8
Italy	483	533	572	590	597	598	0.3
Latvia	106	134	236	324	360	398	10.6
Liechtenstein	582	609	663	699	691	689	– 0.2
Lithuania	133	199	336	428	470	472	0.3
Luxembourg	477	556	622	655	661	665	0.6
Malta		487	483	525	535	548	2.5
Netherlands	367	364	409	434	442	451	1.9
Norway	380	386	411	437	445	455	2.2
Poland	138	195	261	323	351	383	9.0
Portugal	171	255	336	397	405	412	1.9
Romania	56	99	124	156	167	164	– 1.6
Slovakia	166	189	237	242	247	265	7.4
Slovenia	294	357	435	479	488	501	2.7
Spain	309	360	431	463	479	521	8.7
Sweden	419	411	450	459	461	464	0.6
Switzerland	442	457	492	518	519	521	0.3
Turkey		49	65	80	88	92	4.1
United Kingdom	361	378	425	469	471	476	0.9
EU-27	345	381	417	448	456	464	1.8

Note: Estimates are in red.

Source: DG TREN pocketbook 08-09 http://ec.europa.eu/transport/publications/statistics/doc/2009_energy_transport_figures.pdf.

Table A.8 Greenhouse gas emissions from transport in Europe (million tonnes, unless otherwise stated)

	Total transport excluding international aviation and international navigation *			Civil aviation (domestic) *			Road *			Rail *			Navigation (domestic) *		
	1990	2007	Growth in %	1990	2007	Growth in %	1990	2007	Growth in %	1990	2007	Growth in %	1990	2007	Growth in %
EU-27	779.72	982.52	26 %	17.30	22.44	30 %	715.27	920.38	29 %	14.67	8.66	– 41 %	20.90	22.10	6 %
EEA-32	832.79	1067.68	28 %	19.19	29.65	54 %	762.12	991.30	30 %	15.32	9.18	– 40 %	23.52	26.53	13 %
Austria	14.02	24.22	73 %	0.03	0.07	131 %	13.53	23.46	73 %	0.18	0.17	– 7 %	0.06	0.08	32 %
Belgium	20.58	25.93	26 %	0.01	0.01	8 %	19.72	25.17	28 %	0.24	0.15	– 37 %	0.41	0.48	17 %
Bulgaria	11.00	8.29	– 25 %	0.32	0.13	– 58 %	7.69	7.38	– 4 %	0.34	0.08	– 76 %	0.06	0.00	– 100 %
Cyprus	0.78	2.26	188 %	0.00	0.00		0.78	2.26	188 %	0.00	0.00		0.00	0.00	
Czech Republic	7.45	19.22	158 %	0.15	0.03	– 78 %	6.09	18.79	209 %	0.66	0.30	– 54 %	0.06	0.02	– 72 %
Denmark	10.70	14.15	32 %	0.25	0.11	– 56 %	9.43	13.35	42 %	0.30	0.23	– 23 %	0.73	0.46	– 36 %
Estonia	3.39	2.62	– 23 %	0.01	0.00	– 77 %	2.19	2.30	5 %	0.16	0.11	– 31 %	0.58	0.05	– 91 %
Finland	12.79	14.75	15 %	0.39	0.31	– 21 %	11.09	13.00	17 %	0.19	0.11	– 43 %	0.45	0.59	32 %
France	118.78	136.86	15 %	4.29	4.60	7 %	111.48	128.08	15 %	1.08	0.58	– 47 %	1.71	3.03	77 %
Germany	164.58	153.18	– 7 %	3.05	2.36	– 22 %	152.24	145.34	– 5 %	2.89	1.28	– 56 %	2.06	0.53	– 74 %
Greece	14.79	23.75	61 %	0.72	1.36	88 %	11.99	20.11	68 %	0.23	0.13	– 42 %	1.84	2.13	16 %
Hungary	8.47	12.83	52 %	0.00	0.00		7.90	12.64	60 %	0.53	0.19	– 64 %	0.03	0.00	– 89 %
Iceland	0.61	1.02	67 %	0.03	0.02	– 30 %	0.52	0.93	81 %	0.00	0.00		0.06	0.06	1 %
Ireland	5.17	14.38	178 %	0.06	0.12	107 %	4.80	13.97	191 %	0.15	0.15	– 1 %	0.09	0.00	– 95 %
Italy	103.28	129.19	25 %	1.63	2.45	51 %	95.25	120.56	27 %	0.50	0.37	– 26 %	5.49	5.03	– 8 %
Latvia	2.95	3.83	30 %	0.00	0.00		2.34	3.55	52 %	0.59	0.27	– 54 %	0.02	0.01	– 71 %
Liechtenstein	0.08	0.09	13 %	0.00	0.00		0.08	0.09	13 %	0.00	0.00		0.00	0.00	
Lithuania	5.79	5.18	– 11 %	0.00	0.00	501 %	5.41	4.92	– 9 %	0.36	0.23	– 35 %	0.02	0.02	15 %
Luxembourg	2.76	6.68	142 %	0.00	0.00	154 %	2.73	6.68	144 %	0.03	0.00	– 94 %	0.00	0.00	95 %
Malta	0.34	0.53	54 %	0.00	0.00		0.34	0.51	52 %	0.00	0.00		0.01	0.02	125 %
Netherlands	26.44	35.69	35 %	0.04	0.04	0 %	25.90	34.94	35 %	0.09	0.10	6 %	0.41	0.61	50 %
Norway	11.33	15.92	41 %	0.69	0.92	34 %	7.74	10.32	33 %	0.11	0.05	– 55 %	1.95	2.66	36 %
Poland	25.39	38.81	53 %	0.06	0.08	45 %	21.62	37.51	74 %	2.09	0.54	– 74 %	0.22	0.01	– 95 %
Portugal	10.15	19.50	92 %	0.24	0.39	65 %	9.46	18.82	99 %	0.18	0.08	– 57 %	0.26	0.21	– 20 %
Romania	7.69	12.85	67 %	0.02	0.05	119 %	6.51	12.10	86 %	0.96	0.57	– 41 %	0.19	0.09	– 52 %
Slovakia	5.04	6.72	33 %	0.01	0.01	75 %	4.59	6.58	43 %	0.43	0.12	– 71 %	0.00	0.00	
Slovenia	2.74	5.40	97 %	0.00	0.00	57 %	2.67	5.35	101 %	0.07	0.04	– 42 %	0.00	0.00	
Spain	57.48	112.27	95 %	4.17	7.66	84 %	51.36	100.86	96 %	0.42	0.29	– 30 %	1.51	3.29	117 %
Sweden	18.58	20.84	12 %	0.69	0.61	– 11 %	17.07	19.52	14 %	0.12	0.08	– 34 %	0.55	0.45	– 18 %
Switzerland	14.77	16.35	11 %	0.26	0.14	– 45 %	14.17	15.94	12 %	0.03	0.04	27 %	0.11	0.12	3 %
Turkey	26.29	51.79	97 %	0.91	6.13	569 %	24.35	43.64	79 %	0.52	0.43	– 17 %	0.50	1.60	219 %
United Kingdom	118.59	132.60	12 %	1.17	2.00	70 %	111.09	122.63	10 %	1.88	2.48	32 %	4.14	4.97	20 %

Note: * Emissions covered by the Kyoto Protocol reduction targets; ** Emissions not covered by the Kyoto Protocol reduction targets.

Source: EEA greenhouse gas data viewer, 2010.

Table A.8 Greenhouse gas emissions from transport in Europe (million tonnes), unless otherwise stated (cont.)

	Other transportation *			International bunkers **			International aviation **			International maritime **		
	1990	2007	Growth in %	1990	2007	Growth in %	1990	2007	Growth in %	1990	2007	Growth in %
EU-27	11.58	8.94	– 23 %	176.21	315.05	79 %	66.19	138.81	110 %	110.02	176.25	60 %
EEA-32	12.63	11.03	– 13 %	187.91	335.62	79 %	76.30	157.12	106 %	111.61	178.50	60 %
Austria	0.22	0.45	100 %	0.90	2.20	145 %	0.90	2.20	145 %			
Belgium	0.20	0.13	– 36 %	17.13	35.88	109 %	3.10	3.79	23 %	14.03	32.08	129 %
Bulgaria	2.60	0.69	– 73 %	1.77	0.70	– 61 %	0.89	0.53	– 41 %	0.88	0.17	– 81 %
Cyprus	0.00	0.00		0.94	1.49	58 %	0.75	0.89	18 %	0.19	0.60	217 %
Czech Republic	0.49	0.08	– 85 %	0.65	1.14	76 %	0.65	1.14	76 %			
Denmark	0.00	0.00		4.90	6.36	30 %	1.76	2.73	56 %	3.15	3.63	15 %
Estonia	0.45	0.14	– 68 %	0.68	0.93	36 %	0.11	0.15	41 %	0.58	0.78	35 %
Finland	0.67	0.74	10 %	2.89	3.19	10 %	1.03	1.68	64 %	1.86	1.50	– 19 %
France	0.22	0.57	164 %	16.65	26.70	60 %	8.64	17.29	100 %	8.01	9.41	17 %
Germany	4.34	3.66	– 16 %	19.55	35.67	83 %	11.49	25.65	123 %	8.06	10.02	24 %
Greece	0.00	0.01		10.58	13.06	23 %	2.47	2.95	19 %	8.11	10.11	25 %
Hungary	0.00	0.00		0.50	0.75	51 %	0.50	0.75	51 %			
Iceland	0.00	0.00		0.32	0.73	125 %	0.22	0.52	133 %	0.10	0.21	109 %
Ireland	0.06	0.13	111 %	1.13	3.39	200 %	1.07	3.03	183 %	0.06	0.36	529 %
Italy	0.41	0.78	88 %	8.63	18.34	112 %	4.20	10.51	150 %	4.43	7.83	77 %
Latvia	0.00	0.00		1.78	0.84	– 53 %	0.22	0.25	11 %	1.56	0.59	– 62 %
Liechtenstein	0.00	0.00		0.00	0.00	77 %	0.00	0.00	77 %			
Lithuania	0.00	0.00		0.73	0.54	– 26 %	0.42	0.20	– 51 %	0.31	0.33	8 %
Luxembourg	0.00	0.00		0.41	1.34	230 %	0.41	1.34	230 %	0.00	0.00	
Malta	0.00	0.00			2.74			0.05			2.69	
Netherlands	0.00	0.00		39.02	62.67	61 %	4.56	11.14	144 %	34.46	51.53	50 %
Norway	0.85	1.97	132 %	8.28	15.88	92 %	6.79	13.84	104 %	1.49	2.04	37 %
Poland	1.40	0.67	– 53 %	1.94	2.10	8 %	0.58	1.31	126 %	1.37	0.80	– 41 %
Portugal	0.00	0.00		2.86	4.30	50 %	1.47	2.52	72 %	1.39	1.77	27 %
Romania	0.01	0.04	522 %	1.05	0.64	– 39 %	0.17	0.42	148 %	0.88	0.22	– 75 %
Slovakia	0.01	0.00	– 66 %	0.13	0.16	20 %	0.06	0.12	86 %	0.07	0.04	– 44 %
Slovenia	0.00	0.00		0.08	0.27	244 %	0.08	0.10	23 %		0.18	
Spain	0.02	0.16	703 %	15.11	37.62	149 %	3.48	10.53	203 %	11.63	27.09	133 %
Sweden	0.16	0.17	6 %	3.62	9.76	170 %	1.35	2.22	64 %	2.26	7.54	233 %
Switzerland	0.20	0.12	– 42 %	3.10	3.96	28 %	3.10	3.96	28 %			
Turkey	0.00	0.00										
United Kingdom	0.30	0.52	71 %	22.59	42.28	87 %	15.86	35.31	123 %	6.73	6.97	3 %

Note: * Emissions covered by the Kyoto Protocol reduction targets; ** Emissions not covered by the Kyoto Protocol reduction targets.

Source: EEA greenhouse gas data viewer, 2010.

Table A.9 Investments in infrastructure (million euro)

	Road			Rail			Inland waterways			Sea transport			Air transport		
	1992	**2000**	**2007**	**1992**	**2000**	**2007**	**1992**	**2000**	**2007**	**1992**	**2000**	**2007**	**1992**	**2000**	**2007**
Austria	557	477	870	640	1 199	1 505	11	0					116	82	
Czech		309	1 493		371	612		11	14					28	77
Denmark	191	510	1 020	724	564	232				61	57	99	20	118	
Estonia	2	19	131	0	20	27					18	55	0	1	4
Finland	340	488	803	174	233	211	2	0	5	41	59	223	60	65	74
France	10 218	10 545	12 489	3 601	2 955	4 424	104	114	168	214	197	252	703	783	1 052
Germany	12 159	11 967	10 160	4 673	5 305	4 716	593	828	809	476	562	640	1 580	1 411	1 620
Hungary	167	177	646	41	197	376	3	0	4				20	27	2
Liechtenstein	19	24													
Lithuania		109	277	0	18	75	0	0	3	0	13	26	0	1	53
Norway	1 002	909	1511	125	363	283				57	123	82	88	72	
Portugal	398	964	1 453	114	401	329	6	1	12	52	126	116	44	168	93
Slovakia	85	227	382	24	53	287	35	1	0				9	4	16
Spain	4 213	4 738	7 780	973	920	2 368				337	498	1 188	154	460	2 013
Switzerland	2 198	2 717		815	1 463	2 619	3	17	0				59	411	0
United Kingdom	6 445	5 564	7149	3 174	4 578	8 098				145	336	417	586	1 196	

Source: OECD/IFT, 2009.

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