

# **Energy Efficiency Trends and Policies in the Transport Sector in the EU**

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# **Energy Efficiency Trends and Policies in the Transport Sector in the EU**

## **Lessons from the ODYSSEE MURE project**



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## Acknowledgements

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This brochure was prepared by Bruno Lapillonne from Enerdata with the support of Karine Pollier. All the information on energy efficiency indicators is taken from the ODYSSEE database and website, managed by Enerdata in France. The information on policy measures is derived from the MURE database, which is developed and maintained at ISIS in Italy by Stefano Faberi, Michela Fioretto and Nicola Piccioni, and coordinated by Wolfgang Eichhammer and Barbara Schломann from Fraunhofer ISI in Germany. These researchers continually propose improvements, which over time have led the ODYSSEE-MURE tools to become the leading instrument in European monitoring and evaluation of energy efficiency trends.

Among the many participants in the ODYSSEE-MURE network, particular thanks are due to<sup>1</sup>: Bettina Emmerling and Reinhard Jellinek (AEA, Austria), Yvonne Baillet and Francis Altdorfer (Econotec, Belgium), Filip Fikov and Ludmil Kostadinov (EEA, Bulgaria), Helena Bozic, Branko Vuk and Dino Novosel (EIHP, Croatia), Kyriatos Kitsios (CIE, Cyprus), Jiri Spitz (Enviros, Czech Republic), Ali A. Zarnaghi and Peter Dal (DEA, Denmark), Sulev Soosaar (TUT, Estonia), Martin Howley and Dennehy Emer (SEI, Ireland), Emidio d'Angelo, Pier Giorgio Catoni and Giulia Iorio (ENEA, Italy), Saara Elväs and Lea Gynther (Motiva, Finland), Gregory Chedin and Eric Vesine (ADEME, France), Lazlo Elek (ENCEN, Hungary), Barbara Schломann and Wolfgang Eichhammer (Fraunhofer ISI, Germany), Minas Iatridis (CRES, Greece), Gaidis Klavs (IPE, Latvia), George Cassar (MRA, Malta), Joost Gerdes and Piet Boonekamp (ECN, the Netherlands), Eva Rosenberg (IFE, Norway), Ryszard Wnuk (KAPE, Poland), Grazyna Berent-Kowalska and Szymon Peryt (GUS, Poland), Alberto Tavares (ADENE, Portugal), Maria Rugina and Vasile Rugina (Icemenerg, Romania), Iulia Lazar (ARCE, Romania), Jan Rousek, Pavel Starinsky and Maria Svobodova (SEA, Slovak Republic), Fouad Al Mansour (JSI, Slovenia), Pilar de Arriba Segurado and Jesús Pedro García (IDAE, Spain), Linn Stengård, Malin Lagerquist, Helen Lindblom, and Emma Ostensson (STEM, Sweden), Heather Haydock, Tom Hazeldine and Tricia Wiley (AEA Technology, United Kingdom).

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<sup>1</sup> Alphabetic order of countries

Finally, we extend our thanks to Vasco de Janeiro from the Intelligent Energy for Europe Programme (IEE) and Ms Pirjo-Liisa Koskimaki from the DG-TREN for their support and belief in this project and their encouragement and advice.

Didier Bosseboeuf  
Project leader

## Key Messages

- In terms of policy measures, the main focus was on cars, and especially on increasing the efficiency of new cars. Those measures have already led to significant improvements in efficiency and/or specific emission reduction.
- Since 2007/2008 measures on new cars have clearly been reinforced, involving increased subsidy schemes and a new EU Directive on mandatory emission limits for new cars. That new regulation, which introduces an emission limit of 130 gCO<sub>2</sub>/km by 2015, should speed up technical progress. The increasing use of biofuels will also contribute to the achievement of that target.
- Most countries have established some form of greening of tax systems related to car use and ownership. However, the lack of comparable data makes it difficult to compare the total amount of those taxes.
- The relative contribution of the different measures to the market transformation for new cars is difficult to assess, since it is the outcome of a large variety of measures and increased fuel prices.
- In addition to taxes, other measures that are more focused on the total car fleet have also been implemented. They include eco-driving, information campaigns and, more recently, car scrappage schemes to replace the oldest cars.
- Trucks and light-duty vehicles are not sufficiently addressed by policies, despite the rapid growth of their energy consumption.
- Modal shift measures are still scarce, especially with regard to freight transport, and only very limited results have been achieved in that area.
- Innovative measures in the transport sector include “green” car taxation by linking purchase and/or annual tax to specific CO<sub>2</sub> emissions; car labels combined with easily accessible web-based information for comparing the energy performance of cars; innovative toll systems for trucks and cars; innovative information campaigns aimed at promoting mobility management; and modal shift.
- The impact of infrastructure measures on the modal split is not yet visible, which is understandable given the fact that investments in road infrastructures still exceed investments in public transport infrastructures by an order of magnitude.
- Since 1998 there has been a decoupling of the energy consumption trend of transport from the GDP growth at EU level. Since 2000 the sharp increase in oil prices has caused the energy consumption growth rate to slow down at EU level

and in most EU-15 countries, to the extent that consumption levels stabilised in France and even dropped in Germany. New member countries, however, have not been impacted by the increase in oil prices.

- Since 1994 passenger traffic, which is responsible for two-thirds of the sector's total consumption, has been growing at a slower pace than the GDP. The opposite trend is observed in the case of freight transport, with freight traffic increasing at a faster pace than the GDP since 2002.
- The transport sector was 15% more energy efficient in 2007 than in 1990. Most of the gains come from cars.
- The energy efficiency of cars is improving on a regular basis (by 1.3%/year since 1990), despite a slowdown in recent years; on average in the EU, cars consumed 1 litre/100 km less in 2007 than in 1990.
- As a result of the agreement between the Commission and the associations of car manufacturers (ACEA, JAMA and KAMA), as well as the increase in fuel prices, new cars sold in 2007 were 15% more efficient than new cars sold in 1995. Part of the improvement in the performance of new cars is offset by a general shift towards larger cars over most of the periods, although in 2007 and 2008 that trend was reversed, seeing an increase in smaller cars.
- The annual distance travelled by cars has been steadily decreasing since 1999.
- The transport sector is the only end-use sector in which CO<sub>2</sub> emissions continue to increase: emissions in 2007 were 26% above their 1990 levels.
- The CO<sub>2</sub> emissions of new cars have decreased by 17% since 1995. However, in 2008 the average specific emissions were 10% above the 2008 target of 140 g/km stipulated in the agreement between the European Commission and the associations of car manufacturers.

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# 1. Introduction

## 1.1. Objective of the brochure

The aim of this brochure is to provide insight into past developments for energy use, energy efficiency trends and related policy measures in the transport sector in the EU-27. This should help policy makers and other parties involved in energy efficiency and CO<sub>2</sub> emission reduction to adapt current policies and to define new, effective policy measures. Although the main focus is on the improvement of energy efficiency and the effect of various policy measures, other drivers affecting the energy demand trend in the sector -such as the impact of economic growth, energy prices and driving behaviour- are also considered.

This publication was created using the data contained in the following two databases that cover all EU-27 Member States, Croatia and Norway:

- ✓ The **ODYSSEE** database on energy efficiency indicators, with data on energy trends, drivers for energy use, explanatory variables and energy-related CO<sub>2</sub> emissions (**Box 1.1**) ([www.odyssee-indicators.org](http://www.odyssee-indicators.org)).
- ✓ The **MURE** database with policy measures on energy efficiency, including the impact of the measures (**Box 1.2**) ([www.mure2.com](http://www.mure2.com)).

Both tools are used to support energy policy formulation by the European Commission, e.g. as part of the monitoring and evaluation of the Energy Service Directive.

### Box 1.1 ODYSSEE database

The ODYSSEE database ([www.odyssee-indicators.org](http://www.odyssee-indicators.org)) is used for the monitoring and evaluation of annual energy efficiency trends and energy-related CO<sub>2</sub> emissions. The energy indicators are calculated for the years from 1990 onwards (EU-15 countries) or from 1996 onwards (new Member States). The inputs for the indicators are provided by national energy agencies or institutes according to harmonised definitions and guidelines.

ODYSSEE encompasses the following types of indicators<sup>2</sup>:

- Energy/CO<sub>2</sub> intensities which compare the energy used in the economy or a sector to macroeconomic variables (e.g. GDP, value added).
- Specific energy consumption which compares energy consumption to physical indicators (e.g. specific consumption per tonne-km, per car, per km);
- Energy efficiency indices by sector (ODEX) to evaluate energy efficiency progress (in %).
- Energy savings to measure the amount of energy saved through energy efficiency improvements.
- Adjusted indicators to allow the comparison of indicators across countries (e.g. adjustments for differences in modal structure, in size of vehicles).
- Benchmark/target indicators by sector to show the potential improvement based on countries with the best performance (evaluation based on adjusted indicators).
- Diffusion indicators to monitor the market penetration of energy-efficient technologies (e.g. share of low emission cars below 100 g of CO<sub>2</sub> per km) and practices (% of passenger transport by public modes).

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<sup>2</sup> The methodological issues and precise definitions of indicators and data are explained at the end of this brochure in a specific section, “Definitions and Glossary”.

ODYSSEE database indicators are now used to monitor trends in energy efficiency in a harmonised way among countries. They are increasingly used by the European Commission as well as by several international organisations, including:

- **DG-TREN:** the EC explicitly refers to the ODEX indicators in the Energy Service Directive as a way of contributing to the monitoring of the Directive in a so-called “top-down” approach. The EMOS (Energy Market Observatory) database includes about 20 ODYSSEE indicators. The Energy Demand Management Committee of ESD has proposed indicators similar to those by ODYSSEE for the measurement of energy savings using top-down methods.
- **EEA (European Environmental Agency):** uses data and indicators taken from the ODYSSEE database for different annual reports such as the Energy and Environment Report<sup>3</sup> and the TERM report<sup>4</sup>. ODYSSEE indicators were also used in the fourth pan-European environment assessment report (UNECE).
- **IEA, the International Energy Agency:** ODYSSEE data are used by the IEA to construct their own indicators for European countries. In addition, IEA has developed a questionnaire for the collection of the data necessary to calculate the indicators similar to the ODYSSEE data template.

### **Box 1.2: MURE database**

**The MURE database ([www.mure2.com](http://www.mure2.com))** provides an overview of the most important energy efficiency policy measures by sector (households, industry, transport and tertiary), as well as general or cross-cutting measures. Information about these measures is collected by national energy agencies or institutes according to harmonised guidelines. The measures are classified according to various criteria:

- their status (completed, ongoing or planned) and year of introduction and completion;
- their type: legislative/normative (e.g. standards for new dwellings), legislative/informative (e.g. mandatory labels for appliances), financial (e.g. subsidies), fiscal (e.g. tax deductions), information/education, co-operative (e.g. voluntary agreements) and taxes on energy/CO<sub>2</sub>);
- their qualitative impact: low, medium or high impact, based on quantitative evaluations or expert estimates (see glossary and definitions);
- the targeted energy users, the actors involved, etc.

For each policy measure a detailed description is available which contains, if available, a quantitative impact in terms of energy savings and/or CO<sub>2</sub> emission reduction.

The MURE database provides EU Member States with a structured format to report on measures taken under the National Energy Efficiency Action Plans requested by the European Commission in compliance with the Energy Service Directive (ESD). In addition, the MURE simulation tool, which is linked to the database, was used by the EU Commission to assess the energy saving potentials over the period 2010-2030<sup>5</sup>.

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<sup>3</sup> EEA (2008): Energy and environment report.

<sup>4</sup> EEA (2009). TERM monitors indicators tracking transport and environment integration in the European Union.

<sup>5</sup> DG TREN (2009): Energy Savings Potentials in EU Member States, Candidate Countries and EEA Countries

## 1.2. Content of the brochure

All EU countries and the European Commission agree that the transport sector is a strategic sector for the reduction of CO<sub>2</sub> emissions. Yet it is difficult to implement effective policies because of the strong lobby of the car industry and transport companies, and the particular relationship of European consumers to cars, who see them both as a means of transport as well as a status symbol. This report aims to review the policies actually implemented and the trends observed in transport energy use and emissions. It will try to answer various questions:

- Has the strong increase in oil prices over recent years had a visible impact?
- To what extent are traditional motor fuels (gasoline and diesel) being replaced by alternative fuels?
- Is passenger mobility becoming saturated?
- Although all policy makers agree on the need to reduce the role of roads in both passenger and freight transport, what is really happening? Are the policies in that area effective? Have energy savings been achieved as a result of modal shift?
- What innovative measures have been taken with regard to cars and other transport modes?
- What are the common features and differences between countries' national policies, in particular regarding fuel taxation?
- Why do fuel performance and annual car use vary so greatly between countries? What role do policies, market forces and national circumstances play?

Although the analysis will mainly focus on the overall EU<sup>6</sup> trend, the differences between countries will also be highlighted<sup>7</sup>, so as to pinpoint the countries with the most innovative measures and the most interesting trends.

Chapter 1 will look at the overall energy consumption trend in the transport sector and describes the balance of implemented policy measures, in terms of types of instruments (e.g. regulation versus financial incentives) and target (e.g. efficiency of cars versus modal shift). Chapters 3 and 4 focus on the two most important transport modes in terms of energy consumption and of policies: on the one hand cars (Chapter 3) and on the other hand trucks and light-duty vehicles (i.e. road freight transport, Chapter 4). Those two chapters will be concluded with an analysis of trends in modal distribution. Finally, Chapter 5 summarises energy efficiency and CO<sub>2</sub> emission trends in the entire transport sector.

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<sup>6</sup> The EU will always refer to the 27 countries it currently covers.

<sup>7</sup> Although not part of the EU, Croatia and Norway will be included in the comparison of countries, since they are part of the ODYSSEE-MURE project.



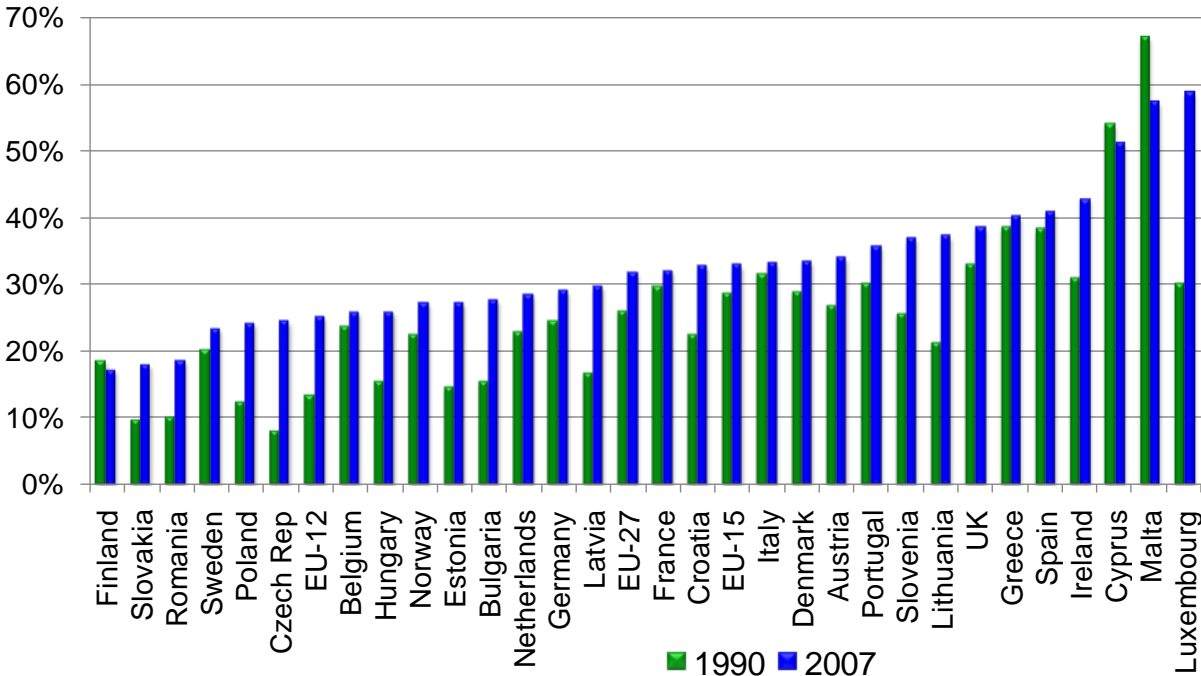
## 2. General overview

### 2.1. Energy consumption

#### An explosion of the transport sector in Central and Eastern European new member countries

Of all sectors, transport has the most rapid energy consumption growth. As a result, its share in final energy consumption is increasing almost everywhere: it has now reached 32% in the EU as a whole (378 Mtoe in 2007), up from 26% in 1990 (281 Mtoe) (**Figure 2.1**). Growth in this sector has been especially rapid in new EU Member States from Central and Eastern Europe, with the share of the transport sector nearly doubling from 13% in 1990 to 25% in 2007 in the EU-12 (+ 12 points). That spectacular rise is due both to the reduction or slowdown of industrial energy consumption as well as the rapid increase in car ownership. With the exception of smaller countries like Luxembourg, Cyprus and Malta, where air transport is proportionally very developed, the weight of transport is particularly high in certain countries: 38% in the UK, 40% in Greece, 41% in Spain and 43% in Ireland.

**Figure 2.1: Share of transport in final energy consumption<sup>8</sup>**



Source ODYSSEE and Eurostat

<sup>8</sup> EU-12 refers to the new EU member countries.

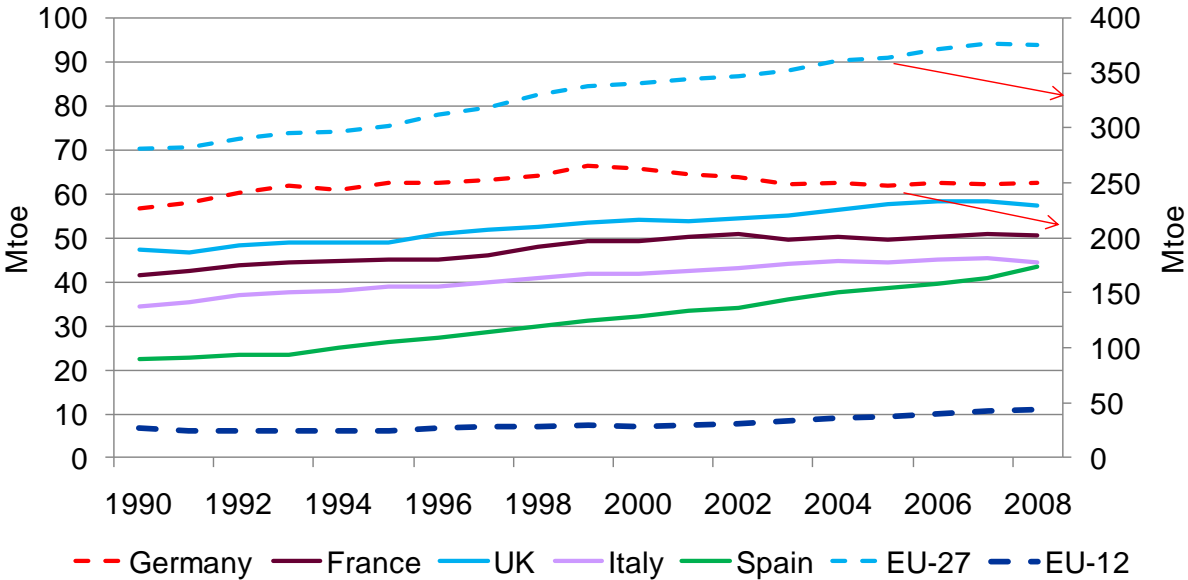
**Rapid growth until 1999 followed by a net slowdown in EU-15 countries and in the EU as a whole; sustained growth in new member countries since 1995**

The energy consumption of the EU-15 transport sector increased very rapidly between 1990 and 1999 (at about 2.2%/year) (Figure 2.2). Since then, there has been a net slowdown in the energy consumption growth (around 0.8%/year over the period 1999-2008).

In certain large countries the slowdown in the growth of energy consumption is significant. In Germany consumption has been falling since 2000 (-0.6%/year on average), in France it has remained stable since 2001 and in most other countries it has slowed down. This new trend is the result of several factors: the sharp increase in oil prices in 2000 (+60% compared to 1999 for Brent), followed by an almost fourfold increase between 2002 and 2008, the slowdown in air traffic and national measures in certain countries (e.g. motor fuel tax increases in Germany and the UK, enforcement of speed limits via automatic speed control devices along the roads in France). The combined effect of oil price hikes, changes in taxation and the fluctuations of the euro-dollar exchange rate led to a 50% higher average motor fuel price in 2008 than in 1990, in real terms (+ 40% for gasoline and 60% for diesel).

The growth in new member countries (EU-12) has been very strong since 1995, with a rate of 4.5%/year. Moreover, they have not felt the impact of the post-1999 oil price increases. Contrary to the other EU-15 countries, Spain’s transport energy demand has grown steadily since 1990, by about 4%/year.

**Figure 2.2: Trends in the energy consumption of transport in the EU**

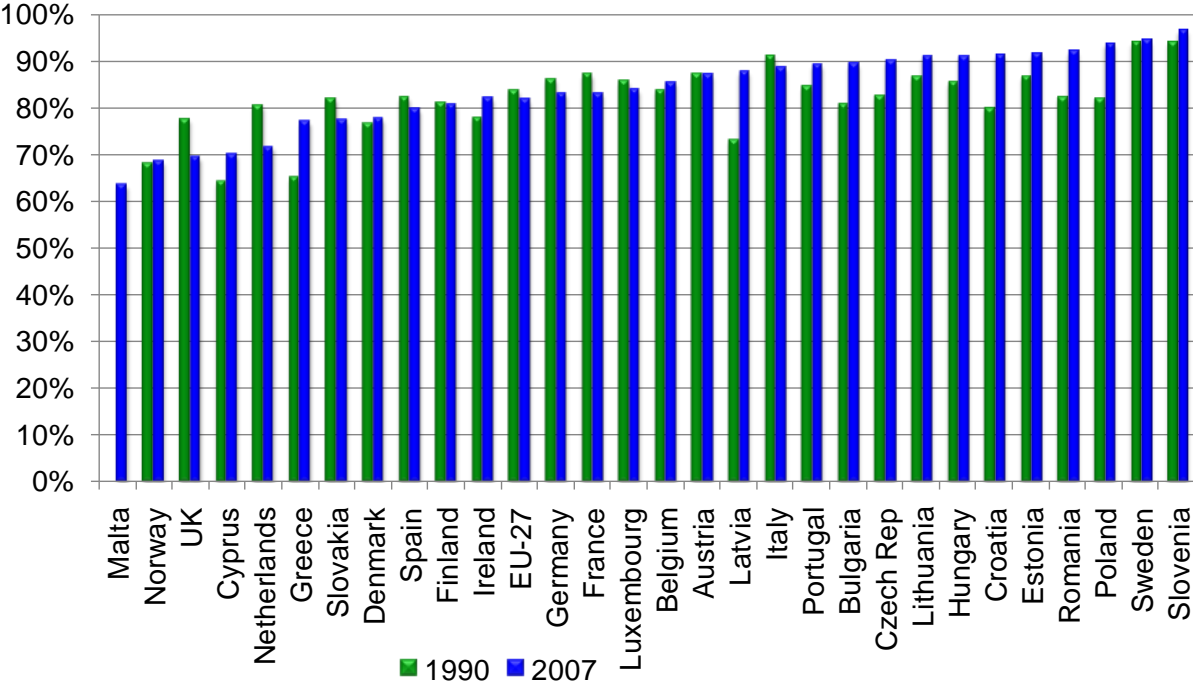


Source: ODYSSEE and provisional data from Enerdata for 2008.

**The role of road transport is declining slightly**

In 2007 road transport represented 82% of the total EU transport consumption (ranging from 60-95%), down from 84% in 1990 (**Figure 2.3**); in about half of the countries and in the EU as a whole, the share of road transport is decreasing slightly (by 2 points for EU-27) due to the growing importance of air transport.

**Figure 2.3: Share of road transport in total energy consumption of transport<sup>9</sup>**



Source: ODYSSEE and Eurostat

**Rapid growth of air transport until 2000**

Domestic and international air transport went from accounting for 11% to 14% of the energy consumed by the sector over the period. Total air transport consumption increased at the rapid rate of about 5% per annum between 1990 and 2000, until in 2001 the sector was struck by a crisis. Rail and domestic water transport accounted for about 4% of total transport energy demand (with 2.5% and 1.5%, respectively). Passenger transport represented about two-thirds of the total consumption and grew less rapidly than freight transport.

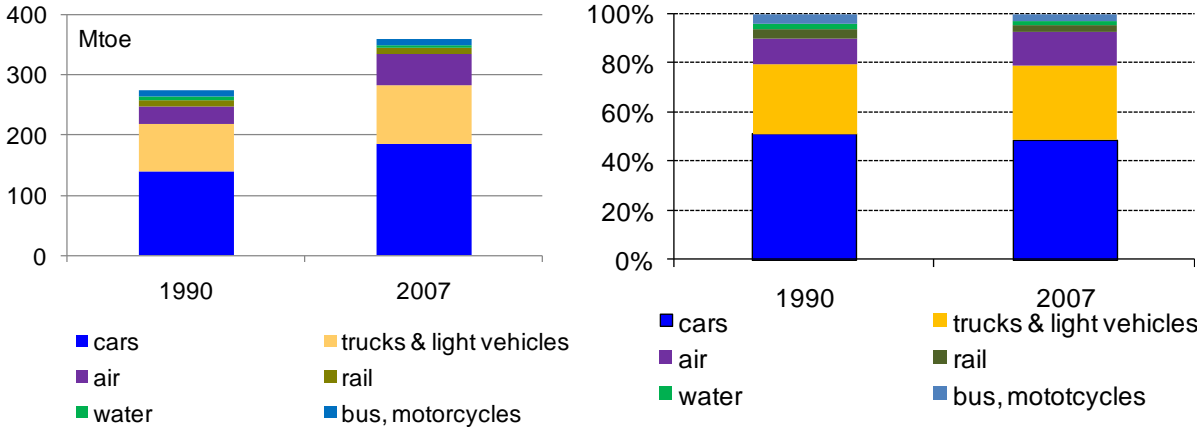
**Almost half of the energy consumption for cars and 30% for trucks**

The sector’s energy consumption has increased by about 100 Mtoe since 1990, with cars accounting for 45% of that growth, trucks and light vehicles for one-third and air transport (both domestic and international) for about 20%.

<sup>9</sup> For certain countries the energy consumption of road transport is corrected in ODYSSEE to account for the consumption of foreign vehicles (“border trade”), as explained in the glossary (e.g. France, Germany, Ireland, Austria, Slovenia). The share of road transport for those countries is calculated on the basis of Eurostat to include the fuel consumption of both national and foreign vehicles.

Cars account for about half of the sector’s total consumption and for about 60% of road transport consumption (**Figure 2.4**). The share of cars is declining (49% in 2007 compared to 51% in 1990), whereas that of road freight transport (trucks and light-duty vehicles) is on the increase (31% in 2007 compared to 29% in 1990). Light-duty vehicles have the fastest consumption growth among road vehicles (3.3%/year compared to 1.2%/year for cars). The energy consumption growth of heavy trucks remained stable over the period (at 2%/year) and did not slow down after 2000, as it did in the case of other vehicles.

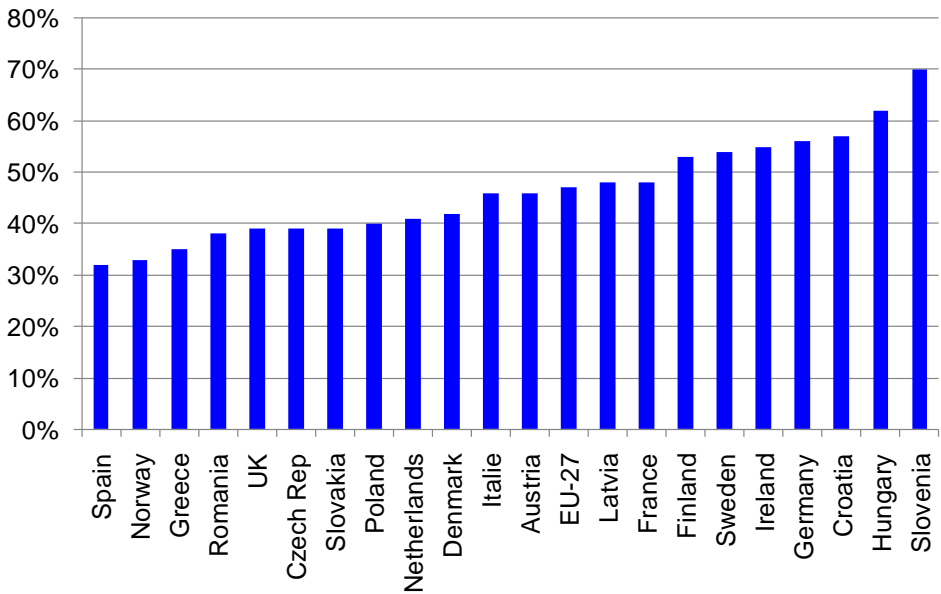
**Figure 2.4: Consumption of transport by mode in the EU-27**



**The importance of cars in transport energy consumption varies greatly among countries**

The share of cars in the energy consumption of transport varies from 30% in Spain to 70% in Slovenia. These differences stem from the level of car ownership and the importance of other transport modes, namely air transport (high in UK and the Netherlands), water transport (high in Greece and the Netherlands) and road freight transport.

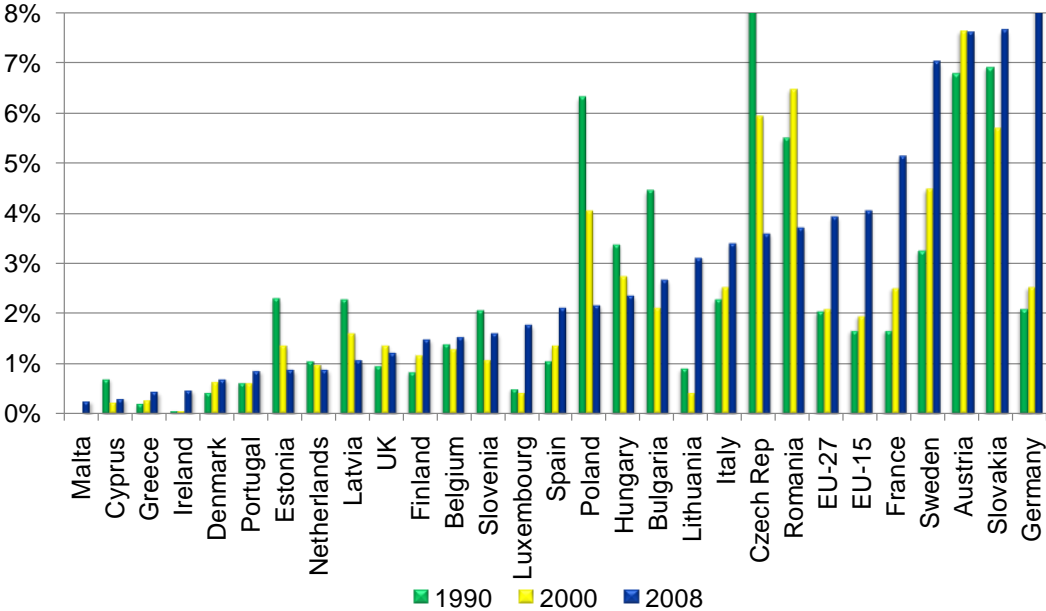
**Figure 2.5: Share of cars in transport energy consumption**



### Reduction of the high dependence on oil in certain EU-15 countries

Oil products make up the bulk of the sector’s consumption (96% on average in the EU in 2007, ranging from 91.5% to 100%): on average alternative fuels (electricity, natural gas and biofuels) supplied 4% of the consumption (**Figure 2.6**).

**Figure 2.6: Share of alternative fuels to oil in transport in the EU**



Source: ODYSSEE; for 2008: Enerdata estimates from national data, Eurostat/AIE and Observ’ER

Four countries have a high share of alternative fuels: Germany, Slovakia, Austria and Sweden (between 7% and 8.5%). Germany ranks first and registered the most spectacular growth, from 2.5% in 2000 to 8.5% in 2008. That good performance is mainly explained by the rapid penetration of biofuels, and especially of biodiesel, following the prompt implementation of the EU Directive on biofuels. The 4 countries which in 2008 witnessed the greatest penetration of biofuels are Germany (6%), Austria and Sweden (5%) and France (4.5%)<sup>10</sup>. The share of electricity is highest, at around 3%, in three countries, namely Austria, Sweden and the Czech Republic; the EU average is around 1.5%. The use of natural gas (CNG) is most strongly developed in Italy and Bulgaria, where gas represents around 1% of the consumption.

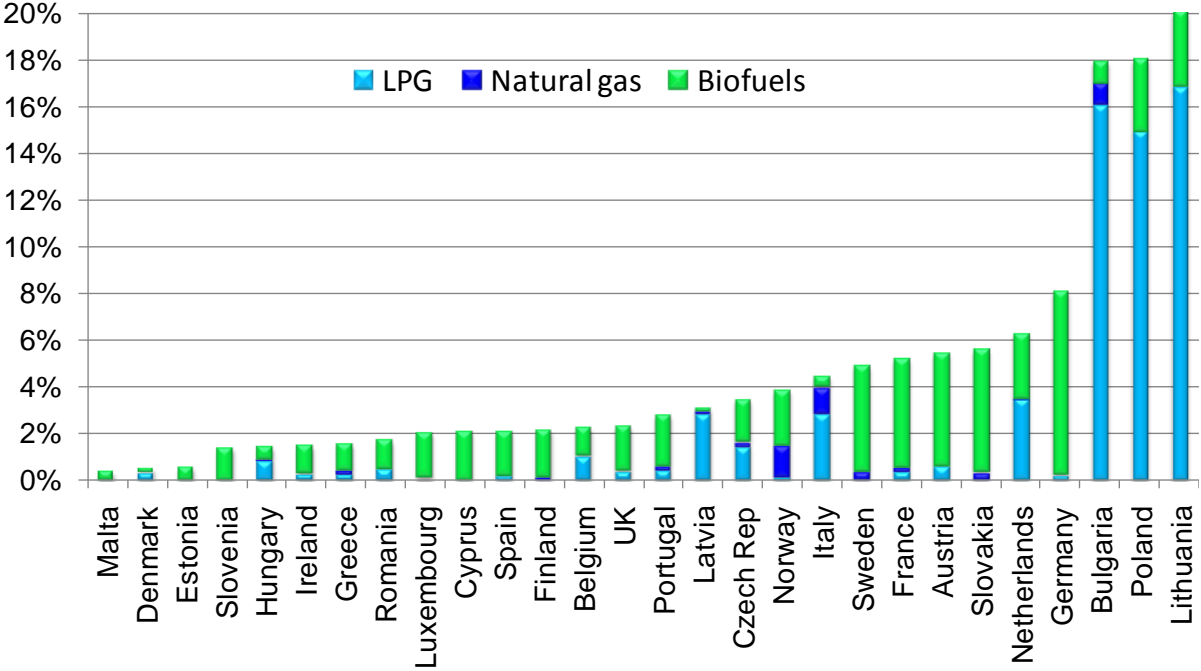
In most Central and European countries, the share of alternative fuels has dropped due to a reduction in the share of electricity (linked to the declining role of public transport); that trend is especially striking in the Czech Republic and Poland and has continued in recent years.

LPG is included in oil consumption, in keeping with international definitions. Nevertheless, in certain countries LPG is considered to be an alternative fuel to gasoline or diesel for road vehicles, used to reduce the dependence on oil since LPG is

<sup>10</sup> In percentage of total fuel consumption of road transport, Germany’s market share is around 8% and that of the 3 other countries around 5% (Figure 2.6).

also produced from natural gas processing. If LPG is included as an alternative fuel, the ranking of countries and the magnitude of the penetration of alternative fuels differ from the figures displayed in Figure 2.5. Bulgaria, Poland and Lithuania rank first with a market share of around 18-20% (**Figure 2.7**).

**Figure 2.7: Share of biofuels, LPG and natural gas in road transport**



Source: Enerdata estimates from national data, Eurostat/AIE and Observ'ER

**Diesel makes up more than half of transport energy consumption**

Diesel consumption has grown quickly in the EU, by nearly 4%/year between 1990 and 2007. As a result, diesel replaced motor gasoline as the sector’s leading energy source in 1998. Its market share now totals 52%, compared to 38% in 1990. The market share of diesel is particularly high in Belgium (72% in 2007) and in 4 other countries: Austria, France, Spain, and Portugal (around two-thirds). The largest growth was seen in Slovenia and Bulgaria, where the market share of diesel has doubled since 1990. Two countries show entirely different trends: Greece, where the share of diesel is stable, and Slovakia, where it is falling. Those trends are mainly linked to the relative taxation of gasoline and diesel. Gasoline now accounts for 28% of the total consumption (48% in 1990).

**2.2. Mobility trends**

**The mobility of EU citizens is increasing on a regular basis, although the growth rate has halved since 2000; great differences are seen among member countries**

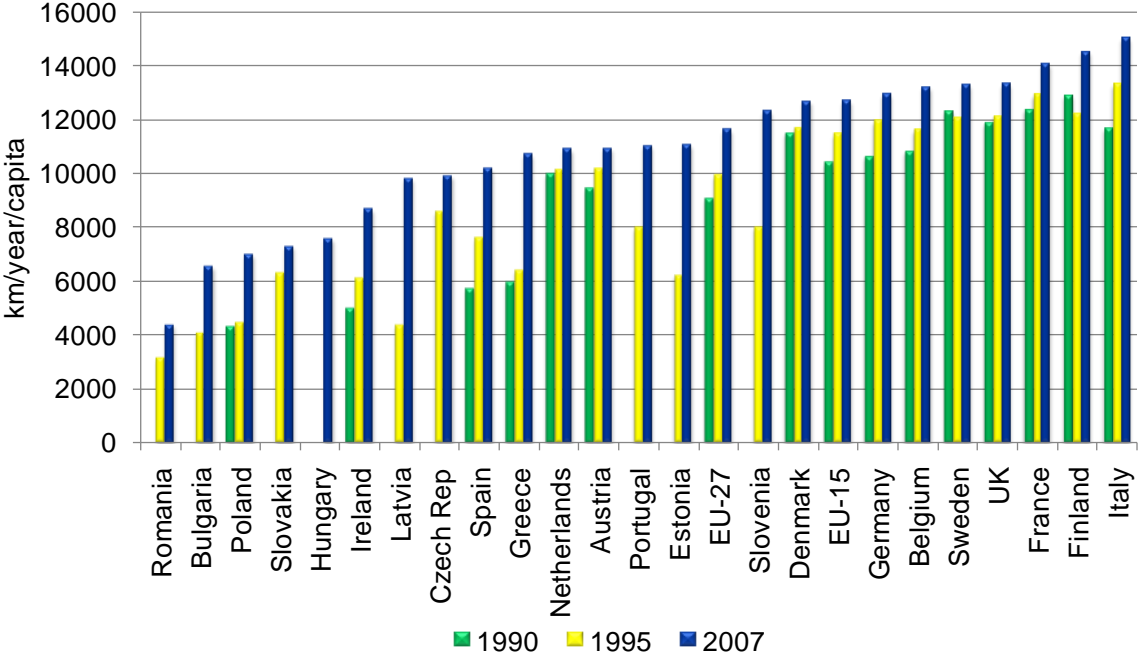
Personal mobility, measured in km/capita, is still growing, but since 2000 it has done so at only half the pace seen between 1990 and 2000 (0.9%/year, compared to

1.9%/year). However, since 1994 that increase has been slightly slower than GDP growth: the traffic (in passengers-km) per unit of GDP is decreasing by 0.3%/year.

On average in the EU personal mobility reached 11,600 km/capita in 2007, compared to 9,100 km<sup>11</sup> in 1990 (**Figure 2.8**). The level of mobility is very heterogeneous among EU countries because of differences in incomes, car ownership levels, country size and density: low mobility in Romania (below 5,000 km/year) and in most Central and European countries (lower income); and between 13,000-15000 km in seven EU-15 countries, with Italy in the lead (high car ownership), followed by Finland, France, UK, Sweden, Belgium and Germany.

So far no countries show a saturation of mobility. The slowest growth is found in Sweden, the Netherlands and Denmark (around 0.5%/year between 1990 and 2007). Mobility has greatly increased (more than 3%/year) in most new member countries, as well as in Spain, Greece, Ireland and Portugal.

**Figure 2.8: Mobility per capita (km/year per capita)**



Source: ODYSSEE

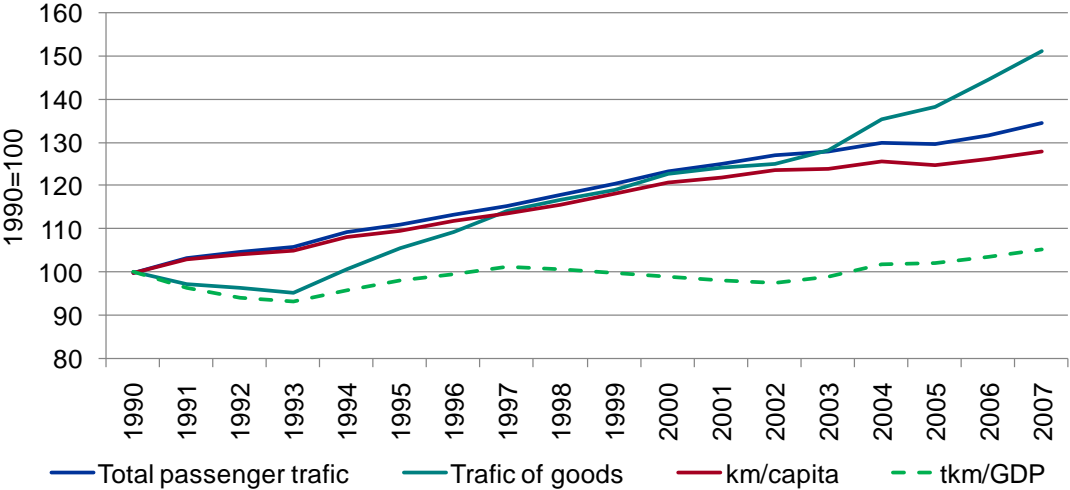
**Freight traffic has been growing faster than the GDP since 2002**

Since 2002 freight traffic, measured in tonne-km, has been growing at a much faster pace than the GDP (3.9%/year compared to 2.3%/year), while over the period 1997-2002 the opposite trend was observed (**Figure 2.9**). This is probably due to the increasing trade among EU countries, following the expansion of the internal market.

<sup>11</sup> Personal mobility is calculated by dividing the traffic in passengers-km by land transport and domestic air transport (i.e. excluding international air transport) by the population. To be more precise, it should exclude small children.

Traffic growth is much slower than the GDP in the Netherlands, the Czech Republic and Estonia; it is much faster in Hungary and Austria.

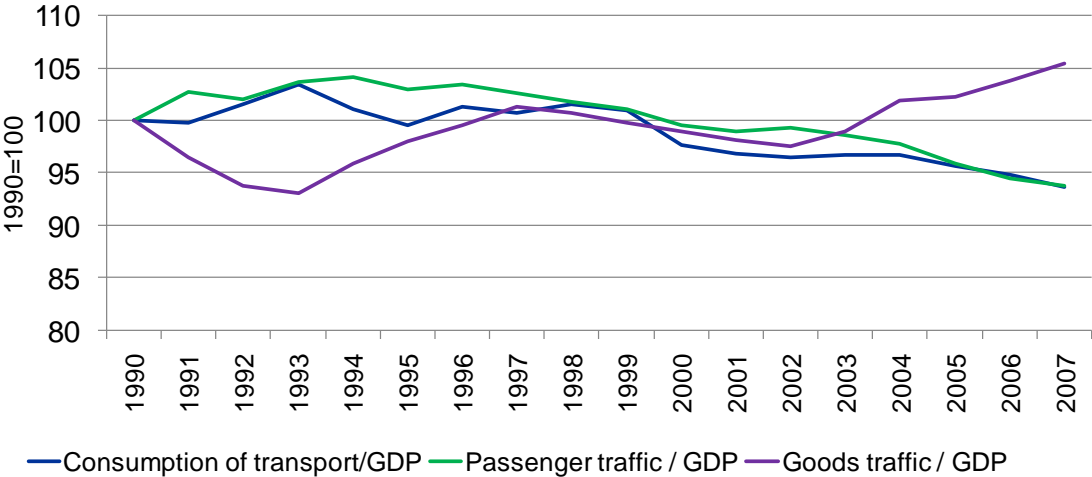
**Figure 2.9: Trends in traffic and GDP (EU-27)**



**Transport energy consumption has been growing at a slower rate than the GDP since 1998**

Since 1998, there has been a decoupling of the energy consumption of transport from the GDP; from that year onwards the growth in the energy demand for transport has been slower than the growth in GDP. So, the ratio of transport energy use over GDP has decreased at an average rate of 0.9%/year in the EU-27 (Figure 2.10). This surprising trend is linked to the fact that passenger transport, which is responsible for two-thirds of the consumption, has been increasing at a slightly slower rate than the GDP, as indicated above. This trend has also been reinforced by the high oil prices that have prevailed since 1998.

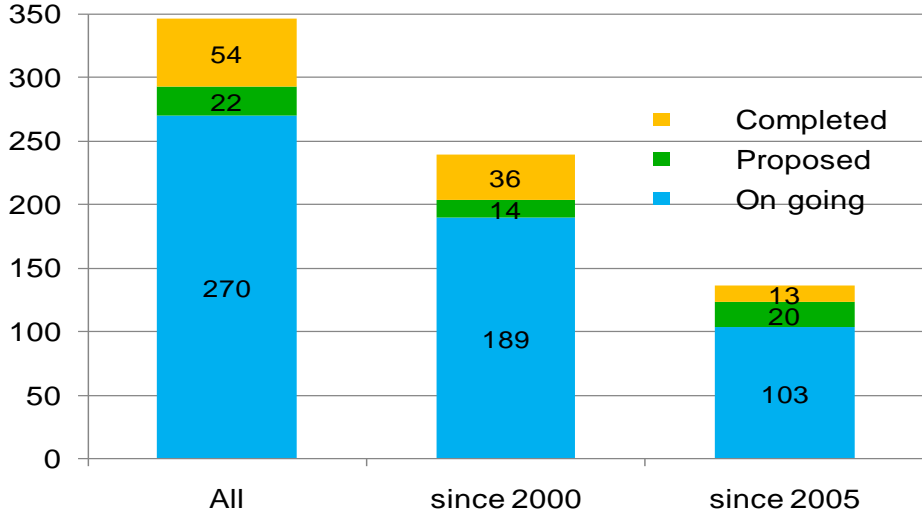
**Figure 2.10: Energy consumption of transport, traffic and GDP (EU-27)**



### 2.3. Policies: an overview of the main measures

A total of around 350 measures have been implemented in the transport sectors of EU countries, Norway and Croatia, and 270 of those measures are still in place (Figure 2.11). It is fair to conclude that decision makers have only recently started to consider this sector seriously, since most of the ongoing measures are quite recent: 70% were implemented after 2000 and almost 40% after 2005. This situation is mainly explained by the fact that the large number of players concerned makes transport a difficult sector to tackle. In addition, most of the measures are national measures and are not linked to EU Directives or to EU involvement (~85%). Until recently, the only actions taken by the Commission in that sector were the agreement signed in 1995 with car manufacturers regarding a CO<sub>2</sub> emissions target for new cars, and the 1999 Directive on the mandatory introduction of car labelling<sup>12</sup>. Since then this sector has become a much higher priority for the Commission, which issued a Directive on mandatory efficiency standards for new cars and a Directive promoting the use of biofuels<sup>13</sup>. In certain countries local and regional measures may play an important role in the development of public transport and soft modes. Such measures are not included in this report; their impact depends on the number of cities that are active in this area, and there is no systematic compilation of all the measures implemented<sup>14</sup>.

**Figure 2.11: Number of measures in the EU in transport**



Source: Adapted from MURE

<sup>12</sup> Directive 1999/94/EC relating to the availability of consumer information on fuel economy and CO<sub>2</sub> emissions in respect of the marketing of new passenger cars.

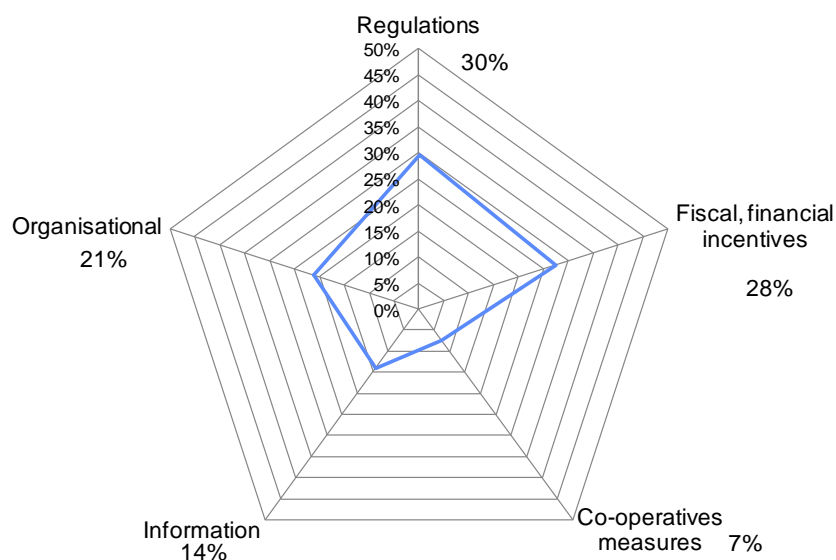
<sup>13</sup> Directive 2003/30/EC on the promotion of the use of biofuels or other renewable fuels for transport, setting a target of 5.75% by 2010.

<sup>14</sup> Some information can be obtained from FEDARENE, the main European network of regional and local agencies (<http://www.fedarene.org>) and from Energie- Cités, the association of European local authorities promoting sustainable local energy policies (<http://www.energie-cites.eu>).

## Regulations are the most common measures, followed by fiscal and financial incentives

Regulations (EU Directives or national regulations such as speed limits) are the most common measures (30% of all ongoing measures) (**Figure 2.12**). They are very closely followed by fiscal and financial incentives (with 28% of the total), which mainly consist of taxes on motor fuels (e.g. ecotax, CO<sub>2</sub> tax), incentives for the purchase of efficient new cars, and taxes linked to the efficiency/emissions of new cars. Around 20% of the measures are organisational measures aimed at the development of public transport infrastructures or bicycle paths, and at the implementation of mobility plans for companies, schools, administrations or other institutions; such measures are mainly targeted at a modal shift from cars to public transport or the use of bicycles. Next come information-related measures intended to enhance the information available to consumers (14%), and voluntary agreements with transport companies or vehicle manufacturers (known as “cooperative measures” in MURE) (7%).

**Figure 2.12: Number of measures by type in transport in the EU**



Source: Adapted from MURE

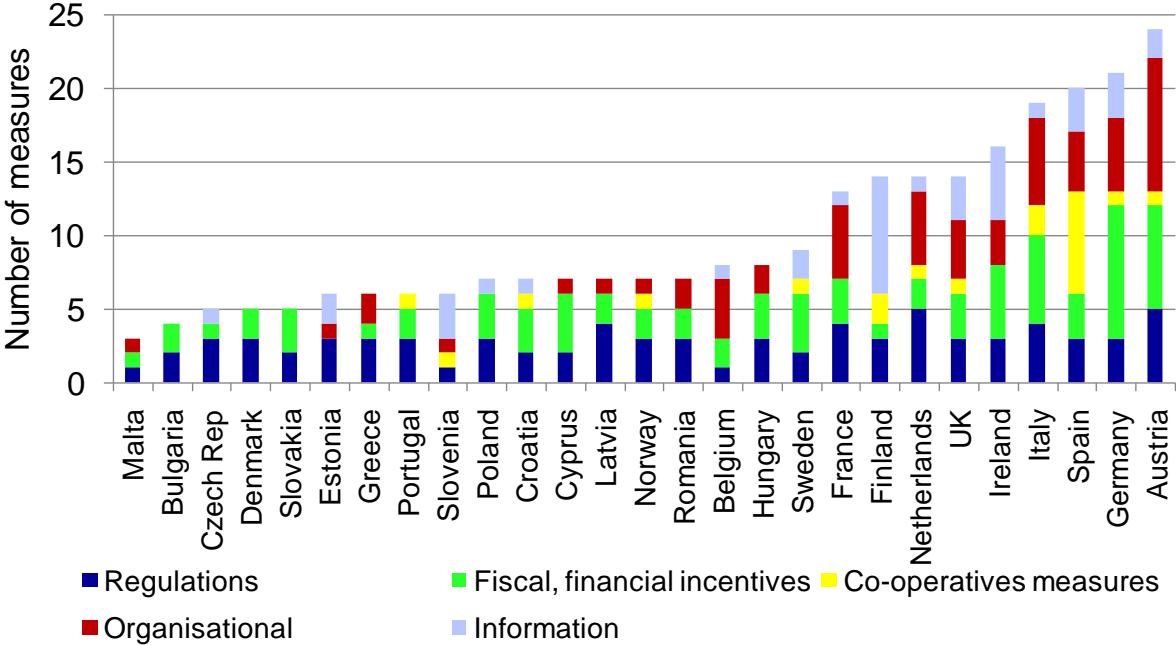
## The number of measures per country varies greatly

The number of measures taken by each country varies greatly: in nine EU-15 countries the number of measures is above average, which is about 10 measures per country, and in six countries the number of measures is low (equal to or below 5 measures). Three countries stand out with more than 20 measures targeted at the transport sector: Austria, Germany and Spain (**Figure 2.13**).

On the whole, in the countries with the largest number of measures the distribution of measures per type tends to be well balanced. However, six countries (Germany, Austria, Italy, Ireland, Sweden and Cyprus) show a preference for financial and fiscal measures. Organisational measures (mobility plans, infrastructures) too are mainly used in six countries (Austria, the Netherlands, Italy, France, Germany and UK).

France and the Netherlands primarily focus on regulations, Spain on voluntary agreements and Finland on information. This reflects national circumstances, and in particular preferences for specific types of policy interventions.

**Figure 2.13: Number of measures by country in transport in the EU**

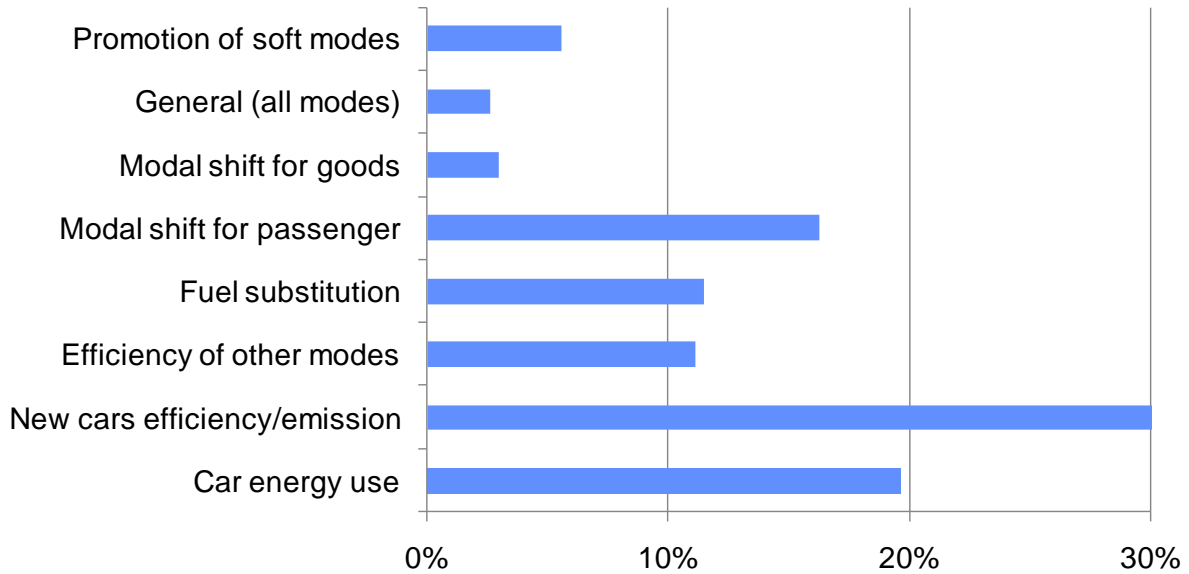


Source: Adapted from MURE

**More than half of the measures target cars**

On average in the EU, half of the measures are directly targeted at cars, and that share rises to 60% if measures on fuel substitution (e.g. on the promotion of biofuels) are included (**Figure 2.14**). Around 40% of the measures correspond to technological measures aimed at the improvement of the energy efficiency of transport vehicles or the reduction of their specific CO<sub>2</sub> emissions (30% of which for cars alone). Around 15% of the measures target a modal shift from cars to public transport. Finally, only a limited number of measures address freight transport, despite it being the transport mode with the most rapid increase in its energy consumption.

**Figure 2.14: Distribution of measures by target in transport in the EU**



Source: Adapted from MURE

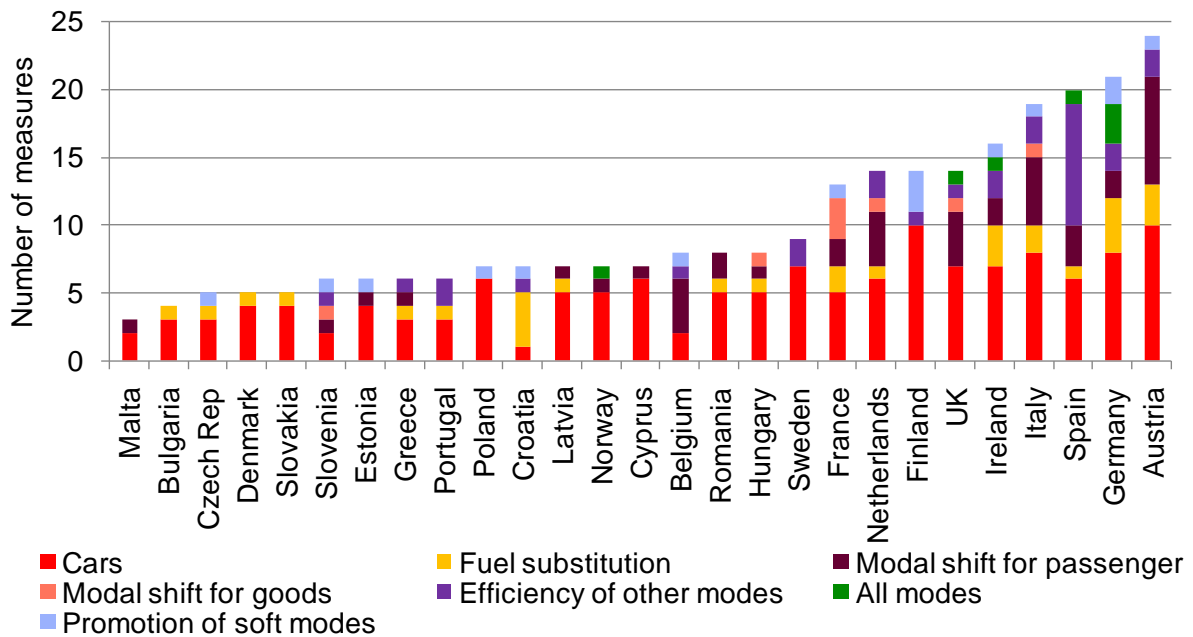
### **An increasing influence of EU Directives and measures in the transport sector**

In the past, the influence of the European Union on the transport sector was limited to the following three areas: voluntary agreements with car manufacturers, the Biofuels Directive and the mandatory labelling of cars. In the future the impact of EU policies will undoubtedly be greater, through measures such as the new Directive on mandatory CO<sub>2</sub> standards for cars; a higher biofuels target for 2020 (10%); the integration of air transport in the European Emission Trading scheme; and the Energy Service Directive which explicitly identifies transport as an area for action, although so far countries have proposed only a limited number of measures.

### **Most national measures are aimed at cars**

Cars are given special priority in eleven countries in which more than two-thirds of the measures target cars (**Figure 2.15**): all Scandinavian and Baltic countries, Bulgaria, Slovakia, Cyprus and Malta. Four countries stand out for prioritising measures aimed at modal shift for passengers, namely Belgium, the Netherlands, the UK and Austria. France is the only country with several measures to encourage a modal shift for freight from road to rail and water transport.

**Figure 2.15: Distribution of measures by target in transport in the EU**



Source: Adapted from MURE

A good mix of policies is currently available to continue improving the energy efficiency of new cars. While most of those measures concern CO<sub>2</sub> emissions, they will undoubtedly impact fuel efficiency too. The new EU Directive establishing mandatory targets for CO<sub>2</sub> emissions, as well as national fiscal incentives, are currently the most important and innovative measures.

Greater efforts must be made to address freight transport, both to raise the energy efficiency of vehicles and to change the distribution by mode of total freight traffic, so as to reduce the role of road transport in that area.

## 2.4. Conclusions

- In terms of policy measures, the main focus was on cars, and especially on increasing the efficiency of new cars. Those measures have already led to significant improvements in efficiency and/or specific emission reduction.
- Since 2000 the sharp increase in oil prices has caused the energy consumption growth rate to slow down at EU level and in most EU-15 countries, to the extent that consumption levels stabilised in France and even dropped in Germany. New member countries, however, have not been impacted by the increase in oil prices.
- Since 1998 there has been a decoupling of the energy consumption trend of transport from the GDP growth at EU level

- Since 1994 passenger traffic, which is responsible for two-thirds of the sector's total consumption, has been growing at a slower pace than the GDP. The opposite trend is observed in the case of freight transport, with freight traffic increasing at a faster pace than the GDP since 2002.
- Regulations are the most common measures in the transport sector, followed by fiscal and financial incentives
- Innovative measures in this sector include "green" car taxation by linking purchase and/or annual tax to specific CO<sub>2</sub> emissions; car labels combined with easily accessible web-based information for comparing the energy performance of cars; innovative toll systems for trucks and cars; innovative information campaigns aimed at promoting mobility management; and modal shift.

### 3. Cars

#### 3.1. Policies on cars

Cars are the main target of energy efficiency measures in the transport sector. Measures on cars fall into three main categories: measures aimed at raising the efficiency (or lowering CO<sub>2</sub> emissions) of new cars; measures aimed at lowering the energy consumption of cars; and, finally, measures on motor fuel taxation.

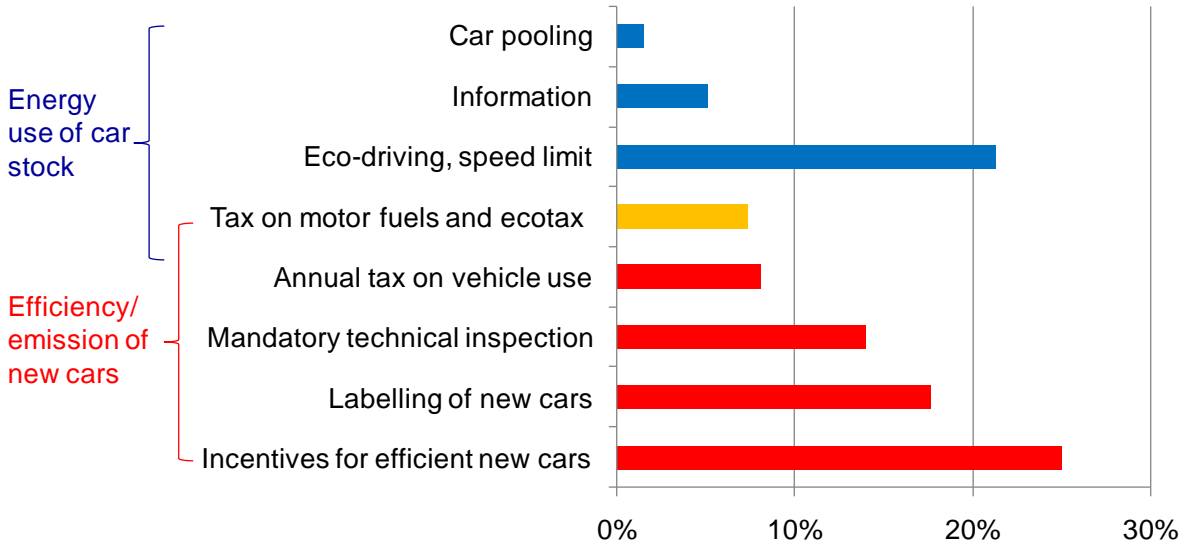
##### Two-thirds of measures on new cars

Policy makers have followed two main approaches to increase the energy efficiency of new cars and to reduce CO<sub>2</sub> emissions<sup>15</sup>:

- Measures on the energy efficiency performance/CO<sub>2</sub> emissions of new cars imposed on car manufacturers;
- Incentives to consumers to buy more efficient/low emission new cars.

Two-thirds of national measures target the improvement of the efficiency (or the reduction of CO<sub>2</sub> emissions) of new cars, with financial incentives to purchase more efficient/low emission new cars being the most common measure (Figure 3.1). One-third of the measures are aimed at reducing the fuel consumption of the car fleet (e.g. eco-driving, speed limit). Although fiscal measures affecting energy prices -with clear objectives regarding energy efficiency or emissions- are more limited, they are likely to have the greatest impact, since they impact the efficiency/CO<sub>2</sub> emissions of new cars as well as the energy consumption of the existing fleet.

**Figure 3.1: Distribution of measures for cars by type**



Source: Adapted from MURE

<sup>15</sup> All the measures reported here are aimed both at reducing CO<sub>2</sub> emissions and at increasing the energy efficiency of new cars. For the sake of simplicity, we will refer to energy efficiency only.

### 3.1.1. Measures to improve the energy efficiency of new cars

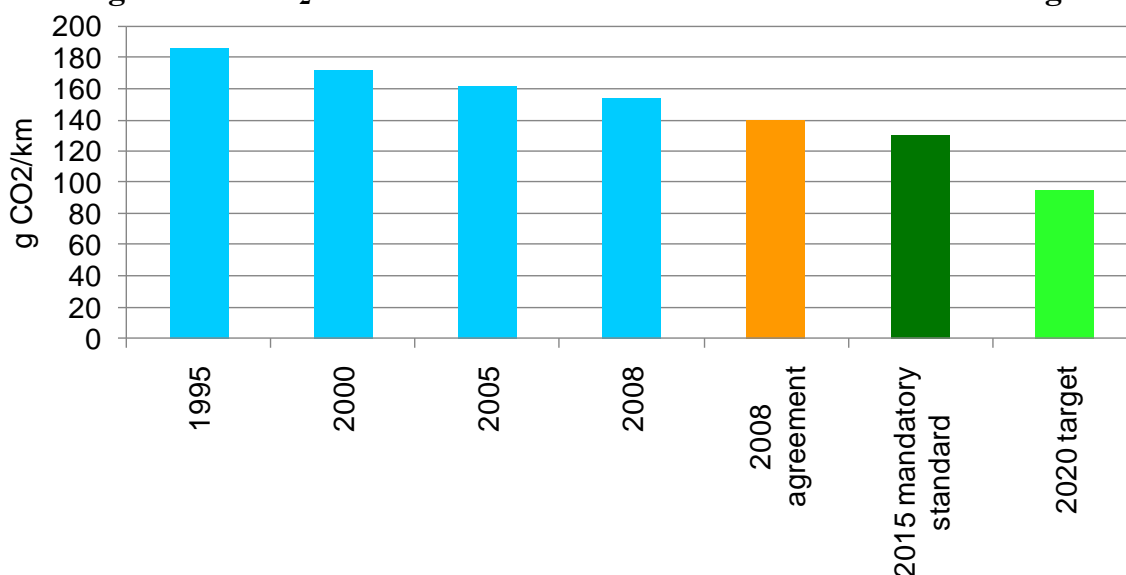
#### 3.1.1.1. Measures on the energy efficiency/emissions of new cars

While most national measures are targeted at car owners and users, the measures aimed at car manufacturers are EU-wide measures initiated by the European Commission and voted by the European Parliament.

The first such measure consisted of the so-called Voluntary Agreements signed with three car manufacturers' associations (ACEA, JAMA and KAMA)<sup>16</sup> on carbon emissions, fixing a target of 140 g of CO<sub>2</sub>/km for the average emissions of all new cars sold in 2008 at EU level by all the members of those associations<sup>17</sup>.

Since that target was not reached, the Commission decided to go for a stricter measure in the form of a maximum emission standard. In December 2008 the European Parliament adopted a regulation on mandatory CO<sub>2</sub> emissions for new cars fixing a limit for each manufacturer of 130 g CO<sub>2</sub> per km for the average of its sales<sup>18</sup> to be achieved in 2015 (**Figure 3.2**). Moreover, the regulation sets intermediate targets: in 2012, 65% of each manufacturer's newly registered cars must comply with the limit value. This will rise to 75% in 2013 and 80% in 2014. Penalty payments for excess emissions are to be paid by the manufacturers for each car registered: €5 for the first g/km of exceedance, €15 for the second g/km, €25 for the third g/km, and €95 for each subsequent g/km. As of 2019, the penalty will be increased to €95 for the first g/km of exceedance. The Directive specifies a long-term target of 95 g/km for the year 2020.

**Figure 3.2: CO<sub>2</sub> emissions of new cars: observed values versus target**



<sup>16</sup> ACEA, European Automobile Manufacturers Association; JAMA, Japan Automobile Manufacturers Association; KAMA, Korean Automobile Manufacturers Association.

<sup>17</sup> Commission Recommendation of February 1999 on the reduction of CO<sub>2</sub> emissions from cars.

<sup>18</sup> Directive 443/2009 of April 2009 setting emission performance standards for new passenger cars.

### 3.1.1.2. Incentives to buy more efficient/low emission new cars

- **Car labelling**

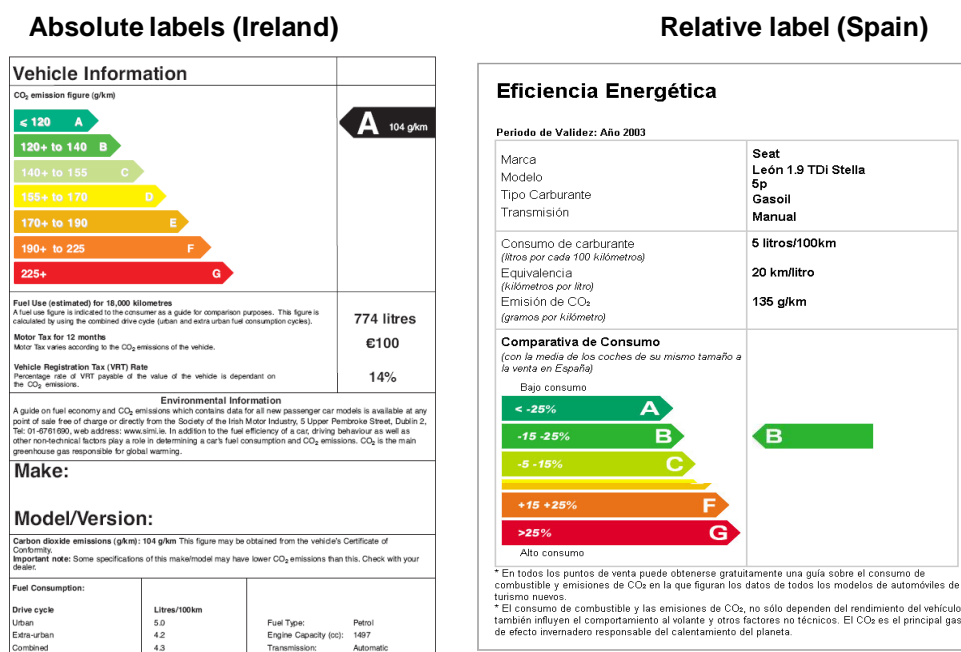
#### A new EU measure but a lack of harmonised labels

Mandatory car labelling of CO<sub>2</sub> emissions was imposed by an EU Directive approved in 1999 and was supposed to be implemented by Member States by January 2001<sup>19</sup>. The purpose of the label is to provide consumer information on fuel economy and the CO<sub>2</sub> emissions of new passenger cars. The Directive did not require the standardisation of the presentation of the labels, as was the case for electrical appliances, for instance. As a result, around 80% of the countries used comparative colour-coded labels with efficiency class A, B, C, similar to those for electrical appliances, and 20% imposed the minimum requirement only, in other words, a simple indication of the value of the emissions (so without coloured tags) (**Figure 3.3**). Labels usually display both CO<sub>2</sub> emissions and specific fuel consumption in litre/100 km.

Among the countries using the comparative colour-coded labels, two approaches were followed:

- absolute labels, type A, B, C, with a band of fixed CO<sub>2</sub> emission values; that emission band can vary from one country to the next<sup>20</sup>;
- relative labels, on which the bands are defined in relation to fleet average<sup>21</sup>;

**Figure 3.3: Examples of car labels in the EU**

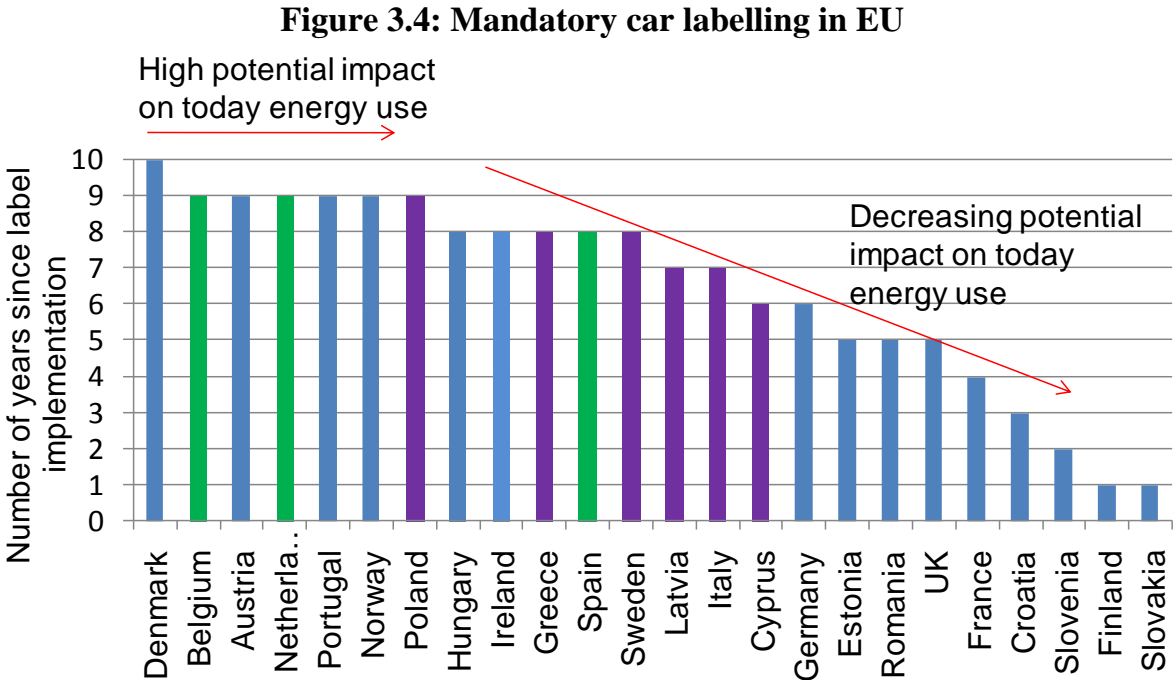


<sup>19</sup> Directive 1999/94 relating to the availability of consumer information on fuel economy and CO<sub>2</sub> emissions in respect of the marketing of new passenger cars.

<sup>20</sup> For instance, in France Class A covers cars with CO<sub>2</sub> emissions below 100 g/km, whereas in Ireland it covers cars with CO<sub>2</sub> emissions below 120 g/km.

<sup>21</sup> In Spain, for example, a car is labelled Class A if emissions are 25% below the market average.

About half of the EU countries finally implemented the absolute comparative label, i.e. the type similar to the label used for electrical appliances, and which probably has the greatest impact<sup>22</sup>. The potential impact on the average energy efficiency/CO<sub>2</sub> emissions of the car fleet will also depend on the number of years of implementation, as indicated in **Figure 3.4**: this measure is more likely to have a significant impact in the countries on the left.



Absolute labels type A,B, C with fixed values of CO<sub>2</sub> emission band  
 Relative labels (band defined in relation to stock average;  
 Minimum requirement (simple display of emissions level)

The Directive also required each country to prepare and regularly update lists of new cars which can be used to compare their energy and CO<sub>2</sub> performance. Many EU agencies are providing such information on websites with the aim of increasing the dissemination of information (e.g. Portugal, France<sup>23</sup>, UK<sup>24</sup>): these websites can greatly help consumers in their choice of vehicle. Another interesting initiative is the publication of the top ten cars classified by category (e.g. small, compact) in terms of specific fuel consumption/emissions (**Table 3.1**). The recent hikes in motor fuel prices have probably increased consumers’ interest in this type of information, and fuel consumption has now clearly become one of the main purchasing decision criteria<sup>25</sup>.

<sup>22</sup> The absolute system is usually considered as the most simple and easiest label for consumers. It avoids the arbitrary and conflicting issues of defining the label categories.  
<sup>23</sup> [http://www.ademe.fr/auto-diag/transports/car\\_lab/carlabelling/SaisieFormulaire/FormulaireMarque.asp](http://www.ademe.fr/auto-diag/transports/car_lab/carlabelling/SaisieFormulaire/FormulaireMarque.asp)  
<sup>24</sup> <http://www.vcacarfueldata.org.uk/>  
<sup>25</sup> The increase in the market of efficient new cars in 2007 and 2008 is linked to the context of high oil prices, as well as to the national fiscal and financial measures implemented, as discussed below.

**Table 3.1: Top ten new cars in the EU<sup>26</sup>**

	<b>Brand</b>	<b>Model</b>	<b>Fuel</b>	<b>Fuel (l/ 100 km)</b>	<b>gCO2/km</b>
Small	Ford	Fiesta 1.6 TDCi Eco	diesel	3.7	98
Small	Seat	Ibiza 1.4 Eco TDI PD	diesel	3.7	98
Compact	Honda	Insight Hybrid	petrol	4.4	101
Mini	Smart	Fortwo coupé 45 kW mhd	petrol	4.4	104
Mini	Daihatsu	Cuore 1.0	petrol	4.4	104
Mini	Toyota	iQ 1.4	diesel	4	104
Middle class	Toyota	Prius 1.5 Hybrid	petrol	4.3	104
Mini	Toyota	IQ 1.0	petrol	4.5	105
Mini	Toyota	Aygo 1.0	petrol	4.6	109
Mini	Peugeot	107 1.0i	petrol	4.6	109

Source: <http://www.topten.info>

- **Fiscal and financial incentives to purchase efficient/low emission new cars**

These measures tend to be introduced at the national level, which is why a great variety of approaches can be found among EU member States. Three main categories can be pinpointed<sup>27</sup>:

- Purchase tax linked to energy efficiency performance;
- Annual car tax linked to energy efficiency performance;
- Subsidies for efficient/low emission cars or combined tax and subsidies (“bonus malus”)

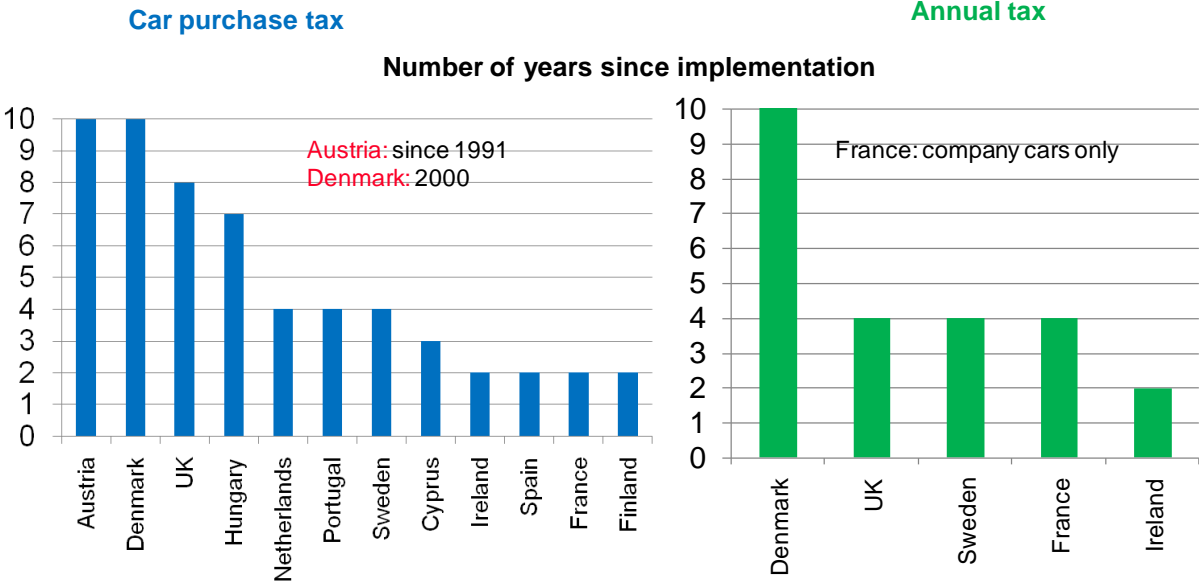
Historically, most countries set up car purchase taxes to be paid by the buyers of new cars. Those taxes were usually linked to the type of fuel (e.g. gasoline, diesel, LPG), the size of the car (based on engine power or engine size) and the status (private versus company cars). Some countries have changed those taxes, making them dependent on the energy efficiency or CO<sub>2</sub> emissions of the new cars, thereby encouraging buyers to pay attention to the energy consumption or emissions of the car they are about to buy. The first country to introduce such a measure was Austria in 1991, followed by Denmark in 2000. At present, 12 countries have a purchase tax linked to energy efficiency/CO<sub>2</sub> performance (**Figure 3.5**): Austria, Denmark, UK, Hungary, the

<sup>26</sup> ADEME is also publishing a top ten for France: <http://www.ademe.fr/auto-diag/transports/rubrique/CarLabelling/Top10Es.asp>

<sup>27</sup> Scrappage schemes of old cars are not considered here. They were implemented in 2009 in several countries as a way to alleviate the impact of the economic crisis on car manufacturers. Although it accelerates the replacement and has an impact on the CO<sub>2</sub> performance of new cars, it is more of a short-term measure than a true energy efficiency measure.

Netherlands, Portugal, Sweden, Cyprus, Ireland, Spain, France and Finland. The levels of tax now tend to be linked to the CO<sub>2</sub> classes introduced through the labelling schemes.

**Figure 3.5: Tax on cars linked to energy or CO<sub>2</sub> performance**



In addition, certain countries have also linked the annual car tax to energy efficiency performance. That is the case of Denmark, since 1999, the UK, Sweden, Ireland and France (company cars only). Four countries have even linked both the purchase tax and the annual registration tax to specific CO<sub>2</sub> emissions and/or energy efficiency performances: Denmark, UK, Sweden and, more recently, Ireland. The measure had quite an impressive effect in Ireland, since it was introduced in mid-2008, a period of very high oil prices, which made it even more attractive to consumers (**Box 3.1**).

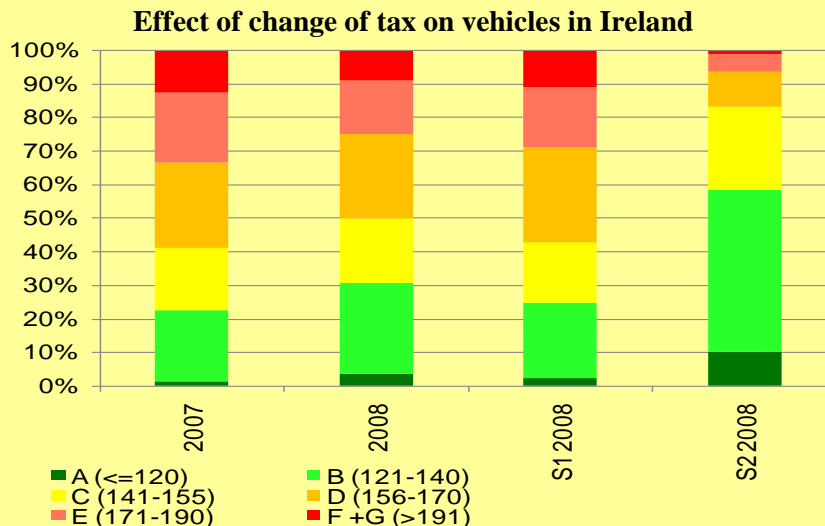
Taxes related to the ownership and use of motor vehicles are classified by Eurostat as transport taxes and are part of total environment taxes<sup>28</sup>. On average in the EU, transport taxes reached 0.6% of the GDP and 1.5% of total tax revenues in 2007. Their revenue is particularly high in Denmark (4.6% of total taxation and 2.2% of GDP), Malta (4% and 1.7% respectively), Ireland (4% and 1.2%), Cyprus (3.9% and 1.6%) and the Netherlands (3.5% and 1.4%).

The previous two measures act as disincentives to the purchase of inefficient cars but may not lead consumers to buy the most efficient cars on the market. Therefore, many countries have implemented subsidy schemes for very low emission or very efficient new cars. Initially, these subsidies were only available for electric and hybrid cars; today several countries have extended these schemes to efficient fuel powered cars, linking eligibility for the subsidy to car labels.

<sup>28</sup> Environmental taxes include energy taxes, transport taxes, and pollution taxes. Transport taxes also include taxes on other transport equipment (e.g. planes) and related transport services (e.g. duties on flights). Energy taxes include taxes on energy products (in particular petrol and diesel), as well as CO<sub>2</sub> taxes.

### Box 3.1: Change of tax system for new cars in Ireland

The Vehicle Registration Tax (VRT) rates and the annual tax were changed in July 2008 from an engine size basis to a new system based on CO<sub>2</sub> emissions class linked to the labels (A to G). As a result the registration tax is twice higher for the least efficient classes (32% for class F and 36% for G) than for the most efficient ones (14% for class A and 18% for B). The annual tax is almost 10 times higher for the least efficient cars (€1050 for class F and €2100 for G) than for the most efficient ones (€104 for class A and €156 for B). The share of the most efficient cars (A+B) increased from around 20% over the first half of 2008 (S1) to almost 60% after July 2008 (S2).



Source: M Howley, B O' Gallachoir & E Dennehy, Sustainable Energy Ireland, 2009

France has taken innovative action in that area by setting up a combined subsidy and tax scheme, called “bonus-malus”, with a subsidy for low emission cars (<130 gCO<sub>2</sub>/km) and a tax on cars with high emissions (above 161 g CO<sub>2</sub>/km)<sup>29</sup>. The most innovative aspect of this measure is that it limits the burden of the subsidies on the public budget since they are paid from the income of the tax. In addition, the measure aims to foster technical progress by lowering the emissions class over time<sup>30</sup>. This scheme, which was reinforced by the high oil prices that prevailed in 2008, was very successful at transforming the market (**Box 3.2**)<sup>31</sup>.

<sup>29</sup> The maximum subsidy is €1000 for cars below 100 gCO<sub>2</sub>/km, and the tax can reach €1600 for cars with emissions between 201-250 gCO<sub>2</sub>/km and even €2600 for emissions above 250 gCO<sub>2</sub>/km.

<sup>30</sup> In 2010, for instance, the tax will be implemented as of 156 g instead of 161 g like in 2008.

<sup>31</sup> In view of the success of the measure, which far exceeded initial expectations, it ended up costing the public budget €300m in 2008; since then, the system has been adapted by lowering the band limits over time to balance the tax income and the volume of subsidies. There are now plans to extend the measures to certain domestic appliances.

### Box 3.2: Bonus-malus in France

The bonus-malus is a combined subsidy and tax scheme for new cars, under which a subsidy is granted for the purchase of an efficient/low emission new car and a tax is imposed on inefficient cars. The subsidy is as follows: €100 below 100 gCO<sub>2</sub>/km (label class A), €700 for the band 101-120 g (label class B), and €200 for 121-130 g. There is neither a subsidy nor a tax for cars in the range 131-160 g. The tax increases from €200 for the band 161-165 gCO<sub>2</sub>/km to €750 for 166-200 g, €1600 for 201-250 g and €2600 above 250 g CO<sub>2</sub>/km<sup>32</sup>.

The market share of class B vehicles increased from 20% to 35% between 2007 and 2008 and the average specific CO<sub>2</sub> emissions of new cars fell by 6%, from 148 gCO<sub>2</sub>/km in 2007 to 139 gCO<sub>2</sub>/km in 2008.

Impact of the bonus malus on new cars in France



Source: G Callonnet, N Blanc, ADEME, 2009

#### 3.1.2. Measures on car energy use

Several measures are aimed at reducing the energy use of cars after they have been purchased; instead of targeting new cars, they look at the entire car fleet. Most of those measures address the behaviour of car users: reduction of the average speed, eco-driving, speed limits, car pooling. One specific measure is to impose regular technical inspections so as to maintain the efficiency of cars as close as possible to their initial technical performance. It is difficult to assess the effect of all these measures.

Speed limits, in turn, can be found in nearly all countries, but the issue at stake is whether or not this measure is really enforced. In this context, France offers quite an illustrative example. Although the country has had speed limits on motorways (130 km/h) since the first oil crisis in 1973, that measure was not fully respected by motorists until the Government decided to install automatic speed control devices throughout the country in 2005. By the end of 2009 about 2500 radars will be in place.

<sup>32</sup> The linkage to the specific fuel consumption is as follows: 120 gCO<sub>2</sub>/km roughly corresponds to 5l/100 km and 140 gCO<sub>2</sub>/km to about 6l/100 km.

The impact both on road safety, which was the main driving force behind the government policy, as well as on fuel use, has been spectacular.

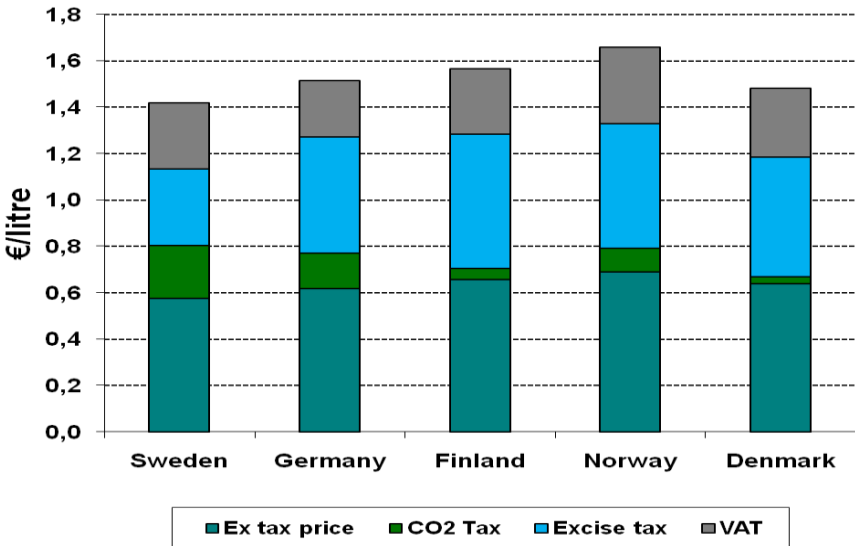
### 3.1.3. Taxes on motor fuels

#### Different strategies among countries

One of the most important drivers of the energy consumption and energy efficiency trends in the transport sector is the price of motor fuels. Since these prices are deregulated, the main source of difference between countries comes from the level of tax. The tax is usually made up of two main components: an excise tax and the general VAT rate.

Excise taxes are generally seen as a source of income for the public budget. However, certain countries have recently increased those taxes with the clear intention of saving fuels (e.g. UK through the fuel escalator). Five countries have introduced an additional component similar to a new excise tax, a CO<sub>2</sub> or environmental tax (**Figure 3.6**): 4 Scandinavian countries and Germany<sup>33</sup>. Sweden has the highest CO<sub>2</sub> tax (€23 cents/l for gasoline), followed by Germany (€15 cents/l) and Norway (€10 cents/l). CO<sub>2</sub>/environmental taxes enjoy greater acceptance among the general public, especially if part of the revenue is recycled to support energy/CO<sub>2</sub> efficiency measures.

**Figure 3.6: Green taxes on motor fuels: case of premium gasoline (2008)<sup>34</sup>**



Source: Enerdata from IEA

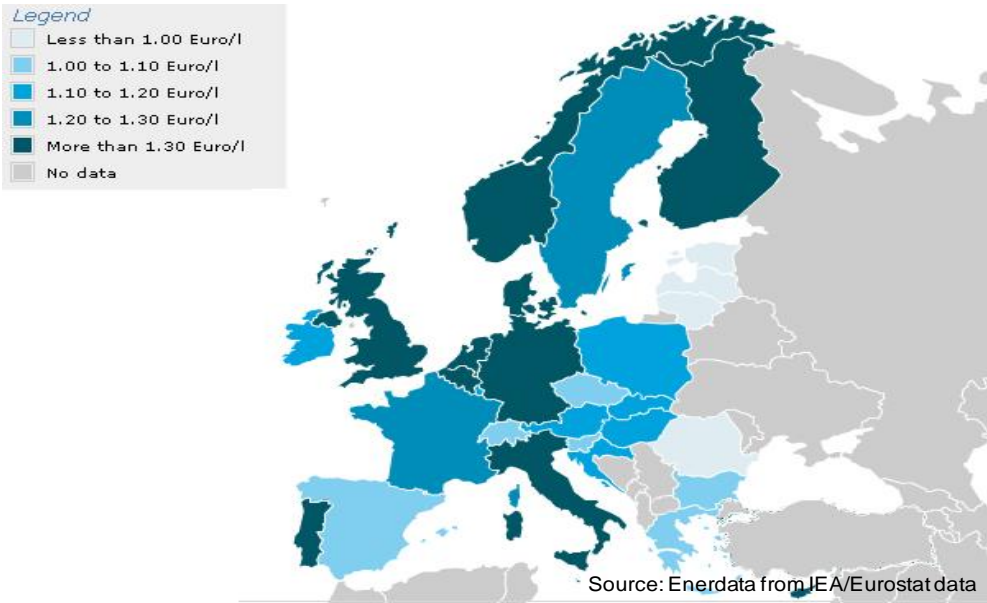
Gasoline prices in the EU are very diverse, with a gap of 70% (or €0.6/l) between the 3 countries with the highest price and the 3 countries with the lowest price (**Figure 3.7**). Ten countries have particularly high gasoline prices, above €1.3/l, with 3 of those countries rising above €1.4/l. Five countries have gasoline prices below €1/l. Countries

<sup>33</sup> France recently (September 2009) decided to introduce a CO<sub>2</sub> tax as of January 2010, which will increase the price of motor fuels by €4-€5 cents/litre.

<sup>34</sup> 3rd quarter 2008 (1 Euro = \$1.5).

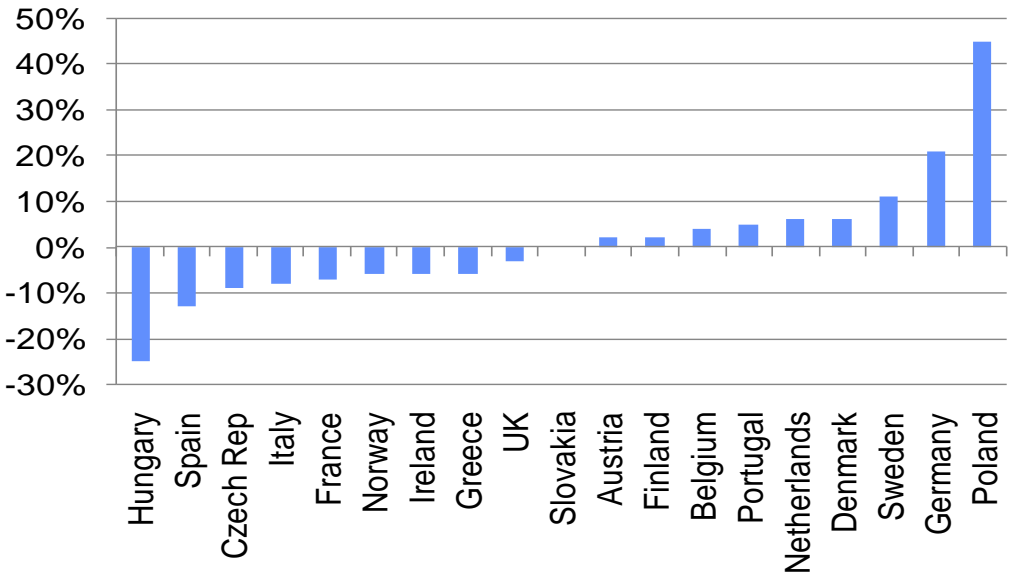
with high taxes do not necessarily impose CO<sub>2</sub>/environmental taxes. The Netherlands, Belgium, UK and Portugal, for example, all have very high taxes but no CO<sub>2</sub>/environmental tax.

**Figure 3.7: Gasoline price in EU countries (2007) (€/l)<sup>35</sup>**



Trends in the levels of taxes on gasoline differ substantially: a decrease is observed in half of the countries and an increase in the other half. There was a strong increase in Poland (45%) and to a lesser extent in Germany (20%), whereas in Hungary and Spain rates fell (25% and 13%) (Figure 3.8).

**Figure 3.8: Variations of taxes on gasoline (1998-2008)<sup>36</sup>**



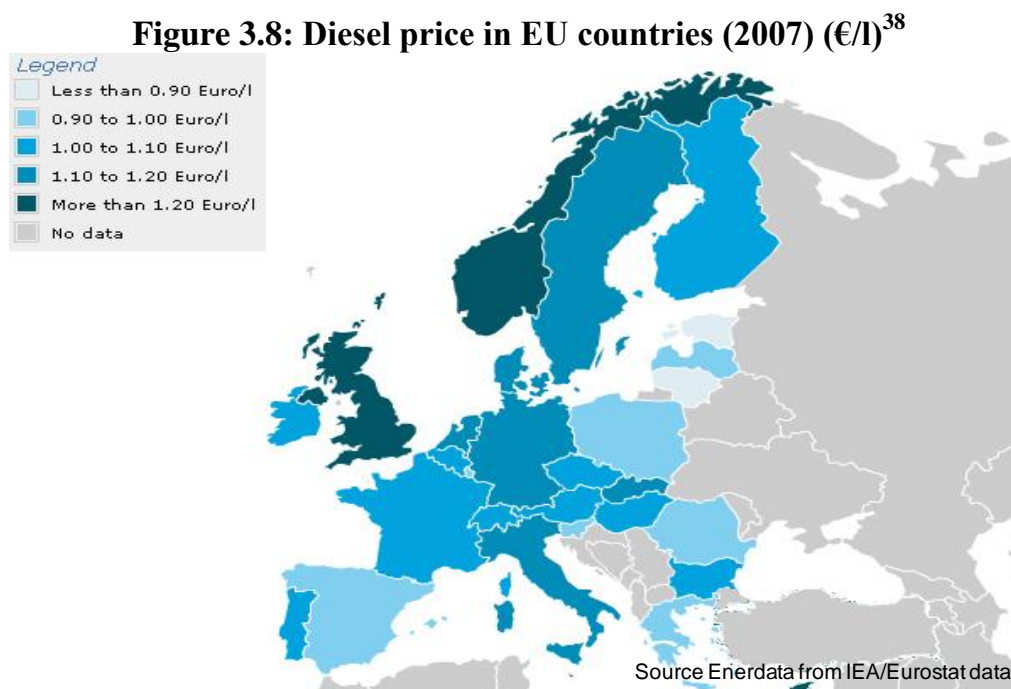
Source: Enerdata from IEA

<sup>35</sup> The prices shown here purposely do not reflect the most recent prices as they have to be related to the analysis of energy efficiency and consumption trends that mainly relate to the period up to 2007.

<sup>36</sup> In real terms in national currency (i.e. corrected for inflation).

In countries that saw a reduction, like Hungary and Spain, nominal taxes actually increased, but less than inflation<sup>37</sup>.

In the case of diesel, there is an even wider gap (60%, or €0.53/l) between the three countries with the highest diesel price and the three countries with the lowest price (below €0.9/l) (**Figure 3.8**). Eight countries have prices above €1.1/l, and two of those countries have very high prices (UK and Cyprus > €1.4/l).



Like in the case of gasoline, trends in diesel prices and, therefore, taxes, vary greatly between countries: strong increases in Poland, Germany and Sweden (over 50%); 20% reductions in Slovakia, Hungary and Norway (**Figure 3.9**).

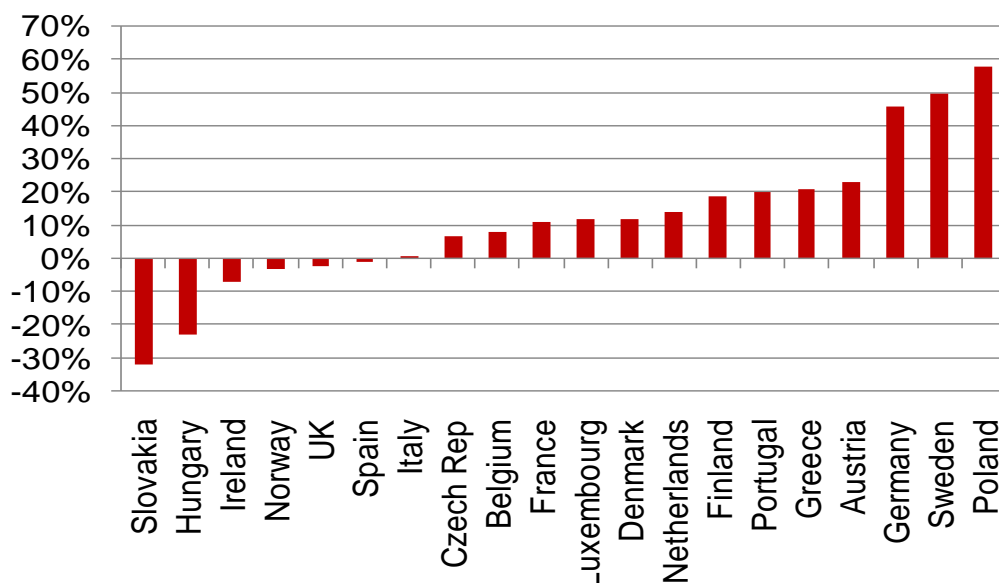
As was true for gasoline, taxes generally increased in all countries, but more or less rapidly than inflation: in countries with a reduction, nominal taxes increased less than inflation and in countries with a strong increase, they increased faster than inflation<sup>39</sup>.

<sup>37</sup> For instance, in Hungary the tax in nominal prices increased by 44% over the period, whereas the general price level (i.e. the inflation) increased by 91%; as a result, the tax in constant prices actually decreased by 25%. In Spain, the nominal tax increased by 20% and inflation reached 37%, which led to a tax reduction of 13% in constant prices. In Poland, the nominal tax increased by 112% and inflation reached 46%, which resulted in a 45% increase of taxes in constant prices.

<sup>38</sup> For non-commercial uses (i.e. for cars).

<sup>39</sup> For instance, in Poland the tax in nominal prices increased by 131% and the general price level by 46%; as a result, taxes in constant prices actually increased by 58%. In Germany and Sweden, nominal taxes increased by around 70% with a low inflation (18%).

**Figure 3.9: Variation of taxes on diesel (1998-2008) (%)**



Source: Enerdata from IEA

In eleven countries diesel is much cheaper than gasoline (by more than €0.1/l), and in five of those countries (Portugal, Belgium, the Netherlands, Denmark, Finland) the gap is significant (above €0.2/l). Those five countries have the highest penetration of diesel cars.

The importance of fiscal policies on motor fuel in terms of potential impact on car users can be assessed using the level of price and the price variation: Germany, Sweden, Portugal, Cyprus and Belgium are the 5 countries with the strongest price signals.

**Table 3.2: Synthesis on motor fuel tax<sup>40</sup>**

Countries with highest level motor fuel price (> €1.2/l) <sup>41</sup>	Countries with largest price increase	Countries with highest price level and increase
Cyprus, UK, Norway, Denmark, the Netherlands, Germany, Portugal, Sweden, Italy, Finland, Belgium	Croatia, Estonia, Cyprus, Poland, Luxembourg, Latvia, Germany, Portugal, Belgium, Sweden	Germany, Sweden, Portugal, Cyprus, Belgium

<sup>40</sup> Weighted average price of gasoline and diesel for cars users, weighted on the basis of the gasoline and diesel consumption.

<sup>41</sup> Price level for 2007 and price variation over 1999-2007, i.e. over the period of oil price hikes.

### 3.1.4. Synthesis of measures on cars

Four countries appear to have the largest mix of measures that have been implemented for some time now: Denmark, Portugal, Sweden and Austria (**Table 3.3**). These countries are expected to be among the countries with the largest reduction in the specific fuel consumption of cars.

**Table 3.3: Countries with the largest mix of measures**

Measures <sup>42</sup>	Countries
Car labels (over 8 years)	Denmark, Belgium, Austria, the Netherlands, Portugal, Norway, Hungary, Ireland, Greece, Spain,
Car tax (purchase) linked to CO <sub>2</sub> /energy efficiency <ul style="list-style-type: none"> <li>▪ over 7 years</li> <li>▪ over 4 years</li> </ul>	<ul style="list-style-type: none"> <li>▪ Austria , Denmark, UK, Hungary</li> <li>▪ The Netherlands, Portugal, Sweden</li> </ul>
Car tax (annual) linked to CO <sub>2</sub> /energy efficiency <ul style="list-style-type: none"> <li>▪ over 10 years</li> <li>▪ over 4 years</li> </ul>	<ul style="list-style-type: none"> <li>▪ Denmark</li> <li>▪ UK, Sweden</li> </ul>
Subsidies on new cars	Very recent in 11 countries
Fuel tax	Germany, Sweden, Portugal, Cyprus, Belgium
<b>Synthesis</b>	<b>Denmark, Portugal, Sweden, Austria</b>

<sup>42</sup> The number of years since the measure has been implemented is indicated in brackets.

## 3.2. Energy efficiency and CO<sub>2</sub> trends for cars

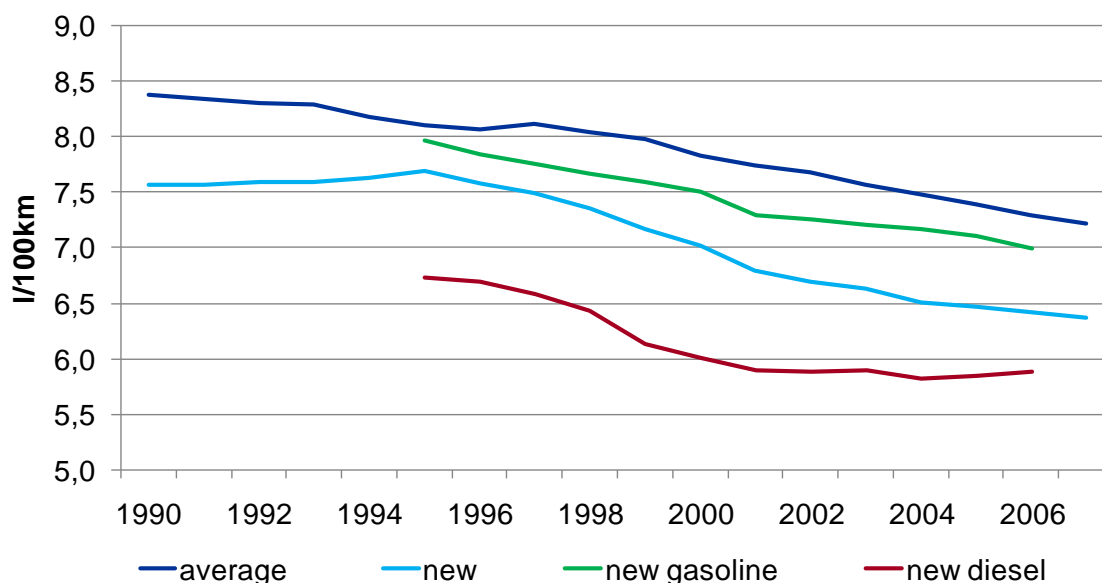
### 3.2.1. New cars

#### A rapid drop in the specific consumption of new cars since 1995

In the EU, the specific energy consumption of new cars<sup>43</sup> remained fairly stable between 1990 and 1995 (**Figure 3.10**). Between 1995 and 2006 there was a net reduction, from 7.7 l/100 km to 6.4 l/100 km (from 8 l/100 km to 6.7 l/100 km for new gasoline cars and from 6.7 l/100 km to 5.9 l/100 km for new diesel cars). However, since 2001 that reduction has slowed down because of the saturation of new diesel cars at 5.9 l/100 km.

Since about 80% of the cars on the road in 2006 had been purchased after 1995<sup>44</sup>, the energy efficiency gains achieved in new cars had a direct impact on the average performance of the car fleet. As a result, the average specific consumption of the car fleet decreased from 8.4 l/100 km to 7.3 l/100 km over 1990-2006 (from 8.6 l/100 km to 7.9 l/100 km for gasoline cars and from 7.1 l/100 km to 6.6 l/100 km for diesel).

**Figure 3.10: Specific consumption of new cars<sup>45</sup> and fleet average (EU-27)**



Source: ODYSSEE<sup>46</sup>

The specific consumption of new cars differs greatly among countries: a difference of 2 l/100km can be seen between Portugal or France (5.8 l/100km) and Sweden (7.8

<sup>43</sup>The energy efficiency progress of new cars is usually assessed using an average “test specific consumption” measured through a fuel consumption test for all new cars sold each year.

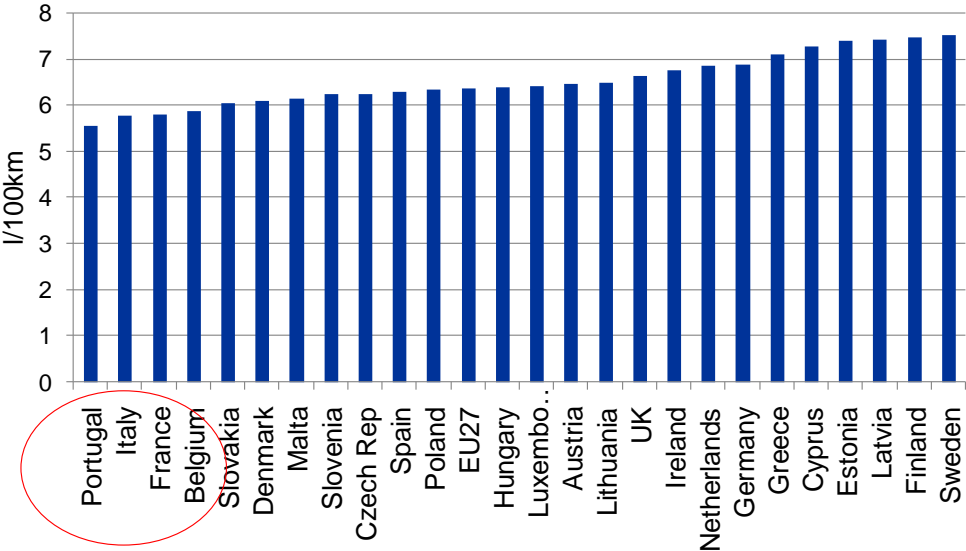
<sup>44</sup> Every year new cars represent about 8%, on average, of the total car fleet in the EU.

<sup>45</sup> Test values for new cars.

<sup>46</sup> The data regarding new cars is based on data from ACEA, JAMA and KAMA since 1995, EU Commission reports and national data for the car fleet.

l/100km), which corresponds to a difference of about 40% (Figure 3.11). The high share of diesel cars, which have a lower specific consumption than gasoline cars for a given type of car, largely explains the good performances of Belgium and France, where diesel cars made up more than 70% of the new registrations in 2007. This is true too in the cases of Portugal, Italy and Austria, with diesel shares of between 60% and 70% (EU average between 40% and 50%).

**Figure 3.11: Specific consumption of new cars in the EU (2006)**

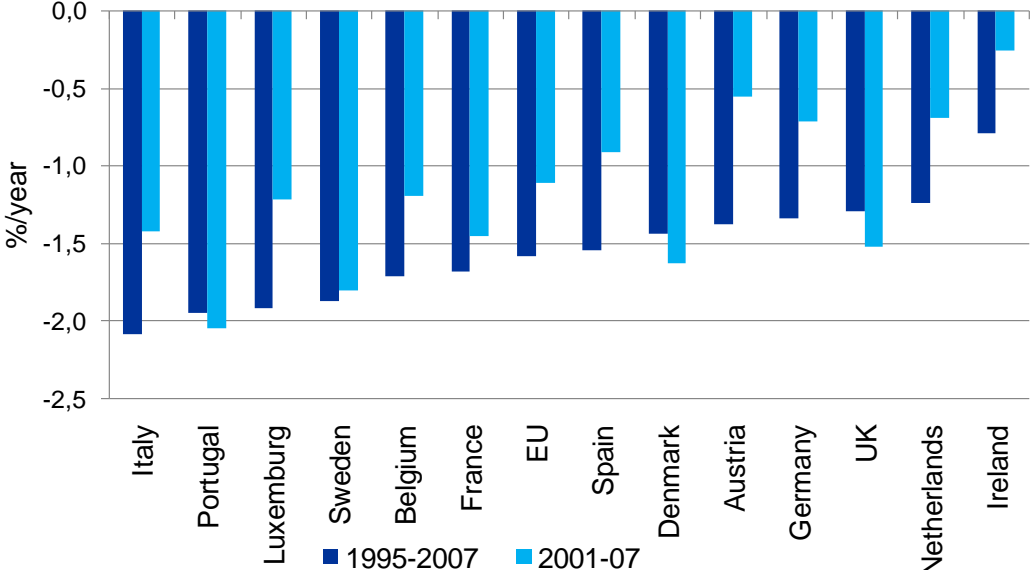


Source: estimation ODYSSEE from EU monitoring report and T&E

**Diverging trends in the reduction of the specific consumption of new cars**

The reduction in the specific consumption of new cars ranges between 1-2%/year depending on the country (1.5%/year on average for the EU) (Figure 3.12). For most countries, as well as at EU level, the trend has slowed down since 2001, mainly due to the saturation of the performance of new diesel cars. The trend was, however, faster in Portugal, UK and Denmark.

**Figure 3.12: Trends in the specific consumption of new cars in the EU**



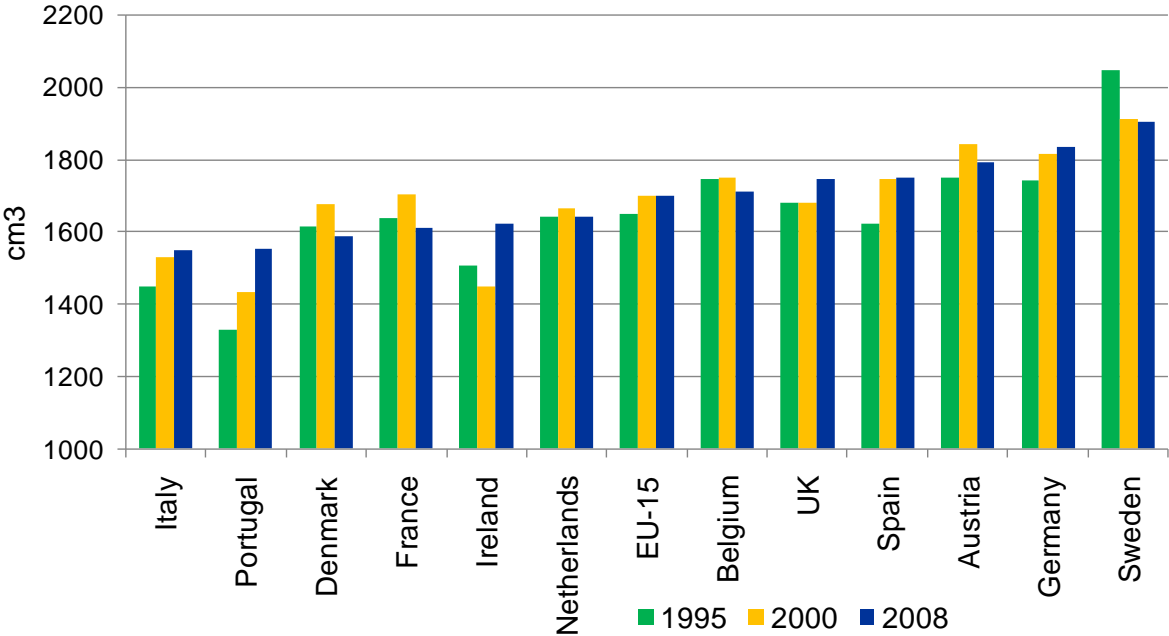
Source: estimation ODYSSEE from ACEA, KAMA, JAMA, EU Commission, T&E

**Until 2005, part of the technical progress was offset by a shift to larger and more powerful cars; since then, and especially since 2008, there has been a clear trend towards smaller cars**

Trends in the test specific consumption of new cars not only reflect changes in energy efficiency from a technical point of view, but also changes in the structure of new car registrations by size or fuel type (gasoline/diesel). For instance, a shift towards larger cars increases the average test specific consumption, all other things being equal.

Clearly, over the past ten years there has been a shift to heavier and more powerful cars in most countries. The average mass of new cars sold in the EU increased by 100 kg, at a rate of around 10-15 kg/year, between 1995 and 2007<sup>47</sup>. According to ACEA, the engine capacity of the new cars registered each year measured in cm<sup>3</sup> increased in every country except Belgium and Sweden between 1995 and 2000 (**Figure 3.13**). Since 2000, this trend has reversed in four countries (Austria, Denmark, France and the Netherlands) and in three more countries (Germany, Italy and UK) and in the EU as a whole since 2005<sup>48</sup>. In 2008, the reduction was very significant almost everywhere and has to be linked to the recent measures mentioned above and to the high oil price. Therefore, before 2005 the actual technical progress achieved was even more pronounced than is suggested by the changes in the test specific consumption of new cars.

**Figure 3.13: Average horsepower of new cars sold by ACEA members**



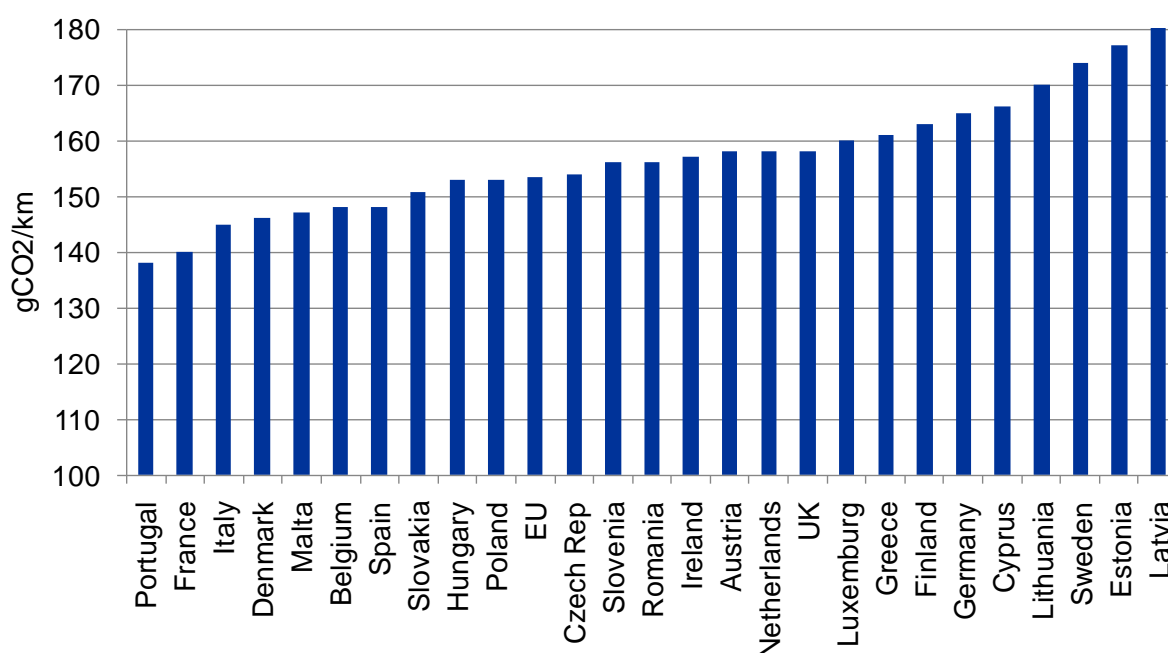
<sup>47</sup> From 1995 to 2001, the average mass of new cars sold in the EU-15 increased by 100 kg (around +15 kg/year). At the EU-27 level this average mass increased by 30 kg between 2004 and 2007 (+10 kg/year). Source: Communication from the Commission to the Council and the European Parliament “Monitoring the CO<sub>2</sub> emissions from cars in the EU”, January 2009. Data for 2002 and 2003 are not comparable.

<sup>48</sup> Source ACEA statistics over 1995-2008 (www.acea.be, 2009).

### Less variation in the specific CO<sub>2</sub> emissions of new cars among countries

The difference among countries in the average specific CO<sub>2</sub> emissions of new cars is lower than for specific fuel consumption, with a range of 30% between Portugal and Sweden, compared to 40% in the case of fuel consumption (**Figure 3.14**)<sup>49</sup>. In 2008, seven countries had average specific CO<sub>2</sub> emissions below 150 g/km for new, registered cars, and four countries had levels equal to or above 170 g/km. Two countries achieved the objective specified for 2008 in the voluntary agreement between the Commission and car manufacturers associations (140 g/km): Portugal and France.

**Figure 3.14: CO<sub>2</sub> emissions of new cars (2008)**

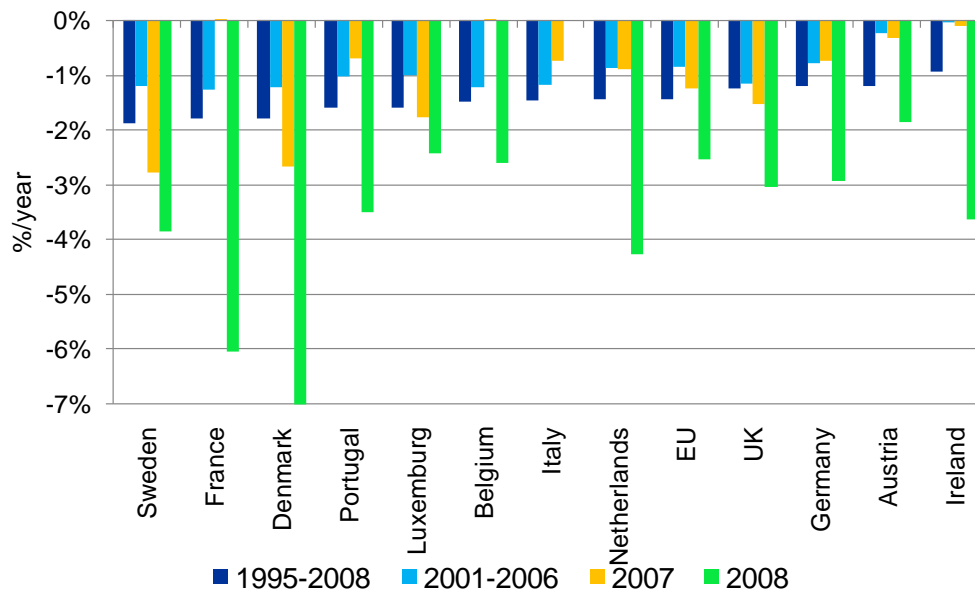


Source: T&E (2009)

The average specific CO<sub>2</sub> emissions of new cars sold in the EU decreased from 186 g/km in 1995 to 154 g/km in 2008; that corresponds to an average reduction of 1.4%/year. The average level achieved in 2008 was 10% above the target of 140 g/km fixed for 2008 in the agreement between the European Commission and the associations of car manufacturers (ACEA, JAMA and KAMA). The specific emissions of new cars decreased rapidly in 2007 and especially in 2008 (almost 3% on average in 2008) (**Figure 3.15**). Those good results have to be linked to the reduction in the average horsepower of cars, as shown above.

<sup>49</sup> This is mainly due to the fact that gasoline has a lower emission factor than diesel: 2.37 gCO<sub>2</sub>/litre for gasoline and 2.66 gCO<sub>2</sub>/litre for diesel.

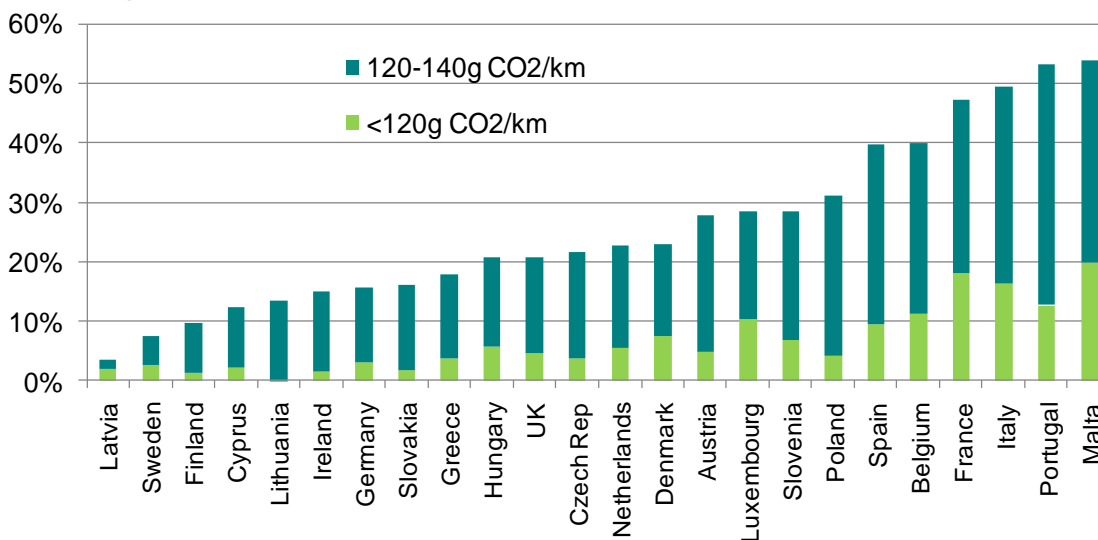
**Figure 3.15: Trends in the specific emissions of new cars<sup>50</sup>**



**An increasing penetration of low emission cars in the EU with different levels of penetration across countries**

According to the Commission monitoring report, in 2006 more than 40% of new cars in France, Italy, Portugal and Malta had specific CO<sub>2</sub> emissions below 140 g/km, and in those same countries almost 20% were even below 120 g/km (Figure 3.16). However, in 12 countries the penetration of those cars was still very low, at less than 20% of new cars with specific emissions below 140 g/km.

**Figure 3.16: Market share of new low emission cars in the EU (2006)**



Source: Enerdata from EU Commission report

<sup>50</sup> Provisional data based on a compilation of various sources; accordingly, it is not available for all countries.

In 2008, the overall market share of new cars sold by ACEA members (i.e. European car companies) with CO<sub>2</sub> emissions below 140 g/km stood at 42%, up from 35% in 2007, 31% in 2006 and 27% in 2004. The increase in 2008 was more rapid than in previous years. The market share of cars below 120 g/km increased from 9% in 2006 to 16% in 2008.

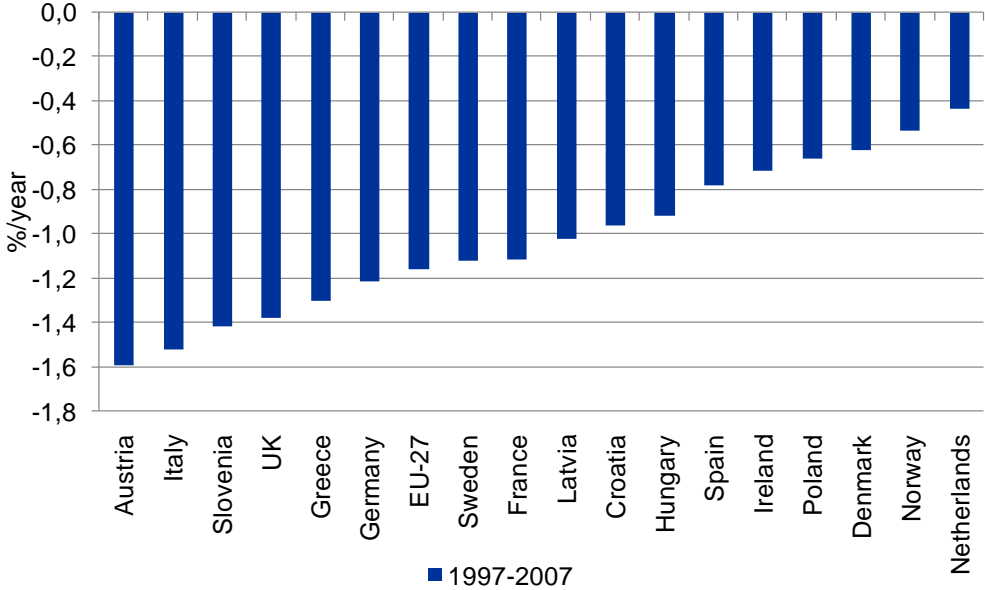
### 3.2.2. Performance of the car fleet average

#### Slowdown in the decrease of the car fleet’s average specific consumption since 1999; trends vary across countries

The average specific consumption of the car fleet has decreased steadily in all EU countries (Figure 3.17). Over the period 1990-2006 there was an average reduction of 1.3%/year at EU level: in 2007, cars consumed 1 litre/100 km less than in 1990.

Each country saw its specific consumption decrease, although to varying degrees ranging between 0.4-1.6%/year. The fall was more rapid than the EU average in Austria, Italy, Slovenia, UK, Greece and Germany. This continual improvement stems from the oldest and less efficient cars being replaced by new ones and in many countries also from the increasing share of diesel vehicles in the car fleet.

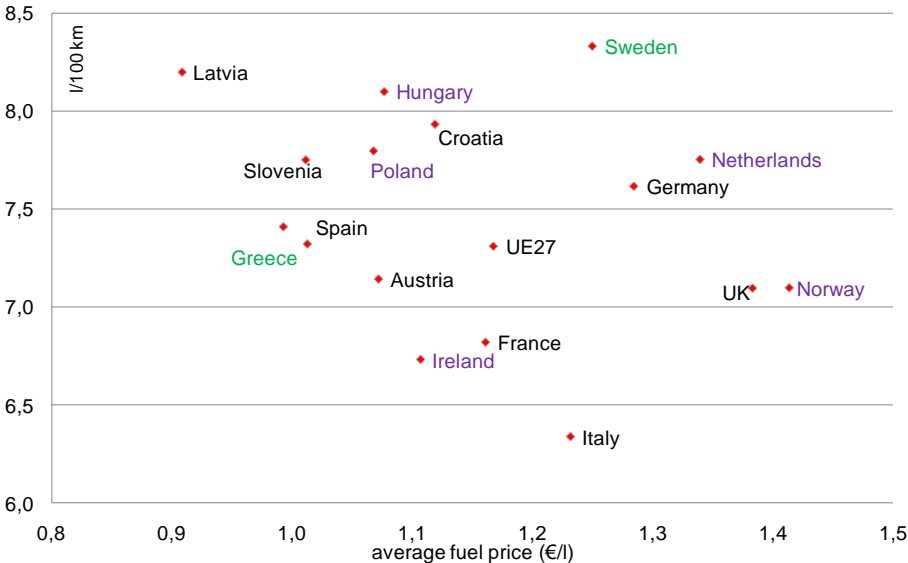
Figure 3.17: Variations in the average specific consumption of cars (l/100km)



Source: ODYSSEE

The average specific consumption of the car fleet ranged between 6.3 l/100 km (Italy) and 8.3 l/100 km (Sweden) in 2007, with an EU average of around 7.3 l/100km. There is no real correlation between the average specific consumption of the car fleet in l/100km and the average fuel price (Figure 3.18): average car size and horsepower and the share of diesel are probably the most important factors. The high value seen in Sweden, which is right at the top, can be partly explained by the fact that it is the country with the most powerful cars and the lowest share of diesel cars. Italy, on the contrary, is the country with the least powerful cars and a high penetration of diesel.

**Figure 3.18: Specific consumption of cars versus average fuel prices (2007)**<sup>51</sup>



**Box 3.3: Impact of motor fuel prices on the specific consumption of vehicles.**

An evaluation of the impact of motor fuel prices on the specific consumption of new vehicles (in litre/100km) was carried out within the EMEEES project<sup>52</sup>. It used a simple formula taking into account an autonomous trend and the average price of motor fuel, as follows:

$$\ln(SC) = T \times t + A \times \ln(P) + K$$

with SC: Specific consumption of cars in litre/100km, T: trend, A: price elasticity and P: motor fuel price

The price elasticity could not be estimated for most European countries. On the one hand, the statistical tests were not validated for many countries. On the other hand, the estimated price elasticity was often positive instead of being negative or was too high and captured most of the reduction. In conclusion, although it is clear that fuel prices have an effect, their impact cannot be differentiated from the other driving factors (e.g. national and EU policies, autonomous progress, change in average car size).

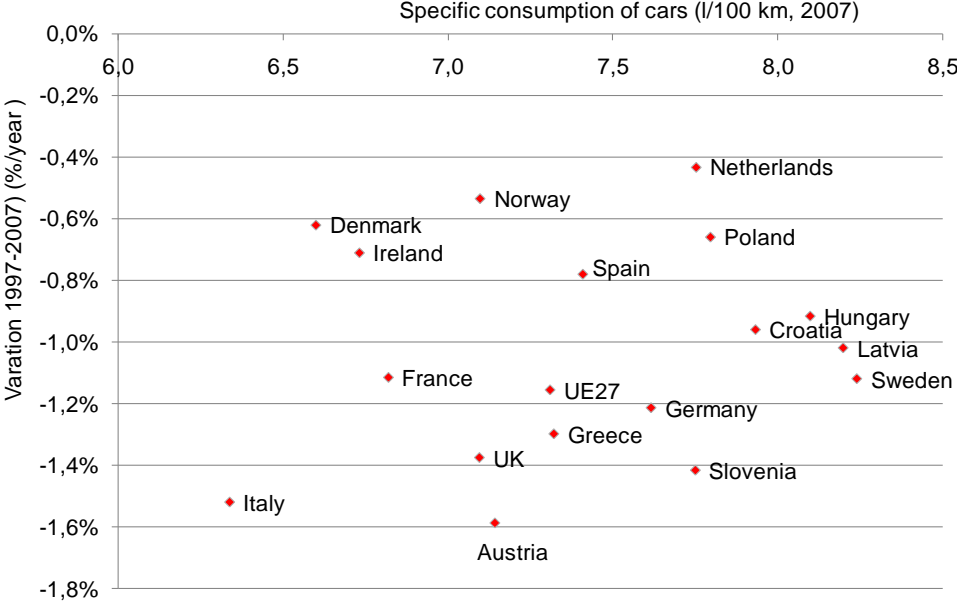
The same conclusions were reached when applying the analysis to the car fleet and not only to new cars.

<sup>51</sup> Countries in green: share of diesel in total car fleet below 10%; countries in purple: share of diesel between 10% and 20%.

<sup>52</sup> Source: Lapillone B, Desbrosses N, 2009

For most countries the trend can be linked to the level of specific consumption (**Figure 3.19**): it is faster in countries with a higher level (e.g. countries on the bottom right) and slower in countries with a lower specific consumption (top left).

**Figure 3.19: Specific consumption of cars: trend versus level**



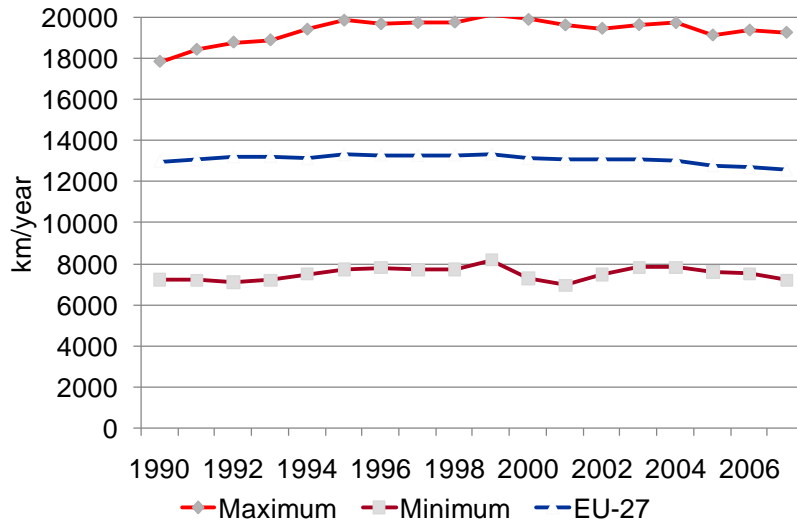
The average amount of energy consumed by a car over one year (in toe per car) does not only depend on the technical performance of the car (in litres/100 km), but also on the annual distance travelled (km/year).

**The annual distance travelled by cars has been decreasing in most EU-15 countries and in the EU since 1999**

The annual distance travelled by cars varies greatly among the different countries, from a minimum of around 8000 km (average of the 3 lowest countries, namely Poland, Hungary and Romania with similar values), to a maximum of 19000 km (Denmark). The EU average stands slightly below 13000 km/year (**Figure 3.20**).

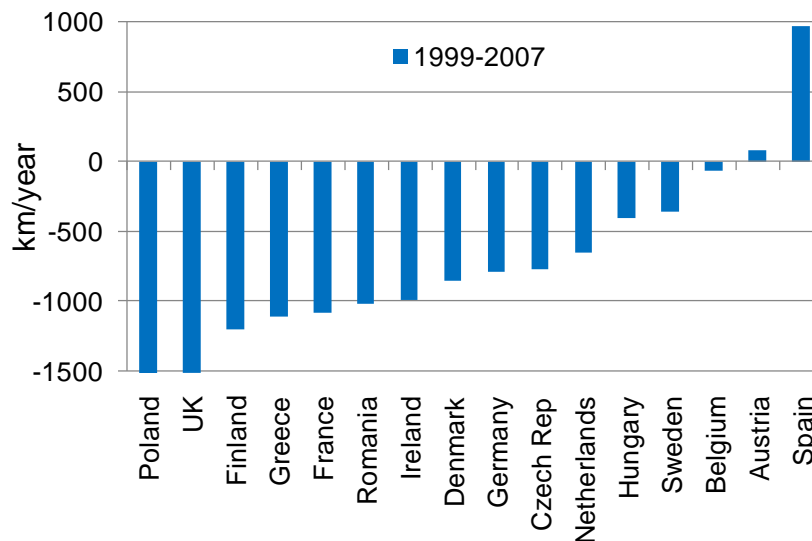
In most EU-15 countries and in the EU as a whole, the average annual distance travelled by cars increased between 1990 and 1999. This trend has been reversed since 1999 in all EU-15 countries except Spain because of the large motor fuel price increases in 1999 and 2000.

**Figure 3.20: Trends in the average annual distance travelled by car<sup>53</sup>**



There was a reduction of about 800 km at EU level between 1999 and 2007; the UK saw a decrease of about 1400 km, France and Denmark of about 1000 km, and Germany, the Netherlands, the Czech Republic and Italy of between 700-800 km (**Figure 3.21**). In most of those countries and in the EU as a whole, the reduction that took place over recent years offset the increase at the beginning of the nineties, and the average distance travelled has returned to the same level as in 1990. In most new Member States an opposite trend can be observed, with a regular rise linked to a rapid increase in car ownership and a disaffection for public transport.

**Figure 3.21: Variation of the average annual distance travelled by car**



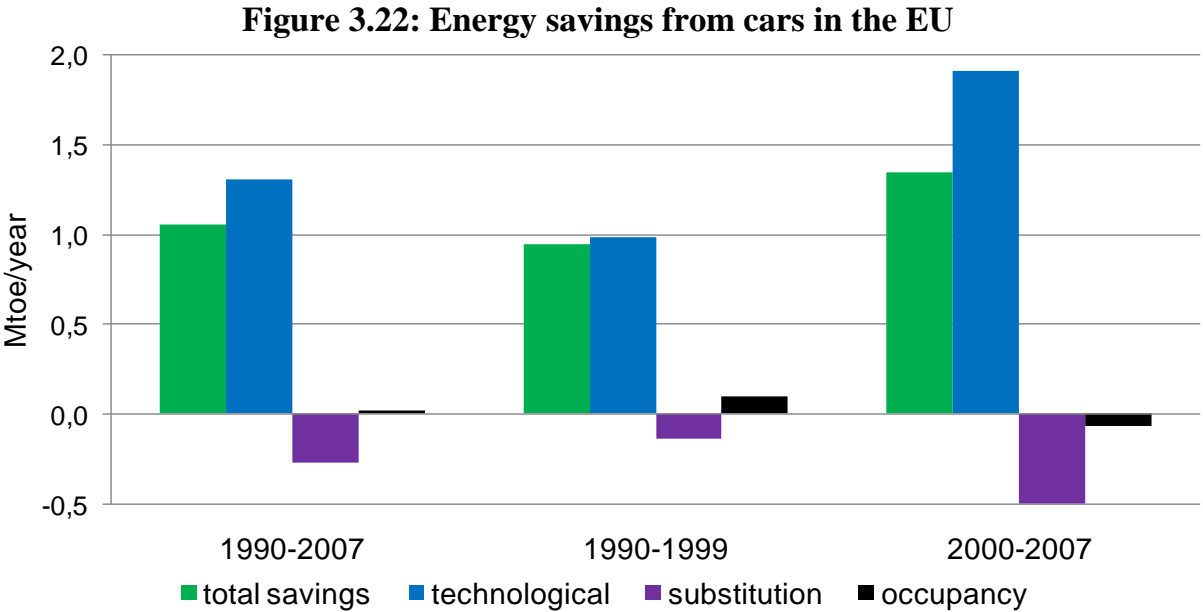
<sup>53</sup> The maximum corresponds to the country with the highest car mileage and the minimum to the average of the 3 countries with the lowest value (the values for those 3 countries are very close).

**Technological savings reached 25 Mtoe in 2007 in the EU**

Energy savings for cars can be measured according to the reduction in the energy used by car per passenger-km<sup>54</sup>. These savings may stem from improvements in their technical performance, from changes in driving behaviour (“eco-driving”), from changes in average car size or horsepower, or from an increase in car occupancy (“car pooling”) (**Box 3.4**).

“Technological savings” resulting from the decrease in the average specific consumption per car are estimated at 25 Mtoe for the EU in 2007 (compared to 1990), i.e. about 14% of the total consumption of cars; in other words, without these savings, the consumption of cars in 2007 would have been 25 Mtoe above its actual level or 14% higher. The average annual savings amount to 1.3 Mtoe/year (**Figure 3.22**). The volume of savings has been increasing since 2000 and over the period 2000-2007 almost reached an average of 2 Mtoe/year. Fuel switching from gasoline to diesel contributed to increase energy consumption by about 0.3 Mtoe/year between 1990 and 2007, and since 2000 even by 0.5 Mtoe/year, as a result of the penetration of biofuels<sup>55</sup>. Changes in car occupancy, which is a behavioural factor, had a small effect.

In 2007 total savings were still 25% below technological savings. The overall energy savings due to both technical and non-technical factors averaged 1.1 Mtoe/year over 1990-2007 and totalled 18 Mtoe in 2007:



<sup>54</sup> This is the definition used to monitor the Energy Service Directive (ESD).

<sup>55</sup> The heat content of diesel and biofuels, in toe/litre, is higher than for gasoline.

### Box 3.4: Calculation of energy savings for cars

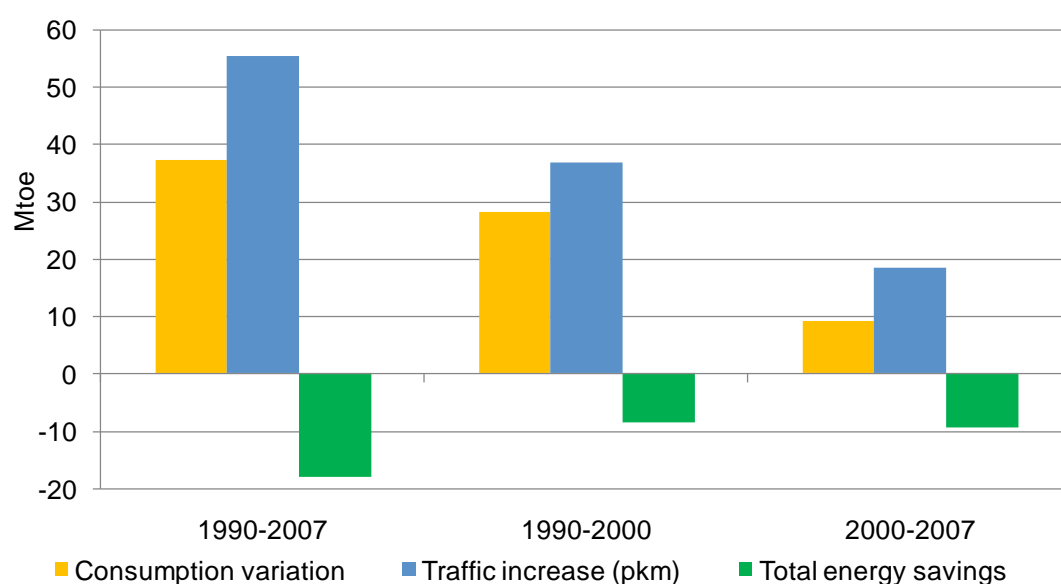
Total energy savings for cars are calculated according to the reduction in the energy used per passenger-km. They can be broken down into three effects or types of savings:

- Savings due to a reduction in the specific consumption in l/100km (1-1.5 Mtoe/year); these savings mainly correspond to technical energy efficiency improvements, but also include the effect of changes in driving behaviour and in car size; they will be referred to as technological savings;
- The effect of a change in the average heat content of one litre of motor fuel due to a change in fuel mix; over the period under study and for all countries, this effect was negative because of a shift from gasoline to diesel and in recent years from oil products to biofuels, which increased the average heat content (i.e. “negative savings”)<sup>56</sup>.
- Savings (positive or negative) linked to an increase in the average car occupancy rate (person/car)

### Energy savings have helped moderate the energy consumption increase

Between 1990 and 2007, the increase in car traffic (measured in passenger-km) should have raised the energy consumption of cars by 55 Mtoe (27%), all other things being equal. That effect was partially offset by a reduction in the energy consumption per unit of traffic (-18 Mtoe), resulting in a net increase of just 37 Mtoe in the energy consumption of cars (**Figure 3.23**).

**Figure 3.23: Breakdown of the energy consumption variation of cars (EU-27)**



<sup>56</sup> The substitution effect measures the impact of changes in the average calorific value of motor fuels, which varies according to the mix between diesel and gasoline: 1 litre of diesel has a calorific value of 0.88 toe/litre, which is 10% higher than that of gasoline (0.8 toe/litre).

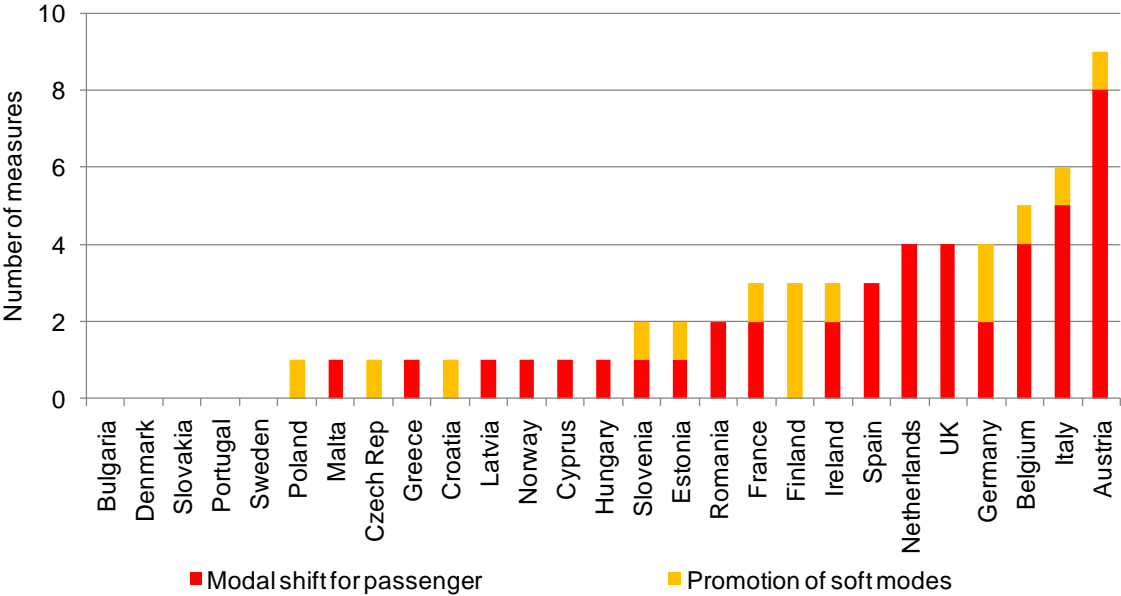
### 3.3. Modal shift

The energy efficiency of cars has improved significantly but the number of cars on the roads and the passenger traffic are still increasing. Another source of energy savings is to slow down the traffic by car and to move part of the traffic to public transport (rail, metro, buses). All countries are implementing national and local measures to transform passenger traffic patterns and to reduce the role of cars.

#### 3.3.1. Measures on modal shifts

Various types of measures are aimed at reducing the role of cars and at promoting public transport or soft modes: information campaigns, development of new public transport infrastructures or bicycles lanes, mobility plans (also called mobility management) for companies, administrations, schools, etc. One of the most active countries in that area is Austria (Figure 3.24).

**Figure 3.24: Measures on modal shift and soft modes per country**



#### Mobility management

Mobility management is a new concept to promote sustainable transport. "Soft" measures comprise the core of mobility management (e.g. information or coordination of existing user services), and are aimed at enhancing the effectiveness of "hard" traffic management measures (e.g. new tram lines, new roads and new cycle paths). Mobility management tools (in comparison to "hard" measures) do not necessarily require large investments measured against their high potential to change mobility behaviour. The objective of mobility management is to reduce the number of one-

person car journeys. The European Platform on Mobility Management (EPOMM)<sup>57</sup>, an international partnership, aims to promote and further develop mobility management in Europe.

In Austria<sup>58</sup>, for example, mobility management includes schools, public administrations, companies, municipal and regional levels, tourism and leisure traffic. France has mobility plans for companies developed by ADEME, the energy and environment agency. These plans consist of a package of measures put in place by companies or schools to encourage and support more sustainable travel patterns among staff, pupils, students, clients and visitors. ADEME subsidises companies planning to propose collective transport schemes to their employees within the framework of the Urban Transport Plans in order to reduce passenger car traffic<sup>59</sup> (**Box 3.5**).

The Netherlands is the champion of soft modes, and is the only country to monitor bicycle traffic. The use of bicycles in cities is intensifying in many countries through public access to bicycles on the basis of a self-service “bike hire” system (e.g. “velib” in Paris).

### **Box 3.5: Mobility management plans in France**<sup>60</sup>

To support and develop mobility management plans in France, ADEME provides methodological assistance (e.g. creation of a methodological guide) and grants, as follows:

- 50% of the cost of the study for mobility plans for companies (up to a maximum cost of €75 000)
- 20% of the cost of implementation (if the operation is exemplary) (30% for the first operations) with up to a maximum cost of €300k.

Today, more than 3,500 mobility management plans have been set up for companies (up from 92 mobility plans over the period 2000-2003 and 257 in 2005) and 1,348 mobility plans for schools.

Impact evaluations of the plans are difficult: the studies indicate a low and very variable environmental impact depending on the company (between 0 and 315 t/CO<sub>2</sub>/year)

### **3.3.2. Trends on modal split**

**The share of public transport in passenger traffic is decreasing almost everywhere**

The share of public transport in passenger traffic is decreasing in most countries. Only eight countries show a different trend and seem to have reversed the increasing role of cars (right side of **Figure 3.25**): on the one hand, Germany, Sweden, Denmark and Hungary, where the share of cars is stable; and on the other hand France, UK, Italy and Belgium, where there is a slight increase in the share of public transport. At EU level the share of public transport stands at around 17%.

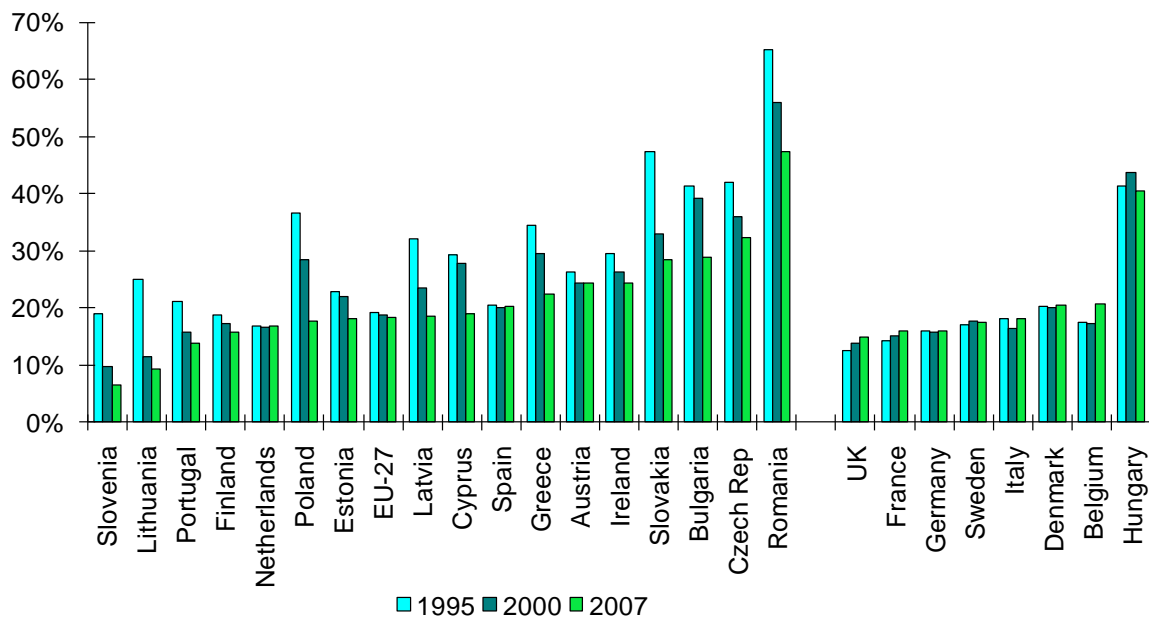
<sup>57</sup> <http://www.mobilitymanagement.org/index.phtml?sprache=en>

<sup>58</sup> <http://www.klimaaktiv.at/article/archive/11981/>.

<sup>59</sup> Urban Transport Plans (PDU) are mandatory plans to be prepared by all large cities in France to define the future development of public transport and soft modes.

<sup>60</sup> Source G. Chédin (2009).

**Figure 3.25: Share of public transport in total passenger traffic<sup>61</sup>**



**Mobility by public transport is increasing in half of the EU countries and in the EU as a whole**

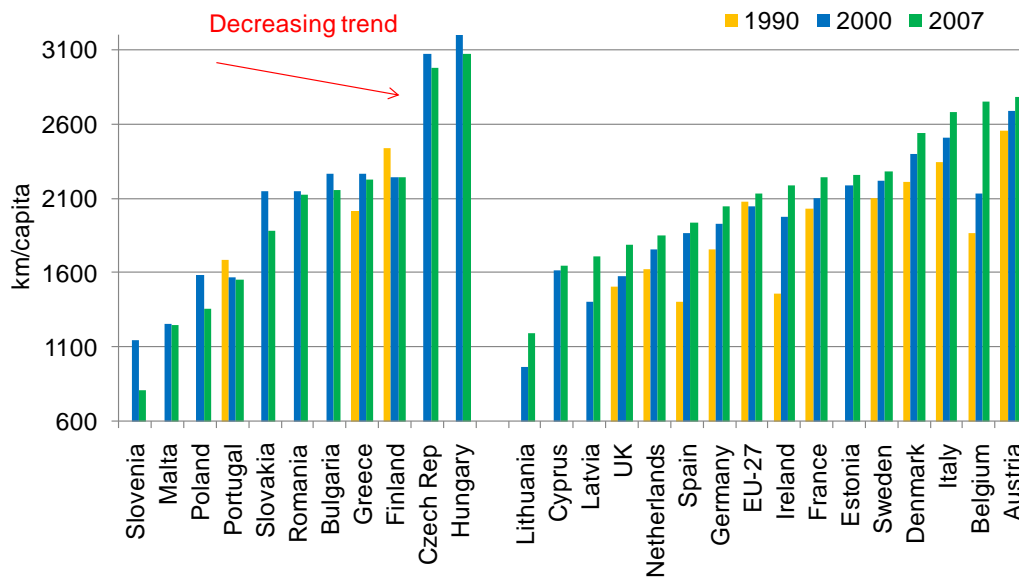
The share of public transport in the total passenger traffic is one indicator of the impact of national, regional and local policies implemented to promote this type of transport (or the lack of such policies)<sup>62</sup>. The trends in mobility by public transport modes (i.e. the annual distance travelled per year by public modes) can also be considered.

The Czech Republic and Hungary have the highest use of public modes (around 3100 km/year), compared to an EU average of around 2100 km (**Figure 3.26**). Belgium and Ireland recorded the highest increase over the period 1990-2007 (about 50%). Since 2000, the strongest growth is observed in Belgium, Lithuania and Latvia (between 20-30%), followed by the UK and Ireland (10-15%). In the EU average the increase is very limited (3% since 2000).

<sup>61</sup> Traffic measured in passenger-km.

<sup>62</sup> In the above description of measures local and regional policies related to the development of public transport are not included.

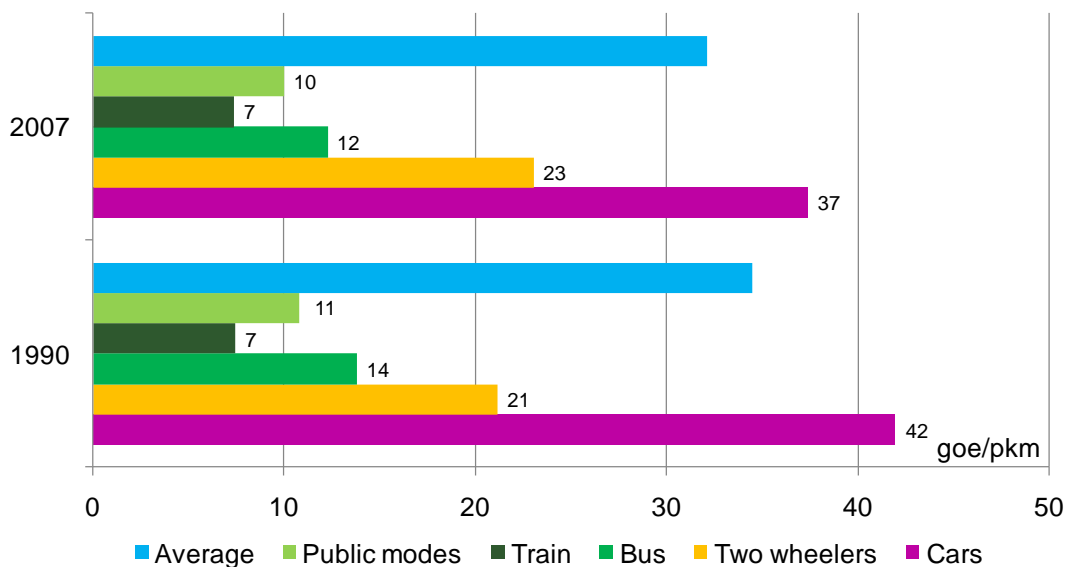
**Figure 3.26: Mobility by public transport in total passenger traffic<sup>63</sup>**



**Public transport is 4 times more energy efficient than cars**

On average, cars require 4 times more energy to transport one passenger-km than public transport (rail transport and buses), and 5 times more energy than rail transport alone (trains, metros and tramways) (Figure 3.27).

**Figure 3.27: Comparison of specific energy consumption by transport mode**



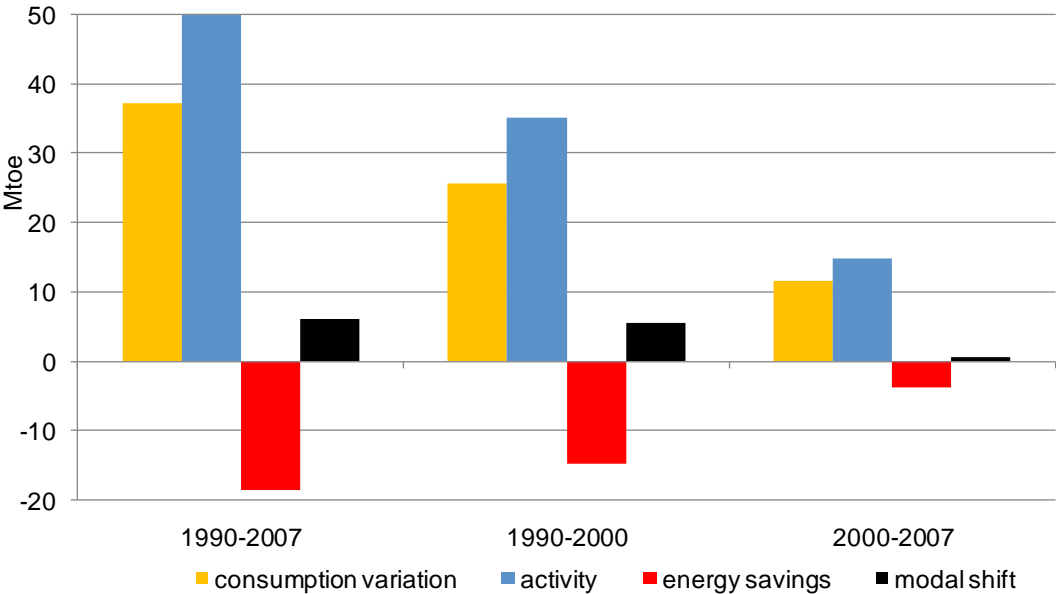
<sup>63</sup> Calculated as the ratio of traffic by public mode of transport (rail, bus, metro and tramway) in passenger-km to the total population.

**Negative energy savings due to the decline of the share of public transport in total passenger traffic.**

At the EU level the share of public transport in passenger traffic decreased by five points between 1990 and 2007, from 22% to 17%. This trend had a negative impact, since cars consume 4 times more energy per passenger-km than public transport. This modal shift contributed to increase the consumption by 6 Mtoe (or 0.35 Mtoe/year). On average, the loss of one market share point for public transport corresponds to an increased consumption (i.e. negative savings) of about 1.3 Mtoe at EU level. The growth in traffic caused consumption to increase by 50 Mtoe. Energy savings (change in specific consumption per unit of traffic) amounted to 19 Mtoe and offset the effect of traffic growth and modal shifts, as well as limiting the increase of the energy consumption to 37 Mtoe (**Figure 3.28**). Since 2000 there has been a slowdown in energy savings (0.6 Mtoe/year compared to 1.5 Mtoe/year over 1990-2000).

In the four countries in which the share of public transport increased slightly (Spain, France, UK and Belgium), modal shift resulted in energy savings that can be added to the savings registered for the different transport modes, especially cars.

**Figure 3.28: Breakdown of the energy consumption variation for passenger transport in the EU-27<sup>64</sup>**



This trend is expected to reverse in the future. First of all, the decline of the role of public transport has slowed down (1 point reduction since 1995 compared to 5 points since 1990). Secondly, many government and local authorities are developing or planning new public transport infrastructures, the impact of which is slow given the long lead time in that area.

<sup>64</sup> The energy consumption variation of passenger transport is broken down into 3 explanatory effects: activity effect (increase in traffic), modal shift effect (from private transport to public transport modes) and energy savings (change in specific consumption per unit of traffic).

### 3.4. Conclusions

- Since 2007/2008 measures on new cars have clearly been reinforced, involving increased subsidy schemes and a new EU Directive on mandatory emission limits for new cars. That new regulation, which introduces an emission limit of 130 gCO<sub>2</sub>/km by 2015, should speed up technical progress. The increasing use of biofuels will also contribute to the achievement of that target.
- Most countries have established some form of greening of tax systems related to car use and ownership. However, the lack of comparable data makes it difficult to compare the total amount of those taxes.
- The relative contribution of the different measures to the market transformation for new cars is difficult to assess, since it is the outcome of a large variety of measures and increased fuel prices.
- In addition to taxes, other measures that are more focused on the total car fleet have also been implemented. They include eco-driving, information campaigns and, more recently, car scrappage schemes to replace the oldest cars.
- The energy efficiency of cars is improving on a regular basis (by 1.3%/year since 1990), despite a slowdown in recent years; on average in the EU, cars consumed 1 litre/100 km less in 2007 than in 1990.
- As a result of the agreement between the Commission and the associations of car manufacturers (ACEA, JAMA and KAMA), as well as the increase in fuel prices, new cars sold in 2007 were 15% more efficient than new cars sold in 1995. Part of the improvement in the performance of new cars is offset by a general shift towards larger cars over most of the periods, although in 2007 and 2008 that trend was reversed, seeing an increase in smaller cars.
- The CO<sub>2</sub> emissions of new cars have decreased by 17% since 1995. However, in 2008 the average specific emissions were 10% above the 2008 target of 140 g/km stipulated in the agreement between the European Commission and the associations of car manufacturers.
- The annual distance travelled by cars has been steadily decreasing since 1999.
- The share of public transport in passenger traffic is decreasing almost everywhere

## 4. Freight transport

### 4.1. Policy measures

#### Limited measures for freight transport

Very few countries have introduced measures to improve the energy efficiency of freight transport. The most innovative country is Germany with its Toll Collect system, aimed both at raising the efficiency of trucks and moving part of the road traffic to rail and water transport. Some countries have measures to improve the efficiency of vehicle fuel use, such as Finland with its voluntary/negotiated agreements with transport companies, or Spain and Ireland with training and information programmes for truck drivers (**Table 4.1**). In countries that have implemented a CO<sub>2</sub> tax, that tax also applies to trucks.

The fact that only a limited number of measures address freight transport may be explained by various factors. First of all, in most countries this sector is facing strong competition, either from other modes or from other countries and, in addition, diesel prices are increasing; national governments are therefore reluctant to increase the burden on their companies, all the more since in certain countries previous attempts to introduce reforms in this sector led to serious trouble. Secondly, the fleet is very heterogeneous and labelling or standardisation schemes, like the scheme for cars, are difficult to design. Finally, measures on infrastructures, such as the promotion of combined rail/road traffic, take time to materialise and in many countries are still at a planning stage.

**Table 4.1: Policy measures on road transport vehicles<sup>65</sup>**

Country	Measure	Type	Date
Belgium	Modulation of the road tax for goods	Fiscal	2001
Finland	Energy Efficiency Agreement for Freight Transport and Logistics 2008-2016	Co-operative Measures	2008
Germany	Distance-based heavy load levy	Fiscal	2005
Ireland	Advice to Fleet Managers	Information/Training	2007
Portugal	Regulation for Energy Management (RGCE)	Regulation	1991
Spain	Management of Road Transport Fleet	Information/Training	2008
Spain	Efficient Driving of Lorries and Buses	Information/Training	2008
Spain	Renewal of the Road Transport Fleet	Co-operative Measures	2008

A few other countries have introduced subsidies to support the development of alternative transport infrastructures to road or rail/road combined traffic, in order to shift part of the road traffic to rail and water transport (**Table 4.2**).

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<sup>65</sup> Speed limits for trucks may reduce the consumption of vehicles if they are enforced; since they exist in most countries, they are not included here.

**Table 4.2: Policy measures on modal shift for freight transport by road**

Country	Measure	Type	Date
France	Grants for rail/road combined transport equipment	Financial	2003
Germany	Distance-based heavy load levy	Fiscal	2005
Hungary	Combined road-rail transportation	Financial	1990
Netherlands	Rail freight (Betuwelijn)	Financial	2008
Slovenia	Promotion of sustainable freight transport	Financial	2008
UK	Freight Facilities Grant	Financial	1974
Italy	Sea motorways: the Ecobonus	Financial	2007
Spain	Greater participation of maritime transport for goods	Financial	2008

Road charges for heavy goods vehicles already exist in many countries. The innovative aspect of the German Toll Collect system is that it uses satellite-guided systems rather than conventional tolls; links road charges to the emissions of vehicles; and, in theory, uses the toll revenues to subsidise rail and water transport infrastructures (**Box 4.1**). This system might pave the way for the introduction of road charging on a European scale.

#### **Box 4.1: Distance-based heavy load levy in Germany (“Toll Collect”)<sup>66</sup>**

A distance-based motorway toll was introduced in Germany in January 2005 for large heavy goods vehicles (above 12 t) using motorways for both national vehicles and those in transit. The average toll charge was about €12.4 cent/km, with the actual level depending on the emissions class, the number of axes and the distance travelled<sup>67</sup>. As of 1 January 2009, the toll rate was increased through a stronger differentiation by emission class: actual rates now vary between €14 cent/km (cat. A) and €29 cent/km (cat. D). An automatic vehicle registration system, based on an innovative combination of mobile telecommunications technology (GSM) and GPS, has been installed allowing distance-based charges to be calculated without affecting traffic flow. The system is managed by a service provider acting on behalf of the government.

The toll system is expected to decrease freight traffic by road due to more efficient transport logistics and a modal shift to railway and waterway, and to decrease the average specific fuel consumption of trucks due to an increasing share of more efficient vehicles. The idea was for the revenue of about €3.4bn per year to be used mainly to develop and maintain road, rail and water infrastructures. However, since the introduction of the toll, the share of investments has decreased. Ex-ante impact estimates of the toll system evaluate the energy savings at 36 PJ/year (~5% of the total fuel consumption of freight traffic) and 2.6 Mt CO<sub>2</sub> savings per year until 2020. The plan is to extend the toll to all trucks and light-duty vehicles ≥ 3.5 t and to introduce it on all major Federal roads; the additional savings are estimated at 72 PJ/year and 5 Mt CO<sub>2</sub>/year in 2020.

<sup>66</sup> Source: Schlomann B. and Eichhammer W (2009).

<sup>67</sup> The charging of fees for heavy vehicles is regulated by the so-called “Eurovignette” Directive 2006/38/EC, that allows Member States to levy charges on heavy goods vehicles above 3.5 tonnes to account for their external costs. Toll revenues should be used to maintain road infrastructures or to finance other modes; as of 2010, toll or user charges should be set according to vehicle pollution standards (Euro standards); an extra 15% 'mark-up' charge can be levied to finance new rail or waterways projects.

Italy and Spain want to make greater use of maritime transport. Italy, for instance, has introduced a subsidy scheme to render maritime transport more attractive (“Ecobonus”) (**Box 4.2**). A measure of this type could be considered by all countries with a sea area, in other words, by most EU countries.

#### **Box 4.2: Ecobonus for maritime transport in Italy**

Since 2007, Italy has had a subsidy scheme (called “Ecobonus”) for freight transport companies that make use of existing or new maritime routes instead of roads, and that guarantee a minimum of 80 trips per year on the same route. The budget allocation amounted to €240m for 3 years. The subsidy ranges between 20-30% of the maritime fare for national routes and 10-25% for international routes (mainly to France, Spain, Tunisia and Croatia)<sup>68</sup>. As a result of the measure, new maritime routes have been created for freight transport (also in connection with the EU TEN-T provisions) and both the average load factor of the cargos and that of the linear km offered per route have increased. The amount of tonnes transported over the period 2007–2010 is expected to have doubled.

## **4.2. Energy efficiency trends for road freight transport**

Freight transport by road absorbs almost 90% of the energy consumption of total freight transport. Therefore, we will mainly focus on road freight transport, which involves heavy trucks and light-duty vehicles. Since heavy trucks account for most of the freight traffic, it would probably be more relevant to consider that category only. Unfortunately, certain countries that are significant in terms of traffic, like the UK and Germany, do not separate energy consumption according to these two categories. Therefore, we will first consider heavy trucks and light vehicles together, and then trucks alone.

### **4.2.1. Trucks and light vehicles**

#### **Energy efficiency of vehicles versus efficiency of transport services**

The energy efficiency of overall freight transport can be assessed according to the **unit energy consumption per tonne-km**. This indicator helps to demonstrate the fact that although a shift towards heavier trucks increases the average specific consumption (l/100 km), it certainly decreases the consumption per tonne-km. In other words, trucks and light vehicles may consume more fuel per 100 km, but at the same time road freight transport may actually become more efficient. Consequently, in the case of road freight transport, energy efficiency acquires two different meanings depending on whether the focus is on the energy efficiency of vehicles (l/100 km) or the energy efficiency of the transport services (toe/tonne-km)<sup>69</sup>.

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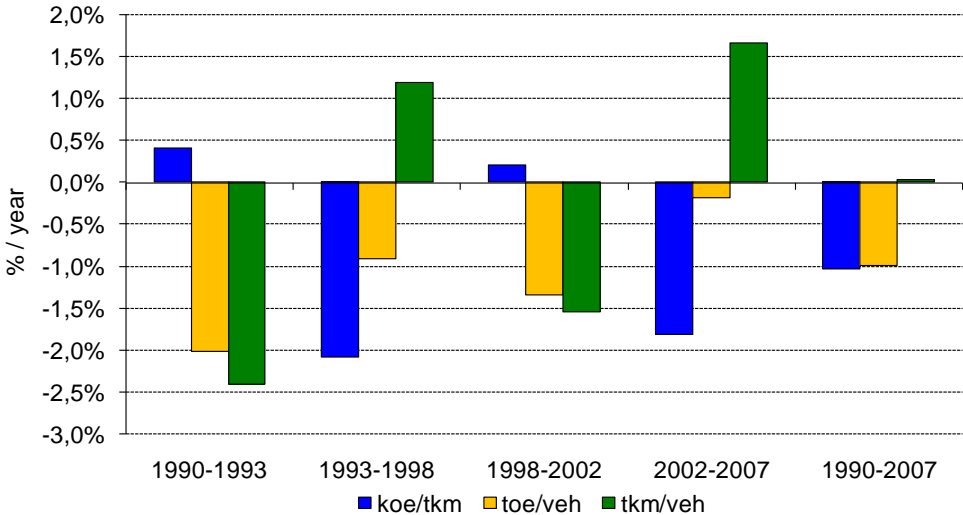
<sup>68</sup> The maximum fare discount is granted to companies with 1,600 trips per year on the same route.

<sup>69</sup> Measuring freight traffic in tonne-km is becoming increasingly inaccurate because of changing packaging techniques: the density of the load is decreasing and there is an increasing difference between the actual tonne-km at full volume capacity and the theoretical one corresponding to the truck's loading capacity.

### Lower efficiency of road freight transport since 2000

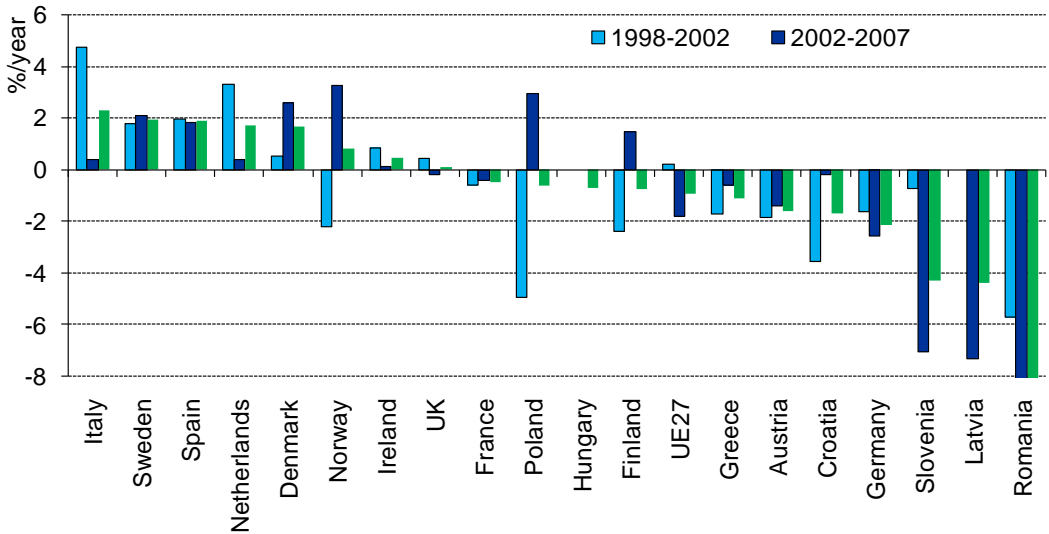
Between 1993 and 1998, and between 2002 and 2007, the energy consumption per tonne-km dropped. This can be explained by improvements in the economic situation after 1993, which enabled the volume of traffic to grow rapidly (nearly 5%/year in tonne-km), combined with the more efficient management of freight transport (higher load factors and reduction of empty running, as shown by the increase in the ratio tonne-km/vehicle) and a shift to bigger trucks (**Figure 4.1**).

**Figure 4.1: Change in the unit consumption of road freight transport (EU-27)<sup>70</sup>**



In most EU countries the average energy consumption per tonne-km has decreased since 1998 because of better vehicle fleet management (increase in tonne-km/vehicle). However, a reverse trend can be seen in several EU-15 countries, especially in Italy, Sweden, Spain, the Netherlands and Denmark (**Figure 4.2**).

**Figure 4.2: Change in the unit consumption of road freight transport**

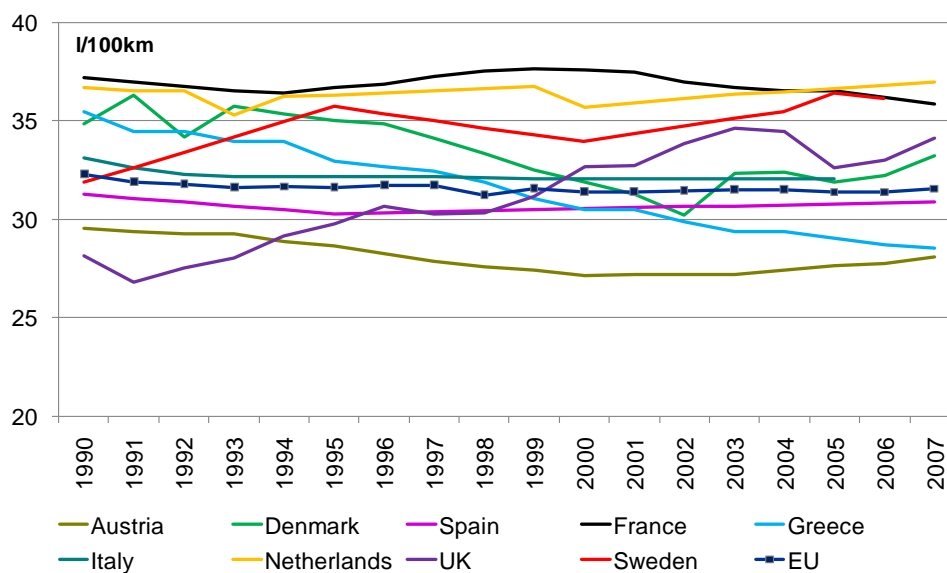


<sup>70</sup> Unit energy consumption measured in goe (gram oil equivalent)/tonne-km.

## 4.2.2. Trucks

The overall energy efficiency of trucks can be monitored according to specific consumption in litres/100 km (**Figure 4.3**). That specific consumption has remained more or less stable for the EU as a whole (around 32 litres/100 km). This stability means that the different factors influencing the specific consumption tend to balance their effects: technical efficiency, driving behaviour, traffic conditions or average speed and, finally, average vehicle size (a higher share of heavy trucks means a higher specific consumption). Nevertheless, values across countries vary significantly, ranging from 29 litres/100km to 37 litres/100km. The differences between countries are mainly explained by different definitions of trucks<sup>71</sup>.

**Figure 4.3: Specific energy consumption of trucks**



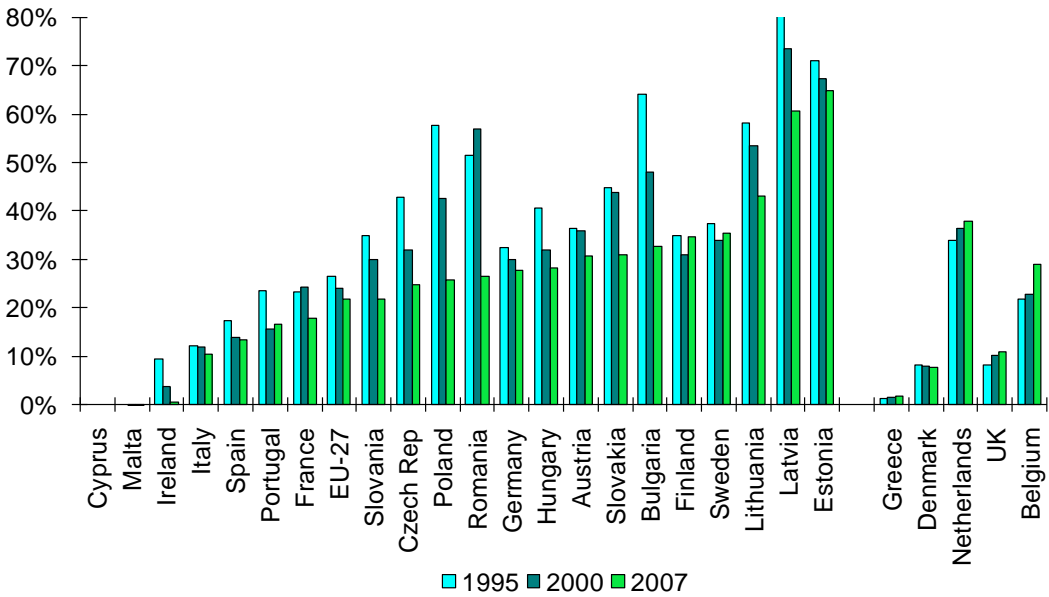
The trend observed in the specific consumption of trucks in litre/100km suggests that most of the progress registered for freight transport is not due to technological progress, but rather to an improvement in fleet management.

<sup>71</sup> In principle above 3 t useful load in ODYSSEE.

### 4.3. Modal shift

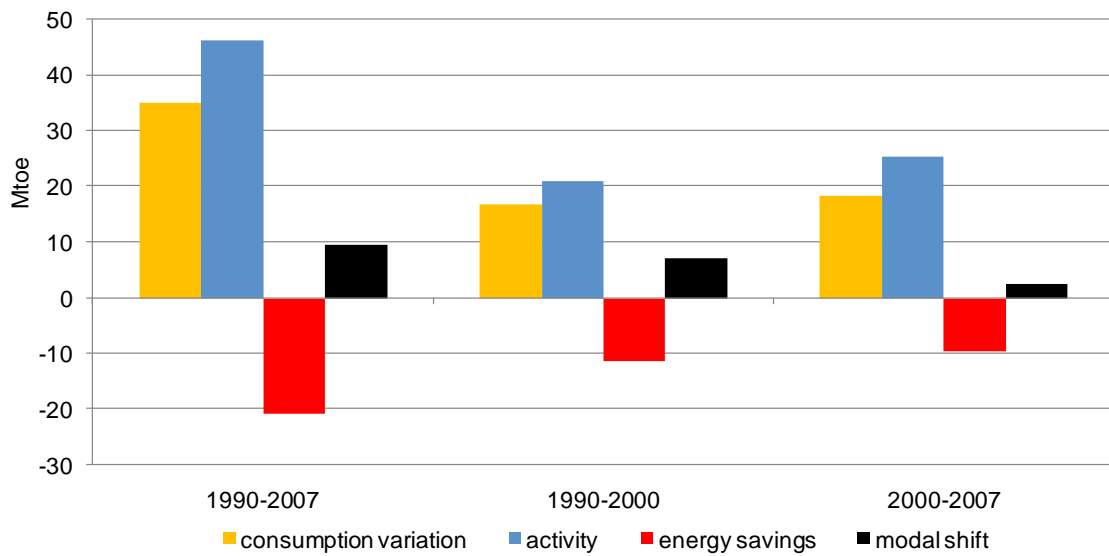
In most countries the share of efficient transport modes (rail and water) is decreasing; in other words, the trend is moving in the direction opposite to the direction in which policy makers plan for it to move. The greatest reduction can be seen in new member countries, especially in Poland and Bulgaria. The share of road transport has fallen in only three countries, namely the Netherlands, Belgium and the UK (Figure 4.4). In 2007 the share of rail and water varied greatly among countries, ranging from less than 10% for Italy and Ireland to 60-65% for Estonia and Latvia.

**Figure 4.4: Share of rail and water in total freight traffic**



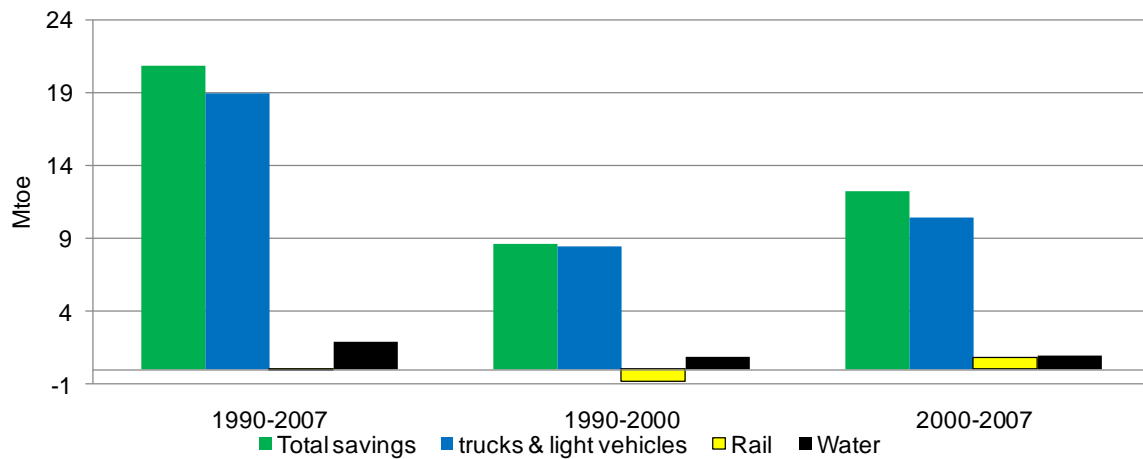
The modal shift from rail and water to road transport contributed to increase the consumption of freight transport by 10 Mtoe at EU level between 1990 and 2007. The increase in freight traffic in tonne-km was responsible for a consumption increase of 46 Mtoe. Energy savings (21 Mtoe) (change in specific consumption per unit of traffic) have limited both these effects by limiting the variation of the total energy consumption to 35 Mtoe (Figure 4.5).

**Figure 4.5: Breakdown of energy consumption variation for freight (EU-27)<sup>72</sup>**



Energy savings for freight (1.2 Mtoe/year from 1990 to 2007) mainly result from a decrease in the specific fuel consumption per tonne-kilometre of trucks and light vehicles (**Figure 4.6**). Since 2000, energy savings from freight have reached 1.8 Mtoe/year, up from 0.9 Mtoe/year over the previous period (1990-2000).

**Figure 4.6: Energy saving for freight (EU-27)**



<sup>72</sup> A positive “modal shift effect” means that the share of road in total freight traffic is increasing (shift from rail-water to road): this offsets energy savings

## 4.4. Conclusions

- Trucks and light-duty vehicles are not sufficiently addressed by policies, despite the rapid growth of their energy consumption.
- Modal shift measures are still scarce in freight transport, and only very limited results have been achieved in that area.
- The impact of infrastructure measures on the modal split is not yet visible, which is understandable given the fact that investments in road infrastructures still exceed investments in rail and water transport infrastructures by an order of magnitude.

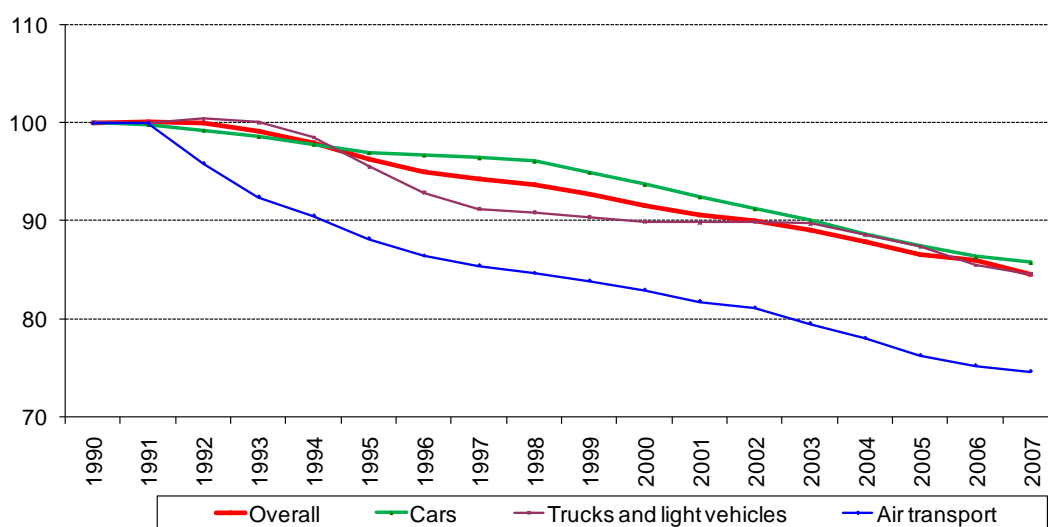
## 5. Overall energy efficiency and CO<sub>2</sub> trends

### 5.1. Overall energy efficiency trends

#### Regular improvement of 1%/year in the energy efficiency of transport in the EU

The energy efficiency of transport in the EU-27 improved by about 15% between 1990 and 2007 (1%/year), as measured according to the ODEX indicator (**Box 5.1**). Greater progress was achieved in the energy efficiency of both cars and airplanes than in the rest of the sector (**Figure 5.1**).

**Figure 5.1: Energy efficiency progress in transport in the EU<sup>73</sup>**



#### Box 5.1: Evaluation of energy efficiency trends with ODEX

The evaluation of overall energy efficiency trends in the transport sector in ODYSSEE is based on the ODEX indicator. ODEX aggregates the energy efficiency progress at the level of each transport mode into a single indicator as follows:

The energy efficiency progress by mode is captured by a specific consumption measured in:

- litres/100km for cars, buses and motorcycles;
- goe (gram oil equivalent) per tonne-km for freight transport (trucks, rail and navigation);
- toe/passenger for air transport; and
- goe/passenger-km for passenger rail.

The overall trend is an average of the trend by mode weighted according to the share of each mode in the energy consumption of the transport sector.

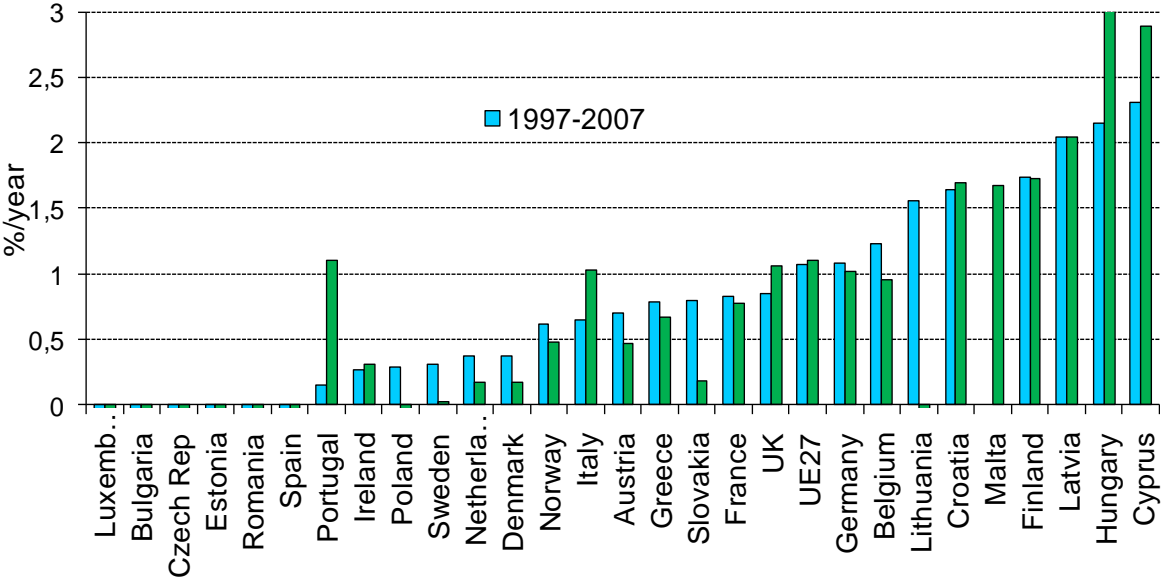
The ODEX presented here is calculated as a 3-year moving average (see glossary and definition).

<sup>73</sup> Only the trends of the main modes are shown in the graph.

**In nine EU countries the rate of energy efficiency progress is above 1%/year**

In nine EU countries, and in Norway, the rate of progress was above 1%/year, i.e. above the target of the Energy Service Directive (**Figure 5.2**). In 7 countries the efficiency of transport decreased because of road freight transport.

**Figure 5.2: Energy efficiency progress in transport in EU countries<sup>74</sup>**



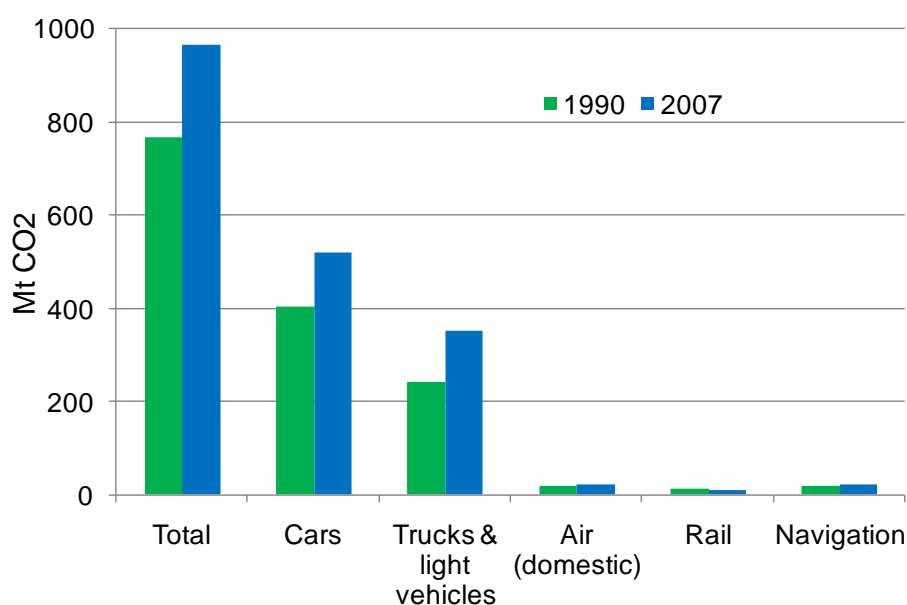
<sup>74</sup> Countries with an increase in the ODEX indicator are shown as having no energy efficiency progress.

## 5.2. CO<sub>2</sub> emission trends in transport

### CO<sub>2</sub> emissions in the transport sector have increased by 26% since 1990

The transport sector is driving total CO<sub>2</sub> emissions from energy use: CO<sub>2</sub> emissions from transport have increased by almost 26% since 1990<sup>75</sup>, whereas in all other sectors these emissions are far below their 1990 levels (reduction of 22% in industry and 18% in households, services and agriculture)<sup>76</sup> (**Figure 5.3**). As a result, transport represents a growing share of the total emissions of final consumers (i.e. excluding the power sector): 43% in 2007 compared to 32% in 1990. Since 2000, the increase of emissions from transport has slowed down (1%/year compared to 1.6%/year over 1990-2000).

**Figure 5.3: Variation of CO<sub>2</sub> emissions from transport (EU-27)<sup>77</sup>**



Source: EEA for total emissions and ODYSSEE for the emissions by mode

### Road freight transport is driving CO<sub>2</sub> emissions from transport

Road transport represents 94% of total emissions from transport. The emissions from road freight transport increased by nearly 47% between 1990 and 2007 and made up 36% of the sector's emissions (compared to 31% in 1990)<sup>78</sup> (**Figure 5.3**); this is the main source of the sector's rapid growth in emissions. Emissions from cars have

<sup>75</sup> CO<sub>2</sub> represent 99% of the sector's greenhouse gas emissions

<sup>76</sup> Source : EEA inventory (2009)

<sup>77</sup> Direct emissions as in the CO<sub>2</sub> inventory; adding the indirect emissions from the sector's electricity consumption would not really change the picture since electricity use is not important in that sector

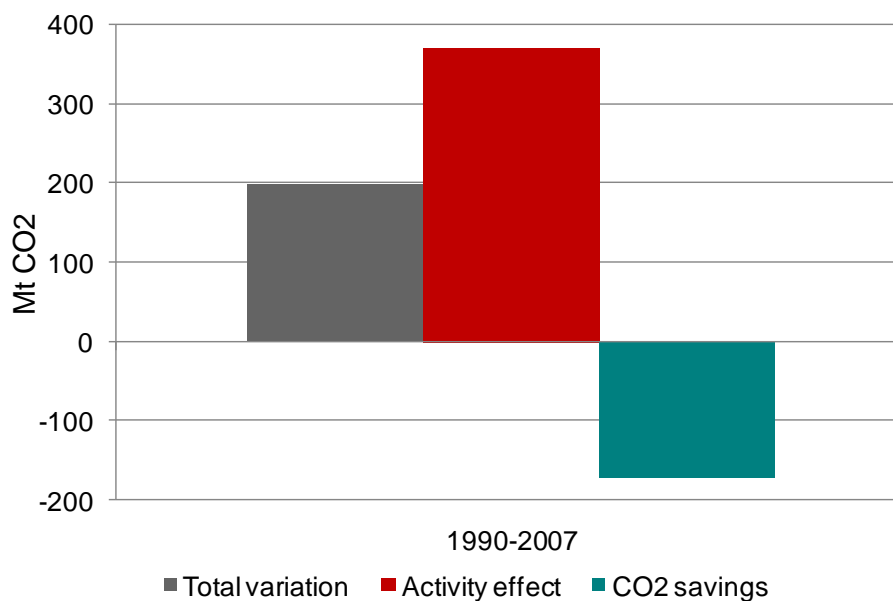
<sup>78</sup> Source: ODYSSEE estimates

increased by 29%. Although emissions from domestic air transport<sup>79</sup> have increased by 30% since 1990, they represent less than 3% of the total.

### **Around 170 Mt CO<sub>2</sub> avoided in 2007, which has offset almost half of the increase in CO<sub>2</sub> emissions since 1990**

The increase in the traffic of passengers and freight should have increased CO<sub>2</sub> emissions by 370 Mt CO<sub>2</sub> between 1990 and 2007. Savings in CO<sub>2</sub> amounted to 170 Mt and were almost exclusively due to the reduction in the specific emissions of road vehicles per unit of traffic. These savings limited the increase in CO<sub>2</sub> emissions to 200 Mt and have offset almost half of the CO<sub>2</sub> emission increase since 1990 (**Figure 5.4**). Around 40% of the savings come from trucks and light vehicles and 30% from cars.

**Figure 5.4: Variation of CO<sub>2</sub> emissions in transport (EU-27)**



### **5.3. Conclusions**

- The transport sector was 15% more energy efficient in 2007 than in 1990. Most of the gains come from cars.
- The transport sector is the only end-use sector in which CO<sub>2</sub> emissions continue to increase: emissions in 2007 were 26% above their 1990 levels.
- CO<sub>2</sub> savings have offset almost half of the increase in CO<sub>2</sub> emissions since 1990.

<sup>79</sup> Emissions from international air transport are not included in countries' emissions, in accordance with the UNFCCC methodology.

## 6. Glossary and definitions

- **ODEX moving average**

Year-to-year values of indicators can fluctuate due to the limited accuracy of the input data used. Moreover, the value for the most recent year is often unreliable due to the preliminary nature of the statistical data. The annual figures presented could lead to ill-conceived conclusions on year-to-year trends of cumulative changes over the period. To avoid this, the yearly figures for ODEX are converted into three-year moving average values.

- **Total impact of policy measures**

The semi-quantitative impact categories low, medium or high are linked to the sector's energy or electricity consumption through a percentage range<sup>80</sup>. In order to evaluate the overall impact of a set of policy measures, the categories are weighted according to relative factors (high impact= 5, medium impact= 3, low impact= 1), which correspond to the defined bands of savings. This type of semi-quantitative evaluation provides useful information for screening the policy measures and providing a first order estimate of the impact of policy measures.

- **Vehicle fleet**

The fleet of vehicles corresponds to the number of road vehicles registered at a given date (usually at the end of the year or in the middle of the year) in a country.

The data for a given category of vehicles may vary depending on the data source. The most common difference stems from the difference between vehicles actually on the road (i.e. in circulation and consuming motor fuels) and registered vehicles (i.e. including vehicles that have been scrapped and that are no longer in use). Official data sometimes relates to the second category only and includes all new registrations in the existing vehicle fleet without retiring the vehicles that are no longer in use. When assessing the energy use of cars and their related energy savings, only data regarding the fleet of vehicles actually on the road should be used.

- **Test specific fuel consumption of new cars**

The test specific fuel consumption of new cars indicates the average consumption of new cars in litres/100 km according to a standardised test in a laboratory or on a car circuit. Since 1997, a standardised European fuel consumption test<sup>81</sup> is available, as

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<sup>80</sup> These ratings represent different ranges of energy savings, expressed as percentages of total sector consumption. Low equals 0-0.1% of total use, medium 0.1-0.5% and high >0.5%.

<sup>81</sup> Before 1997, the test specific consumption was traditionally measured for three driving cycles: motorway (stabilised speed of 120 km/h), road (stabilised speed of 90 km/h); urban (19 km/h in

defined by an EU Directive<sup>82</sup>. The corresponding test value is an average of two cycles (urban and extra-urban cycles).

The test specific consumption is usually lower than the actual specific consumption of the vehicle on the road. The “gap factor” is a function of parameters excluded in the fuel consumption test procedure (e.g. type of tyre used and actual tyre pressure, level of use of certain auxiliaries, such as air conditioning or lights) and of the driving conditions (traffic, congestion) and driving style<sup>83</sup>. There is no clear estimate of the magnitude of this gap. According to IEA estimates, this gap covers a range of about 10-20% in Europe, 15-25% in the US and around 25-35% in Japan<sup>84</sup>.

- **Tonne-km**

This is a unit of measure representing the transport of one tonne of freight by a given transport mode over one kilometre (abbreviation tkm).

- **Passenger-km**

This is a unit of measure representing the transport of one passenger by a given transport mode over one kilometre (abbreviation pkm).

- **Total consumption of road transport versus domestic consumption: correction for border trade/fuel tourism**

Many countries correct the calculation of energy efficiency indicators for road vehicles by removing the consumption of foreign vehicles from that calculation. This consumption corresponds to fuel purchased in one country but consumed in another country as a result of the transit of vehicles and of foreigners who take advantage of fuel prices that are lower than those in their own country (known as “border trade or fuel tourism”)<sup>85</sup>. By making a correction of this type, they introduce the concept of “domestic road transport” into the calculation of their indicators, instead of the total consumption of road transport as defined in Eurostat statistics. This adjustment is important for certain countries with high levels of transit and in countries with motor fuel prices that are significantly lower than in neighbouring countries (e.g. Ireland and Northern Ireland, or Austria and Germany). In the case of countries that make this

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laboratory with warm engine). The average specific consumption for each car was then calculated on the basis of a conventional weight for each driving cycle (e.g. 1/3 urban, 1/3 motorway, 1/3 roads). In the year 1997 the definition of the test value was modified, marking a change in the historical data, since according to an assessment made by ADEME for France or ACEA, the new test leads to values that are about 9-10% higher than those obtained when using the previous method.

<sup>82</sup>Directive 80/1268/EEC, as last amended by 2004/3/EC.

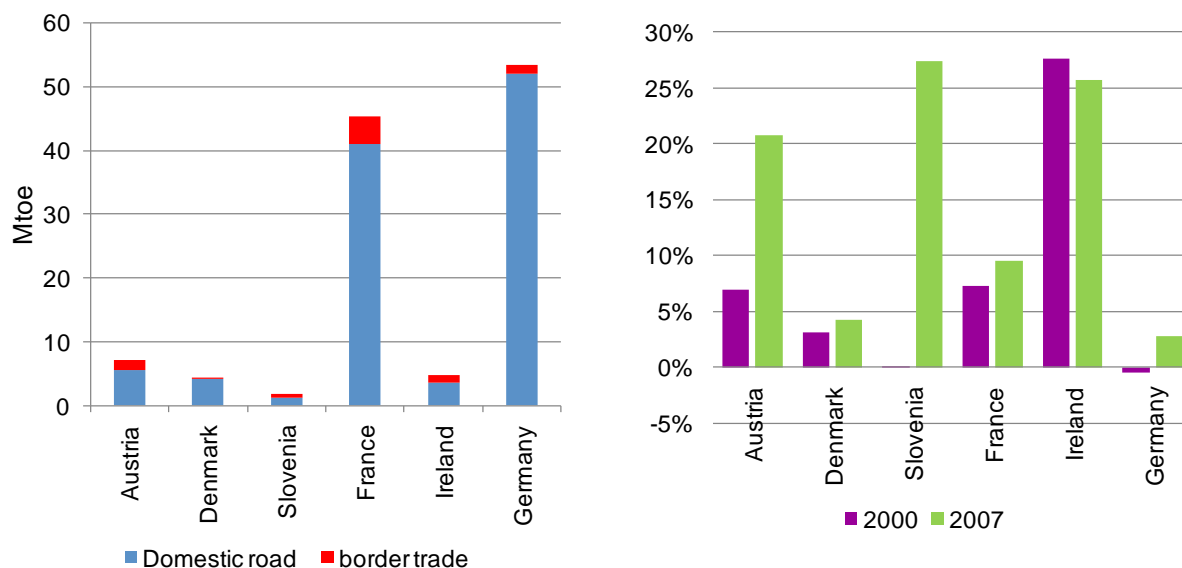
<sup>83</sup> Eco-driving programmes are aimed at reducing the effect of this factor and can achieve fuel savings of up to 10-20% in the short term, and 5-10% in the longer term.

<sup>84</sup>Source: Cazzola Pierpaolo (2009).

<sup>85</sup> Foreigners cross the border with the sole purpose of purchasing fuel at the closest petrol station or purchase larger quantities of fuel than needed when on holiday or on business trips.

correction<sup>86</sup>, the domestic consumption of road transport is lower than the total consumption of road transport shown in statistics, since the consumption of foreign vehicles (“border trade”, transit) is deducted. The difference usually lies within a range of 10-20% of the consumption, but can reach up to 25% in Slovenia<sup>87</sup> and Ireland; it equals 20% in Austria and 10% in France (**Figure 6.1**).

**Figure 6.1: Share of border trade in road consumption**



- **Consumption of road vehicles**

All the indicators set out in this brochure are based on estimates of the fuel consumption of road transport by type of vehicles. Such data are usually not part of official statistics and are not included in Eurostat data, for instance. They are, however, a prerequisite for any understanding of fuel consumption trends in road transport or for the assessment of energy efficiency trends. Therefore, an increasing number of countries are making estimates that are officially published. These estimates are usually based on modelling and rely on the following information<sup>88</sup>:

- Motor fuel sales
- Traffic surveys
- Mobility surveys

<sup>86</sup> At present five countries officially apply this correction: Slovenia, Ireland, Austria, France and Germany. The issue of fuel tourism is very important in Luxembourg and biases all their transport indicators. An example of the methodology used for making such a correction is given by Reinhard Jellinek (2009).

<sup>87</sup> Data for Slovenia are unofficial, estimated data and include consumption of transit

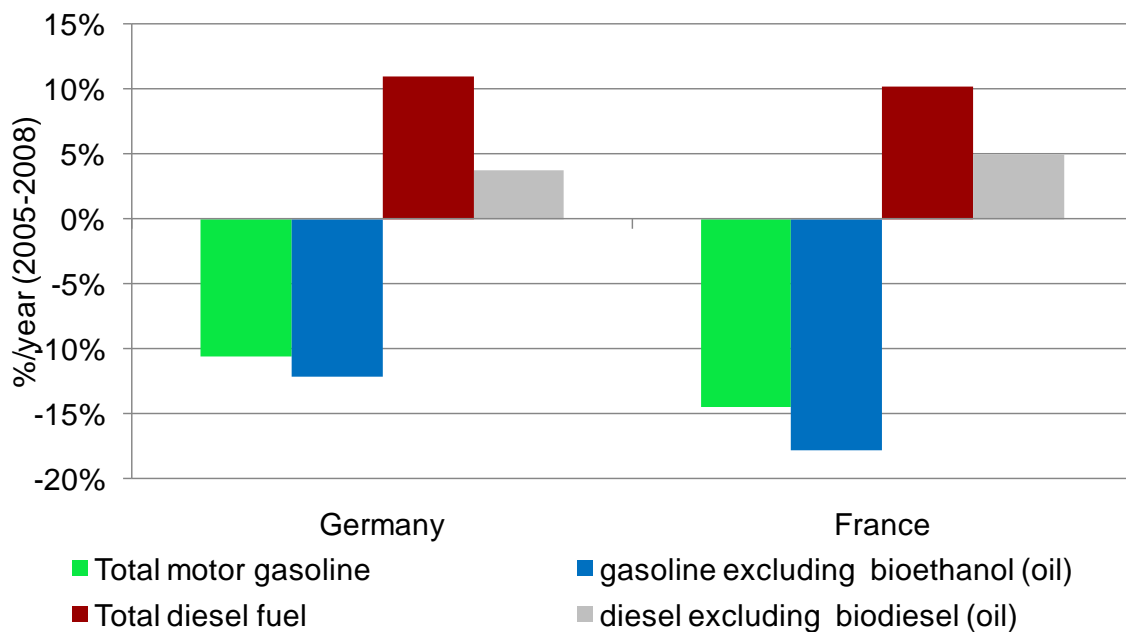
<sup>88</sup> Examples of the methodologies used are explained in the case of France by Boccara Frédéric and Nanot Bernard from the Ministry for Ecology, Energy, Sustainable Development and Town and Country Planning; in the case of Austria by Reinhard Jellinek from the Austrian Energy Agency; and in the case of Croatia by Novosel Dino from Energy Institute Hrvoje Požar (Final meeting of the project “Monitoring of Energy Demand Trends and Energy Efficiency in the EU: Case of Transport”, May 18–19 2009, Paris, IEA. <http://www.odyssee-indicators.org/registred/paris.php>).

- Surveys on the specific consumption of vehicles (in certain countries, e.g. France)

- **Biofuels consumption**

Biofuels have already acquired importance in certain countries and will soon be important in all countries. At present, a degree of confusion exists with regard to fuel consumption data for road transport, since in statistics it sometimes refers to the oil part only and sometimes to the fuel that is sold, i.e. the mixture between the biofuels and the oil product (gasoline or diesel). This affects the trend of motor fuel consumption by mode and the specific consumption, as illustrated in **Figure 6.2**.

**Figure 6.2: Trends in motor fuel consumption with and without biofuels**



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## **7. Annex: Measures on transport in MURE data base**

<b>Number of on-going measures on cars, by measure type</b>	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Netherlands
<b>Financial</b>										
<b>Grants / Subsidies</b>										
For energy efficient vehicles	1	0	0	0	0	1	0	0	0	0
For clean vehicles	3	0	0	0	2	0	0	1	1	0
For the scrapping of old cars	1	0	0	0	1	1	0	0	1	0
<b>Fiscal</b>										
<b>Taxation linked to efficiency/CO2</b>										
Tax on the purchase of cars	1	0	1	1	2	0	0	1	0	1
Annual vehicle tax	2	1	1	0	0	2	0	1	0	1
<b>Tax Exemption / Reduction</b>										
For energy efficient vehicles	0	0	0	0	0	0	0	0	0	0
For clean vehicles	0	0	0	0	0	0	1	1	0	0
For clean fuels	0	0	1	0	0	2	0	1	1	0
<b>Legislative/Normative</b>										
<b>Mandatory Standards for Vehicles</b>										
Mandatory fuel consumption standard	0	0	0	0	0	0	0	0	0	0
Mandatory speed limits	1	0	1	1	1	0	0	2	0	1
Speed limiters for cars and motor cycles	0	0	0	0	0	0	0	0	0	0
Periodic mandatory inspection	1	0	0	1	1	0	1	0	1	1
<b>Legislative/Informative</b>										
Mandatory labelling of vehicles (EU)	1	1	1	1	1	1	1	1	1	1
<b>SocialPlanning/Organisational</b>										
Car-sharing / increased occupancy of cars	4	1	0	0	0	0	0	0	1	1
<b>Information/Education/Training</b>										
Information / training on driving	1	0	0	6	0	2	0	2	0	1



<b>Number of on-going measures on cars, by measure type</b>	Portugal	Spain	Sweden	UK	EU	Bulgaria	Cyprus	Croatia	Czech Republic	Estonia	Hungary	Lithuania
<b>Financial</b>												
<b>Grants / Subsidies</b>												
For energy efficient vehicles	1	3	0	1	0	0	0	0	0	0	0	0
For clean vehicles	1	3	0	1	1	0	1	3	0	0	0	0
For the scrapping of old cars	1	0	0	0	0	0	0	0	0	0	0	0
<b>Fiscal</b>												
<b>Taxation linked to efficiency/CO2</b>												
Tax on the purchase of cars	1	1	0	1	0	0	1	0	0	0	1	0
Annual vehicle tax	0	0	1	1	0	0	1	0	0	0	0	0
<b>Tax Exemption / Reduction</b>												
For energy efficient vehicles	0	2	0	0	0	0	0	0	0	0	0	0
For clean vehicles	0	2	1	0	1	0	1	1	0	0	0	0
For clean fuels	1	0	1	0	1	1	0	0	0	0	0	0
<b>Legislative/Normative</b>												
<b>Mandatory Standards for Vehicles</b>												
Mandatory fuel consumption standard	1	0	1	0	1	0	0	0	0	0	0	0
Mandatory speed limits	0	0	0	2	0	1	0	0	0	1	1	0
Speed limiters for cars and motor cycles	0	0	0	0	0	0	0	0	1	0	1	0
Periodic mandatory inspection	1	1	0	0	0	1	1	0	1	1	1	1
<b>Legislative/Informative</b>												
Mandatory labelling of vehicles (EU)	1	1	1	1	1	0	1	1	0	1	1	0
<b>Social Planning/Organisational</b>												
Car-sharing / increased occupancy of cars	0	4	0	0	0	0	0	0	0	0	0	0
<b>Information/Education/Training</b>												
Information / training on driving	1	6	2	2	0	0	0	0	0	1	0	0

<b>Number of on-going measures on cars, by measure type</b>	Latvia	Malta	Norway	Poland	Romania	Slovakia	Slovenia
<b>Financial</b>							
<b>Grants / Subsidies</b>							
For energy efficient vehicles	0	1	0	0	0	0	0
For clean vehicles	0	0	1	0	1	0	1
For the scrapping of old cars	0	0	0	0	1	0	0
<b>Fiscal</b>							
<b>Taxation linked to efficiency/CO2</b>							
Tax on the purchase of cars	1	0	1	1	0	0	0
Annual vehicle tax	0	0	0	1	0	1	0
<b>Tax Exemption / Reduction / Accelerated Depreciation</b>							
For energy efficient vehicles	1	1	0	0	0	0	0
For clean vehicles	0	0	0	0	0	0	0
For clean fuels	1	0	0	0	0	0	0
<b>Legislative/Normative</b>							
<b>Mandatory Standards for Vehicles</b>							
Mandatory fuel consumption standard	0	0	0	0	0	0	0
Mandatory speed limits	0	1	1	1	1	0	0
Speed limiters for cars and motor cycles	0	1	0	0	0	0	0
Periodic mandatory inspection	1	0	1	1	1	1	1
<b>Legislative/Informative</b>							
Mandatory labelling of vehicles (EU)	1	0	1	1	1	1	1
<b>SocialPlanning/Organisational</b>							
Car-sharing / increased occupancy of cars	0	1	0	0	0	0	0
<b>Information/Education/Training</b>							
Information / training on driving	0	0	1	0	0	0	3

**Example of measures in MURE data base: case of fiscal measures « Tax on the purchase of a car »**

Code	Title	Status	Type	Starting Year	Ending Year	Semiquantitative Impact
<a href="#">AU2 (ex D0AU3)</a>	Tax Depending on Motor Vehicle's Fuel Consumption (NoVA)	Ongoing	Fiscal	1992		High
<a href="#">CY5</a>	Vehicle taxation including CO2 criteria	Ongoing	Fiscal	2007		Medium
<a href="#">DK9</a>	Taxes on registration of a new cars	Ongoing	Fiscal	1971		Medium
<a href="#">FIN22</a>	Car Tax Revision	Ongoing	Fiscal	2008		High
<a href="#">FRA19</a>	Bonus malus for new cars	Ongoing	Fiscal	2007		Low
<a href="#">FRA21</a>	FRA21 Registration surcharge for cars	Ongoing	Fiscal	2006		Unknown
<a href="#">HUN7</a>	HU23 Registration tax on new cars	Ongoing	Fiscal	2003		Unknown
<a href="#">IRL16</a>	Rebalancing of Vehicle Registration Tax (VRT) on the basis of CO2 Emissions	Ongoing	Fiscal	2008		High
<a href="#">LV17</a>	Applying of differential tax rates for passenger cars depending on age and engine size	Ongoing	Fiscal	2004		Low
<a href="#">NLD27</a>	Energy efficiency dependent Taxes: Private Motor Vehicle & Motorcycle Tax (Dutch: BPM) and Motor Vehicle Taxes (MRB)	Ongoing	Fiscal	2006		Medium
<a href="#">NOR1 (ex D0NOR4)</a>	Purchase tax on vehicles (Engangsavgift på motorvogn)	Ongoing	Fiscal	1959		Medium
<a href="#">PL11</a>	Vehicle taxation	Ongoing	Fiscal	2009		High
<a href="#">POR9</a>	Taxation on the purchase of passengers vehicles	Ongoing	Fiscal	2006		High
<a href="#">UK9 (ex D0UK3)</a>	Company Car Taxation	Ongoing	Fiscal	2002		Medium

## Example of measure description in MURE data base

<p><i>Title of the measure:</i></p>	<p>FRA19 Bonus malus for new cars</p>
<p><i>General description</i></p>	
<p>The Environment Round Table highlighted the advantages of an ecological tax on the most polluting new vehicles, the revenue of which would finance the withdrawal of the oldest vehicles, which are, on average, more polluting. It involves rewarding the purchase of an environmentally responsible car and funding this incentive by penalising those who buy vehicles with the highest CO2 emissions. This incentive system would not mean any additional general taxation of households or companies.</p>	
<p>This device is the first concrete application of the "price signal" proposed by the Environment Round Table. It comprises three sections:</p>	
<ul style="list-style-type: none"> <li>- The first involves allocating a "bonus" for any purchase of a new low CO2 emitting car, i.e. one which would have emissions below 130 g/km of CO2 for 2008 and 2009, or 31% of annual sales in 2006. For subsequent years, the bonus would apply to vehicles with CO2 emissions lower than 125 g/km for 2010 and 2011 and lower than 120 g for 2012. The conditions are defined by Decree No 2007-1873, of 26 December 2007 (<i>Official Journal, 30/12/07</i>), establishing aid for purchase of clean vehicles.</li> <li>- The second part, also laid down by Decree No 2007-1873, involves adding to this bonus a "superbonus" (or "scrapping bonus") if the acquisition of the clean vehicle is accompanied by the scrapping of an old vehicle over 15 years old.</li> <li>- Finally, the third part, established by Article 63 of the amending Finance Law, Law No 2007-1824, of 25 December 2007, (<i>Official Journal, 28/12/2007</i>), provides for a malus on the purchase of the new cars with the highest CO2 emissions. According to the scale defined by the 2007 amending Finance Law, the vehicles subject to this tax are those of which the CO2 emissions exceed 160 g/km for 2008 and 2009, 155 g for 2010 and 2011 and 150 g in 2012.</li> </ul>	
<p><i>Results expected</i></p> <p>The measure must influence the purchaser behaviour towards new cars consuming less fuel and emitting less CO<sub>2</sub>.</p>	
 	
<p><i>Last update: July 2009</i></p>	
<p style="text-align: center;"><b>Measure Impact Level</b></p> <p><input checked="" type="checkbox"/> low                      <input type="checkbox"/> medium                      <input type="checkbox"/> high</p>	
<p><i>Interaction of measures</i></p> <p>FRA16 Car labelling in CO2 emissions          FRA13 Grants for LPG and CNG vehicles          FRA 14 Grants for electric vehicles</p>	
<p><i>Historical data</i></p> <p>It's the first time that such a financial bonus or "extra charge" is instituted for buying a new car.          But some years ago (till .....), an annual tax for circulation was existing. The financial amount was calculated about the power of the car. Even if the amount was not calculated about the consumption or CO<sub>2</sub> emissions, it was not so different.          French government decided to stop this system for private vehicles in 2001.</p>	