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Results of the review of the Community Strategy to reduce CO_2 emissions from passenger cars and light-commercial vehicles

Impact Assessment

{COM(2007) 19 final}
{SEC(2007) 61}

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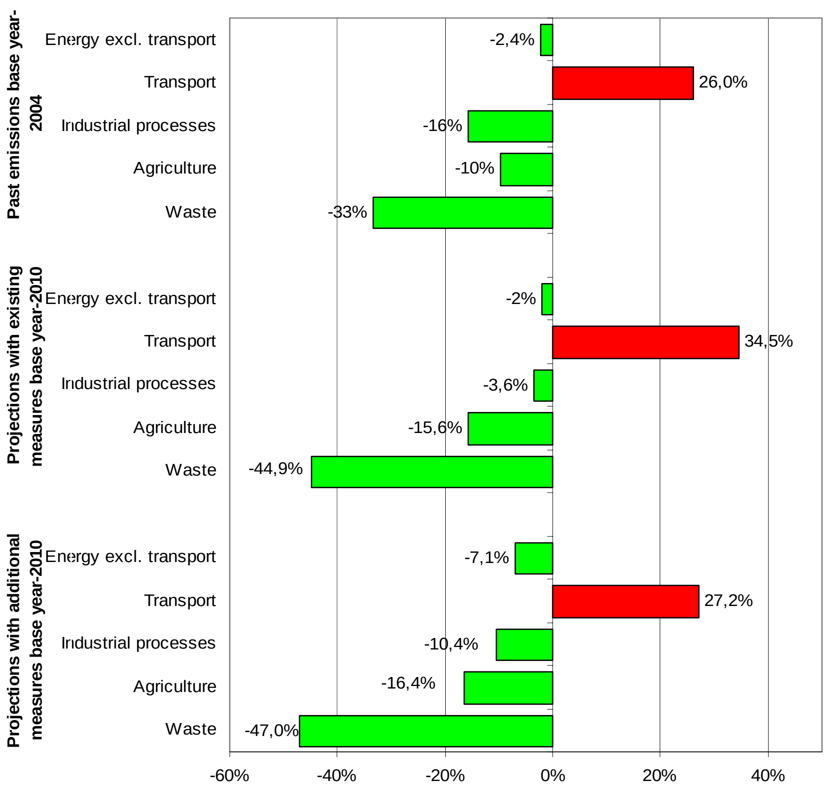
1. PROBLEM DEFINITION

1.1. Nature of the issue or problem that requires action

The European Parliament and European Council in spring 2005 reaffirmed the EU objective that global surface temperatures should not rise by more than 2°C compared with pre-industrial levels in order to prevent dangerous and irreversible anthropogenic climate change. The European Council also stated that reduction pathways of emissions of greenhouse gases for the group of developed countries in the order of 15-30 % compared to the baseline envisaged in the Kyoto Protocol should be envisaged.

However, while the EU as a whole has reduced emissions of greenhouse gases by just under 5% over the 1990-2004 period, CO_2 emissions from road transport have increased by 26%. Road transport is the biggest transport emission source (94% of domestic emissions) with approximately 1/3 from freight, 2/3 from passengers. Furthermore, road transport relies quasi exclusively on fossil fuels, consuming 60 % of all the oil consumed in the EU.

Figure 1 - Change in EU-15 GHG emissions by sector base year to 2004, sector projections "with existing" and "with additional measures" base year to 2010 (source EEA)



In addition, the transport sector is one of the only sectors whose emissions keep increasing (see **Figure 1**), making it harder for the EU to meet its Kyoto commitments by jeopardising the progress made by other sectors. This situation has competitiveness repercussions, since some of those sectors (e.g. energy intensive industries) are subject to international competition while transport, and even more so road transport, is by nature a domestic activity. If domestic transport greenhouse gas emissions continue to increase with economic growth they would increase for the EU-15 by almost 31% by 2010 (compared to 1990) and up to 50% by 2020.

1.2. Underlying drivers of the problem

A wide range of factors influence the observed and predicted growth in CO_2 emissions from passenger road transport, such as supply and demand for cars, individual mobility needs, the availability of alternative public transports services and the costs of car ownership.

1.2.1. Increase in demand for transport

While vehicle efficiency has been increasing, this has been offset by increased journey lengths and other trends leading to higher greenhouse gas intensity. The overall share of cars in passenger traffic has remained fairly constant (74.4 % in 2003). However, transport demand has grown significantly and the number of passenger-kilometres driven increased by 16.4 % over the 1995-2003 period. The level of car ownership also increased substantially as shown below:

Table 1 - Evolution in car ownership and vehicle stock in the EU25 and EU15 between 1990 and 2003 (source EU energy and transport in figures, 2005)

	EU 25			EU 15		
	1990	2003	Change	1990	2003	Change
Number of cars per 1000 inhabitants	355	465	+ 31%	394	495	+ 26%
Vehicle stock (Million)	156	212	+ 36%	144	179	+ 24%

This increase in demand for transport took place despite significant fuel price increases: over the 1995-2005 period in the EU 15, automotive petrol and diesel increased respectively by 74% and 54% (all taxes included).

1.2.2. Evolution of car markets

As regards the evolution of the physical characteristics of passenger cars, **Figure 2** shows that **important increases in mass (+15%) and even more so in power (+28%)** have taken place in parallel to reductions in specific CO_2 emissions.

This trend towards bigger and more powerful cars, also shown by the increasing market share of off-road vehicles (see **Figure 3**), is explained by the evolution of manufacturers' offer and consumer demand, and by the measures adopted to influence these two parameters. Recent surveys[1] of car advertising in the United-Kingdom and in Germany

[1] See 2005 review of car adverts in United-Kingdom national newspapers by Friends of the Earth at http://www.foe.co.uk/resource/press_releases/government_and_industry_mu_09112005.html and

have revealed that cars advertised emitted on average much higher levels of CO_2 than the cars actually bought by consumers. Furthermore, purchasers of passenger cars now enjoy a number of comfort features that have become a quasi standard feature. Mobile air conditioning in particular has a significant impact on the fuel consumption, which is not reflected under the test-cycle of the EU type approval system.

Figure 2 - Physical evolution of ACEA's car fleet compared to base-year 1995 (source SEC(2006)1078)

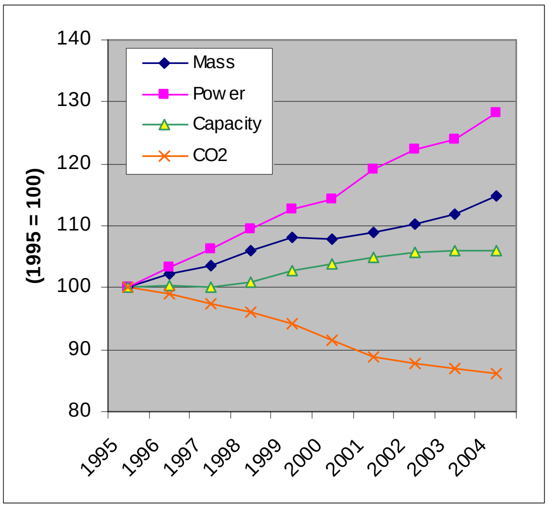
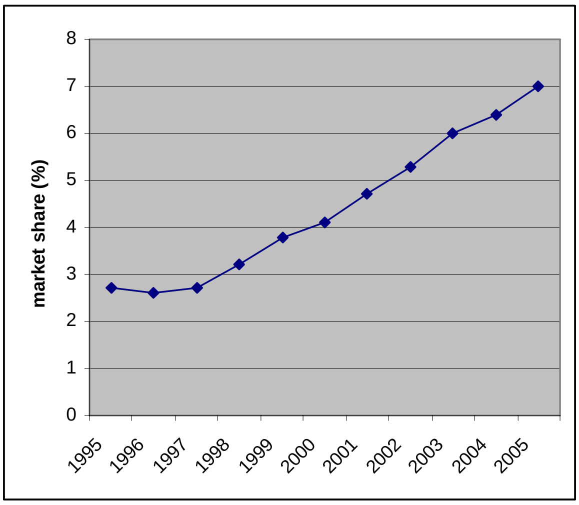


Figure 3 - Evolution of the market share of off-road (4x4) vehicles in EU 15 new passenger car registrations (source ACEA)



At the same time, consumer price for cars have increased significantly less than headline inflation over the last years, de facto making better equipped and more powerful cars cheaper than in the past. It seems that in the majority of the new Member States, vehicle manufacturers have adjusted prices for cars downwards, especially for smaller cars, which suggest not only that car prices across the EU have not tended to converge towards levels in high price countries, but also that carmakers have tried to reduce prices in the new Members States, especially for small-medium cars, so as to attract consumers with lower budget[2].

1.3. Stakeholders affected

A wide range of stakeholders are affected by the problem:

- The population of the European Union is increasingly affected by climate change through the increased climate variability and more frequent extreme weather events, and their related impacts. Higher maximum temperatures, more hot days and heat waves lead to increased incidence of death and serious illness in older or more sensitive groups of the population; more intense precipitation events lead to increased floods, landslide, avalanche, mudslides, soil erosion and related increased pressure on Government and flood insurance systems and disaster relief; increased summer drying

study by Bund für Umwelt und Naturschutz Deutschland (BUND) "*Die Werbung deutscher Automobilhersteller Werbebotschaften · Spritverbrauch CO_2-Emissionen*", March 2006.

2 See European Commission DG MARKT 2006 report on "*Car price differentials within the European Union*", http://ec.europa.eu/comm/competition/car_sector/price_diffs/

over mid altitude continental zones and associated risk of drought lead to decreased crop yields, water resource quantity and quality as well as increased risk of forest fire and damage to building foundations caused by ground shrinkage.

- The consumers of motor vehicles are affected by possible increases in the price of new vehicles and reductions in their running costs, due to stricter requirements on CO_2 emissions and related improvements in fuel consumption. Conversely, poor fuel efficiency contributes to an enhanced dependency on foreign oil imports and to a related exposure to possible price surges due to supply shortages. Consumers of motor vehicles are also affected by possible changes in the level of performance (power, comfort) of new vehicles.

- The EU being the first car market in the world, stricter fuel efficiency requirements in Europe will affect vehicle manufacturers all over the world by requiring improvements to new vehicles through the development and introduction of better technologies. Similarly, stricter rolling resistance requirements affect all tyre manufacturers present on the EU market. Component suppliers will also be affected by increasing demand for advanced technologies. The extent to which industrial players will be affected in their production costs will depend on their efforts to develop new technologies, promote fuel efficient cars, and also on the measures put in place by competent authorities, and notably Member States, to influence consumer demand towards sustainable cars.

1.4. Consequences of no change in policy

As proposed by the Commission in 1995[3] and subsequently supported by the European Parliament and Council, the current Community strategy is based on three pillars, namely the voluntary commitments of the car industry on fuel economy improvements, the fuel-economy labelling of cars and the promotion of fuel efficient cars through fiscal measures[4]. Compared to an EU 15 average of 186 g CO_2/km in 1995, average new car emissions were the following in 2004:

Table 2 - Average sales weighted new car fleet CO_2 emissions in 2004

	EU 25	EU 15	EU 10[5]
2004	162 g CO_2/km	163 g CO_2/km	156 g CO_2/km

A number of issues can be highlighted based on the experience gained in the implementation of the current strategy[6].

- Emissions from the average new car sold reached 163 g CO_2/km in 2004, 12.4% below the 1995 starting point of 186 g CO_2/km[7]. Over the same period, **new cars sold**

3 COM(95) 689 and Council conclusions of 25.6.1996.

4 The Commission has submitted to the European Parliament and Council annual reports on the effectiveness of the strategy – see: http://ec.europa.eu/environment/co2/co2_monitoring.htm

5 Slovakia and Malta did not deliver data in 2004.

6 Preliminary data for 2005 point to limited further progress.

7 EU-15.

in the EU have become significantly bigger and more powerful, while prices increased less than inflation.

- While the combined effect of supply and demand measures was meant to deliver 120 g CO_2/km, only the supply measure (voluntary commitments) was attributed a quantified objective (140 g CO_2/km). Since both types of measures were to be implemented simultaneously, it is **not possible to quantify separately their respective contributions** to reaching the overall objective.

- Investigations on the impact of the limited measures adopted so far by Member States on the demand side have shown that **improvements in vehicle technology delivered the bulk of the reductions.**

- The progress achieved so far goes some way towards the 140 g CO_2/km target by 2008/9, but **in the absence of additional measures, the EU objective of 120 g CO_2/km will not be met at a 2012 horizon.**

1.5. Subsidiarity principle

The subsidiarity principle is respected, since the policy objectives cannot be sufficiently achieved by actions of the Member States, and can be better achieved at Community level. European Union action is necessary because of the need to avoid the emergence of barriers to the single market notably in the field of the automotive industry, and because of the transnational nature of climate change. Member States can facilitate the implementation of the strategy via action at the national level, notably to raise awareness about climate change and drive consumer demand towards more fuel efficient vehicles.

2. OBJECTIVES

2.1. Policy objectives

The proposal pursues the following general policy objectives:

- Providing for a high level of environmental protection in the European Union,

- Improving the EU energy security of supply.

The specific objectives cover:

- Reducing the climate change impacts and improving the fuel efficiency of light-duty road vehicles (passenger cars and light commercial vehicles), by reaching the Community objective of an average emission value of 120 g CO_2/km for newly sold cars by 2012.

The operational objectives include:

- On the supply side, defining a 2012/2015 framework for fuel efficiency in light duty vehicles and their components (tyres, mobile air conditioning etc) that address CO_2 emissions and fuel consumption under both test-cycle and real-world conditions,

- On the demand side, identify the measures that should be taken at the EU and national level as well as by industrial stakeholders to drive demand towards more fuel efficient cars.

2.2. Consistency with horizontal objectives of the European Union

2.2.1. Lisbon strategy

The policy objectives of the revised strategy are in line with the three pillars of the European Union’s Lisbon strategy, namely "making Europe a more attractive place to invest and work", "knowledge and innovation for growth" and "creating more and better jobs".

Tighter requirements on CO_2 emissions and fuel efficiency for passenger cars and light-commercial vehicles will encourage the development and application of new environmental technologies. The policy objectives therefore promote innovation and technological development, enabling the EU car industry to achieve global leadership in the field of clean and lean technologies. Europe already has world leading diesel engine technology, and will be able to further develop this technology while making advances in petrol technology fuel efficiency and hybrid powertrains.

Leadership in fuel efficiency should in the short term pave the way to exports of technologies and vehicles to emerging markets where oil is scarce and that have set ambitious fuel efficiency targets. In the longer term, it is expected to provide a long-standing competitive edge and the advanced technologies required to move towards a truly low-carbon road transport system.

By promoting further advances in technologies, the strategy will promote highly qualified jobs in Europe. Although the industry has pointed to the risk of the production capacity being relocated outside the EU to reduce labour costs while meeting fuel efficiency standards, it should be noted that non-EU manufacturers (from Japan, Korea and the United-States) will be subject to the same standards as regards their exports to Europe, and that stringent fuel efficiency policies are already implemented in their domestic market and, in some cases, currently subject to a revision.

2.2.2. Sustainable Development strategy

The overall objective of the Renewed Sustainable Development Strategy (RSDS) of the European Union[8], as regards sustainable transport is "*to ensure that our transport systems meet society’s economic, social and environmental needs whilst minimising their undesirable impacts on the economy, society and the environment*". The related operational objective and targets is to ensure that "*in line with the EU strategy on CO_2 emissions from light duty vehicles, the average new car fleet should achieve CO_2 emissions of 140g/km (2008/09) and 120g/km (2012)*".

The policy objectives of the revised CO_2 and cars strategy are in line with the RSDS by contributing to a more sustainable mobility. Leaner vehicles will bring economic, social and environmental benefits by reducing the energy consumption induced by their use.

8 European Council, June 2006.

The implementation of the RSDS also means that challenges must be addressed in parallel in the face of sometimes conflicting objectives. Such situations include for example air quality and climate change (e.g. reducing nitrogen oxides vs. reducing CO_2) or environment and safety (e.g. impacts on average car weight), and all aspects must be addressed in a compatible way.

3. POLICY OPTIONS

3.1. Options Identified

Three policy options have been considered as possible means to meet the policy objectives identified in section 2:

(1) **'No policy change' approach**: the current Community strategy to reduce CO_2 emissions from cars and improve fuel efficiency remains unchanged, meaning that the Community objective of 120 g CO_2/km is to be achieved through the combined implementation of the existing three pillars of the strategy, namely voluntary agreements by car manufacturers' associations to reach 140 g CO_2/km by 2008/9, consumer information via labelling and fiscal measures to promote fuel efficiency.

(2) **"Vehicle technology only" approach**: the Community objective of an average new car fleet CO_2 emission of 120 g CO_2/km by 2012 is achieved solely by improvements in passenger cars (M1).

(3) **"Integrated" approach**: the Community objective of an average new car fleet CO_2 emission of 120 g CO_2/km is achieved through an integrated approach involving car manufacturers but also other stakeholders such as tyre manufacturers, competent authorities in Member States etc. The measures under consideration encompass supply and demand measures:

- Technical measures addressing new vehicles (supply)
  - Technical options to reduce fuel consumption in passenger cars (M1)
  - Application of fuel efficient air conditioning systems
  - Tyre pressure monitoring systems
  - Technical options to reduce fuel consumption in light-commercial vehicles (N1)
- Technical measures addressing the existing vehicle fleet (supply)
  - Options to reduce vehicle and engine resistance factors (tyres and lubricants)
  - Increased application of biofuels
- Demand/behaviour oriented measures

- CO_2 based taxation schemes for passenger cars
- Options for improved consumer information (including CO_2 labelling)
- Public procurement proposals
- Fuel efficient driving, including gear shift indicators

3.2. Options discarded at an early stage

The following options have been discarded at an early stage:

3.2.1. EU Emissions trading scheme

Consideration has been given to the inclusion of road transport into the EU emissions trading scheme (ETS) established by Directive 2003/87/EC. The review of the CO_2 and cars strategy is aimed at reaching the EU objective of 120 g CO_2/km by 2012. In the recent Communication on the review of the ETS[9], the Commission has taken "*the firm view that for reasons of regulatory stability and predictability, any changes to the Directive other than the previously decided inclusion of aviation in the ETS should take effect at the start of the third trading period in 2013*". It was thus considered that inclusion of road transport into the EU ETS was not a viable option in the perspective of an achievement of the 120 g objective by 2012. For the third period of allocation, a number of aspects should be considered in relation to the inclusion of road transport into the ETS, taking into account the specificities of the scheme:

- The fundamental approach of the EU ETS is to place the compliance obligation with the entity responsible for the emissions released into the atmosphere i.e. the "direct emissions" approach. This is frequently the principle upheld by trading schemes, since the legal entity emitting greenhouse gases is best able to monitor and reduce those emissions. However, a direct emissions approach for road transport would imply that **each individual owner of a light or heavy duty vehicle** would have a compliance obligation and would therefore have to surrender allowances based on the actual yearly fuel they have consumed. This would lead to prohibitively high administrative running costs (regarding transacting in the market and monitoring and verifying emissions), at odds with the principles of simplification and better regulation, not to mention the practical impossibility of defining an allocation method and emission cap for individual vehicle owners. It should be noted that in the case of aviation, the "direct emissions" approach is feasible and is being respected[10]. Departing from this approach, two options could be considered for an "indirect emissions":

    - **Fuel suppliers could become the accountable entity**, based on yearly fuel sales and carbon content: this would limit the number of players covered by the scheme but as a result would place the compliance obligation on a legal entity that would only be able to control its financial liability under the scheme through the way it priced its fuels. In consequence, the incentive for

9 COM(2006) 676 of 13.11.2006.

10 Other relevant aspect concerning the inclusion of aviation into the ETS is that kerosene is not taxed.

vehicle drivers to change their behaviour would be no different to that from the existing fuel excise duty regime. In addition, such a proposal would open a debate regarding the level of fuel excise duties and the linked impact on Member States' budgets. Therefore, attention should be paid to the outcome of this option in relation to what is already achieved with fuel excise duties.

- **Car manufacturers could become the accountable entity**: for any given car sold in any given year, the gap between the car's average specific emission and the reduction objective would need to be converted into projected overall lifetime emissions, and the corresponding amount of allowances would need to be surrendered by the carmaker concerned. This approach would necessitate detailed investigations to maintain the existing accurate emissions monitoring and reporting system (contrary to the "fuel supplier" option which could be based on more accurate yearly fuel sales), as car manufacturers have no control on the actual use of the cars they sell, nor access to information about actual emissions.

- Finally the **objectives of the review** are to provide a high level of environmental protection by **reducing the climate change impacts of road transport**, and to improve the EU's security of energy supply, **by improving fuel efficiency**. Attention should be paid to these two aspects for the inclusion of road transport into the ETS.

3.2.2. Other options

- Concerns about its effectiveness and political acceptability have led to excluding the option of relying exclusively on **excise duties on transport fuels** as a policy option. The equity considerations raised by the tax rates that would be needed to have a significant impact on vehicle fuel efficiency limit the political acceptability of this option, especially in a context where oil prices have significantly increased in the past years.

- **Mobility/traffic and infrastructure management** present an interesting potential for CO_2 reductions, with measures such as synchronisation of traffic lights, enforcement of speed limits and measures to curb congestion by means of traffic flow management. These measures have a strong subsidiarity dimension, and are currently being investigated in the context of solving local air quality problems and as part of the European Common transport policy. A new generation of emission factor models to assess the impacts of changing traffic dynamics on emissions is only now being developed, and are thus not yet available to deliver a quantitative analysis of the potential contribution of these measures to CO_2 reductions. Furthermore, a number of transport policy initiatives have already been screened as part of the recent review of the Transport White Paper[11] (e.g. development of an EU methodology for infrastructure charging by 2008), and will not be included in the present review of the CO_2 and cars strategy.

[11] COM(2006) 314.

3.3. Detailed presentation of the reduction measures included in the options identified

3.3.1. Technical options to reduce fuel consumption from passenger cars

Based on a review of literature data and input from stakeholders, a review has been carried out of the costs and CO_2-reduction potential of a wide range of technical options that can be applied to passenger cars.

Based on this [Task A][12] review, an assessment has been made of the costs for reaching various possible targets for the average new car fleet CO_2-emissions in 2012, ranging from maintaining the 140 g CO_2/km foreseen in the voluntary agreements to reaching the Community objective of 120 g CO_2/km by 2012.

While the review carried out provides for overall cost estimates, at the scale of the whole fleet, for the achievement of given CO_2 reduction targets (including sensitivity analyses performed with respect to the influence of demand measures and cost curve establishment – see Boxes 1 and 2), it does not provide information on the impacts of the said target at the vehicle or segment level. Indeed the present exercise focuses on assessing the costs of the various measures examined under options (2) and (3), with a view to setting the reduction levels required from these measures. Detailed analyses will be performed subsequently as part of the respective impact assessments underlying the actions required to meet the said reduction levels as part of an integrated approach.

Box 1 - Sensitivity analysis with respect to the influence of measures influencing demand (assumptions on relative up/down-sizing)

The combined evolution of manufacturers' offer and of consumer demand of safer, more powerful, bigger and more comfortable cars has resulted in a substantial increase of the average new car weight. Additional vehicle weight results in additional fuel consumption and associated CO_2-emissions which need to be compensated by additional CO_2-reducing measures to meet the CO_2-emission targets for 2008/9 and 2012. Two alternative scenarios have been considered as regards the future evolution of the weight of cars sold in the EU:

- On the basis of historic trends, it could be assumed that the average weight of passenger cars will carry on increasing on average by 1.5% p.a. between 2002 and 2012. The 1.5% p.a. value results from the data used to monitor the achievements of the car industry in relation to their voluntary commitment for reaching the target of 140 g CO_2/km by 2008/9. It is applied uniformly to all vehicle segments, in the absence of data showing a clear shift towards larger car segments. The 1.5% p.a. value is assumed to include effects of measures to improve safety and reduce exhaust emissions in response to voluntary approaches such as the EuroNCAP rating, consumer demand for additional safety features or European legislation, as well as market trends towards bigger, more powerful and better equipped cars including

12 Review and analysis of the reduction potential and costs of technological and other measures to reduce CO_2 emissions from passenger cars, prepared by TNO Science and Industry , Institute for European Environmental Policy and the Laboratory of Applied Thermodynamics.(N.B.: All [references] are listed in "Annex II – Reference documents").

increased market penetration of auxiliaries such as power steering, electric windows, air-conditioning etc.

- Alternatively, it may be argued that the historic trend will not continue at the same pace in the future thanks on the one hand to policy measures (taxation in particular) that influence consumer demand, and on the other hand because the most important safety measures (restraint systems, airbags) are one-offs that have by now been introduced on most new cars, new exhaust emission regulations will be largely met with system optimisations rather than new, additional systems and new auxiliaries will be largely in the realm of electronic equipment with limited weight implications which furthermore tend to become lighter over time. It would then be assumed that the historic value is valid until 2004 and that this value gradually decreases to 0.5% in 2012 in response to a natural slowing down and to measures aimed at driving demand towards fuel efficiency (e.g. taxation).

Using the lower relative upsizing scenario, the costs for reaching the 2012 target of 120 g CO_2/km are found to be 19% lower than for the calculations based on the 1.5% p.a. value.

Box 2 - Cost curve methodologies

In the supporting study [Task A], cost curves are created based upon the clouds of data points that result from assessing the overall costs and CO_2-reduction of a large number of feasible packages of technical measures. In the questionnaire and meetings as part of the stakeholder consultation process, stakeholders have been requested to submit information on their assessments of overall costs and CO_2-reduction potential of feasible packages but such data have not been provided – the data provided only referred to individual technical measures. While more detailed assessments will be carried out as a follow up to the measures to be included in the present strategy review, preliminary cost curves have been drawn up by [Task A] and follow the curvature of the outer envelope of the “cloud” of data points at a certain distance that serves as a "safety margin". Two options are envisaged:

- In the first option, the cost curves is positioned in such a way that roughly 2/3 of the data points is on the left side of the curve and 1/3 on the right side. This is based on the conservative assumption that the overall CO_2 reduction factor achieved by a given package of technical options would be lower than the product of the individual potential CO_2 reduction factors, while the cost of the said package would strictly be the sum of the costs of the various options in the package.

- As a second option, it could be argued that the safety margin should be smaller. One can argue that the overall cost of a package of technological options is lower than the sum of the costs of the individual options due to synergies in the integration of systems. Indeed, most of the options considered are not simple “add-on” options but advanced technical developments that need to be highly integrated in the design of a new engine, powertrain or vehicle platform. Furthermore there is also a case for taking a smaller "safety margin" to account for technologies not yet available, but that will likely appear between 2006 and 2012 thanks to innovation by the industry. Finally cost estimates provided in task A are established for large scale production at a 2012 horizon, but do not account for learning curves and economies of scale beyond that date as technologies penetrate the market on a wider scale. One can also argue that a safety margin could work both ways. On the one hand, the blind combination of individual technical measures may give rise to technology packages that are less efficient than a straightforward combination, as argued in the previous bullet point. On the other hand, the same methodology of blind combination cannot take into account potential synergies and system optimisations that would only be visible in a detailed study of each technology package. Furthermore, studies[13] have shown that ex-ante estimates of compliance costs in the automotive sector are often overstated, and that ex-post costs can be much lower (e.g. by a factor of 2). Overall, these alternative assumptions would result in lower cost estimates by shifting the cost curves towards the right.

3.3.2. Application of fuel efficient mobile air conditioning systems

The vehicle's additional energy consumption and CO_2 emissions resulting from the use of mobile air conditioning (MAC) systems are currently not included in the type approval test results. As more and more vehicles are standard equipped with air conditioning systems, their impact on the real-world energy use of road traffic is increasing. According to [TNO MAC], the use of air conditioning leads on an average European car to an increase in CO_2 emissions of 7 g CO_2/km.

Furthermore, the release in the environment of refrigerants used in MACs has an important impact on climate change, and the EU has recently adopted a Directive[14] aimed at prohibiting air conditioning systems designed to contain fluorinated greenhouse gases with a global warming potential higher than 150.

Taking into account the implications of this legislation for manufacturers, an assessment of the costs and CO_2 reduction potential of measures to promote the use of fuel efficient MACs has been carried out notably based on assumptions concerning the accelerated market penetration of advanced systems that meet the above mentioned Directive and at the same time deliver energy savings.

3.3.3. Options to reduce vehicle and engine resistance factors

The costs and potential for CO_2 reductions of low rolling resistance tyres (LRRT), tyre pressure monitoring systems (TPMS) and low viscosity lubricants (LVL) have been analysed based on data retrieved from literature and provided by the industry.

- LRRT and TPMS have an important CO_2 reduction potential estimated at 3% and 2.5% respectively. However at present there is no standardised method to measure tyres' rolling resistance and on which legislation or incentives could be based. The use of LRRT is reflected under the test-cycle measurements, and there is a need to ensure that the tyres actually fitted on the cars sold present the same rolling resistance performance as the ones used during type approval. On the one hand, the effect of TPMS relates to real-world driving condition and action by drivers, which raises

[13] http://ec.europa.eu/environment/enveco/studies2.htm#ex_post

[14] Directive 2006/40/EC of the European Parliament and of the Council of 17 May 2006 relating to emissions from air conditioning systems in motor vehicles and amending Council Directive 70/156/EEC (OJ L 161, 14.6.2006).

monitorability concerns; on the other hand, TPMS can contribute to an increased safety.

- The CO_2 reduction potential of LVV is estimated to be 2.5%. Issues identified in relation to LVV are the same as for LRRT regarding the possible discrepancies between test-cycle vehicles and vehicles actually sold, the need for a standardised measurement method and issues linked to vehicle warrantee when using LVL.

3.3.4. *Options to promote application of biofuels*

Currently the biofuels most commonly available as transport fuels are "first generation" biodiesel and bioethanol (the latter being often converted to bio-ETBE used as an additive in petrol). The main feedstock are crops grown for oil (such as rape, soy and sunflower) for biodiesel, and crops high in sugar or starch (including sugar beet and cane, various grain crops, etc) for ethanol. In the future, "second generation" processes should deliver a range of synthetic fuels from a wider range of biomass sources, including bio-wastes, woody crops and grasses, but these are unlikely to represent a significant market share at a 2012 horizon.

The EU has adopted a directive[15] to promote the use of biofuels in the transport sector, setting a 2010 target of 5.75% market share of biofuels in the fuels used by road transport. Based on the recent Commission report[16] on the implementation of the biofuels directive, this target is unlikely to be reached. Furthermore, the Commission has recently proposed[17] the introduction of compulsory requirements aimed at the gradual decarbonisation of road fuels, through an amendment of the fuel quality directive 98/70/EC.

3.3.5. *Technical options to reduce fuel consumption from light-commercial vehicles*

The potential and cost-effectiveness of CO_2-reduction measures concerning light commercial vehicles (N1) has been assessed following the same methodology as the one developed for passenger cars (see 3.3.1), taking into account the specificities of N1 vehicles. For each of the N1 categories Class I, II and III a business-as-usual package (BAU) has been defined of CO_2-reducing options that are assumed to be applied in the period 2002 – 2012 even in the absence of policy aimed at the CO_2-emissions of N1-vehicles, as well as four packages with increasing levels of CO_2-reduction and technical complexity that may be applied by manufacturers in response to policy. For each of these packages the overall costs and CO_2-emission reductions have been assessed.

3.3.6. *Fuel efficient driving*

The assessment of the CO_2-abatement potential of eco-driving is extremely sensitive to the methodology and to variations in the input parameters: while the initial effect of eco-driving is reasonably well documented, there is less data available on the long term effect, which is expected to be significantly smaller. Regarding the costs of promoting

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15 Directive 2003/30/EC of the European Parliament and Council of of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport (OJ L 123, 17.5.2003).

16 COM(2006) 845.

17 COM(2007) 18.

eco-driving, they vary widely depending on the efforts put in place: while an introduction to eco-driving as part of the driving license tuition may be cheap to implement, a large scale campaign to raise awareness amongst all drivers, notably those that would not voluntarily participate in training courses, would require important financial efforts. [Task A] suggests that the long term effect of applying eco-driving is a fuel consumption reduction of 3%, reaching 4.5% when combined with a Gear Shift Indicator (GSI). GSI can be an effective tool to assist drivers in maintaining a correct and effective fuel efficient driving style. In this way the use of GSI in combination with eco-driving is expected to increase the long-term effectiveness of eco-driving. The effect of GSI in the absence of a specific eco-driving training is a fuel consumption reduction of circa 1.5%.

Compared to other policy measures, the monitorability and accountability of a downstream measure such as eco-driving do not provide the same level of reliability in the range of CO_2 reductions to be delivered. This is why the modelling of eco-driving applications will be limited to the use of a Gear shift indicator.

3.3.7. CO_2 based taxation schemes for passenger cars

Car taxation is a powerful instrument to influence the purchase decisions of consumers. Taxes can be differentiated to support the market introduction of fuel efficient and low CO_2 emitting cars. This could greatly facilitate the efforts of car manufacturers to meet their obligations by bringing such vehicles to the market. Of the various taxation instruments available to the policy maker, the present assessment focused on the use of taxes to encourage the purchase and use of low emission vehicles, i.e. taxes on registration and annual circulation; hence, other instruments, such as fuel taxes and road user charges, were not considered (see 3.2).

The Commission has made a proposal for a Council Directive on passenger car taxation[18] which is currently before the Council and Parliament. By adopting this proposal as soon as possible and adapting their car taxation policies so as to promote the purchase of fuel efficient cars throughout the EU, Member States would contribute their share to reducing the CO_2 emissions of cars (by making (relatively) less emitting/smaller cars more attractive to consumers, and thus easing the technological burden on manufacturers). Such taxes would be differentiated over the whole range of cars on the market, rewarding lower emitters of CO_2 while discouraging the sale of vehicles with relatively higher fuel consumption and CO_2 emissions. Evidence provided by Member States to [Task A] indicate that a realignment of vehicle taxes to reflect CO_2 (and other emissions) is currently being considered in a number of countries. Taxation being a policy instrument rather than a CO_2 reduction measure in its own right, it is not modelled independently in the impact assessment. However alternative cost assumptions are made concerning the compliance costs of given CO_2 reduction targets are made (see section 3.3.1), so as to illustrate the potential benefits of applying measures influencing consumer demand.

In addition to taxation schemes, incentives for the most efficient class of cars could be a powerful way of encouraging these vehicles into the market. A Light-duty Environmentally Enhanced Vehicle (LEEV) should be defined as a vehicle that meets the next stage of pollutant emission limit values as laid down in the relevant legislation,

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[18] COM(2005) 261.

while at the same time staying below a certain level of CO_2 emissions. In the current situation, this level should be the Community target of 120 g CO_2/km. The definition of a LEEV should be subject to regular reviews in order to remain focused on the most advanced end of the new car fleet. Taking into account the future EURO 5 and 6 emission limits for conventional pollutants, the definition of the LEEV could be considered as part of the review of the labelling directive (see 3.3.8), whereby a special LEEV label could be defined.

3.3.8. Options for improved consumer information (including CO_2 labelling)

A recent study on the effectiveness of the car labelling Directive[19] points to a disappointing impact of the label so far, with labels of strongly varying quality in different Member States. The labelling scheme is considered a useful tool to raise awareness about the climate change impacts of passenger cars, but there is no evidence that labelling provided a tangible contribution to reductions in the average CO_2 emissions of new cars sold in the EU. It would in any case be difficult to attribute a given CO_2 reduction to such a tool.

There are potential synergies if the label is used as part of a package of measures, e.g. linking vehicle taxation directly to the label's categories. In addition, the scope of the labelling scheme could be widened to cover not only passenger cars but also light-commercial vehicles. The design of the label could also be harmonised, accompanied by the introduction of energy efficiency classes.

It also appears that manufacturers' marketing strategies are often at odds with, and overshadowing, the message that the label is projecting. In order to ensure a level playing field in car advertising, a code of conduct for sustainable advertising could be considered.

3.3.9. Other measures

Some measures initially identified to be included into option (3) have also been excluded from the posterior impact analysis:

- The review of options for application of **alternative fuels based on fossil primary energy** has been included in the preparatory works for the impact assessment (See [Task A] report) and also discussed in CARS21. Stakeholders in the ECCP working group supported a technology neutral approach, thus rejecting the idea of a specific instrument to promote LPG or CNG cars. In the light of this, LPG or CNG technologies have not been considered separately in option (3) – which does not prevent their use as a technical solution under the instrument to promote technical progress in M1/N1 vehicles, nor Member States from promoting them through fiscal incentives for fuels.

- **Public procurement** provides the opportunity to stimulate the market in alternative cleaner or more fuel efficient vehicle technologies and fuels by creating economies of scale for manufacturers and thereby reducing the costs of production. However, since

[19] "*Report on the effectiveness of the car fuel efficiency labelling directive 1999/94/EC, and options for improvement*", ADAC for the European Commission, March 2005.

the recent Commission proposal COM(2005)634 on the promotion of clean transport vehicles does not address CO_2 emissions, public procurement was not included in the detailed analysis of option (3) considering the 2012 horizon of the review. It does not prevent Member States from promoting the purchase of clean and lean vehicles by public procurement, which may be facilitated if a definition of Light-duty Environmentally Enhanced Vehicles (see 3.3.7) is adopted at the EU level.

4. ANALYSIS OF IMPACTS

4.1. Description of the methodology

The methodology followed for the analysis of the impacts of the various policy scenario is based on the supporting studies undertaken for the Commission in 2004-2006 ([Task A] and [Task B], including [TREMOVE]) complemented by stakeholder input, a literature review and additional studies (see Annex 2: Reference Documents and additional precisions on the modelling framework). Inline with the Community objective of 120 g CO_2/km by 2012, the time horizon foreseen for the entry into force of the measures and targets is 2012. This implies that longer term targets (e.g. a 10% biofuels share by 2020 as foreseen in the Renewable Energy Roadmap[20]) are not part of the measures considered. To reflect in the modelling the overall socio-economic impacts, the modelling time horizon is 2020.

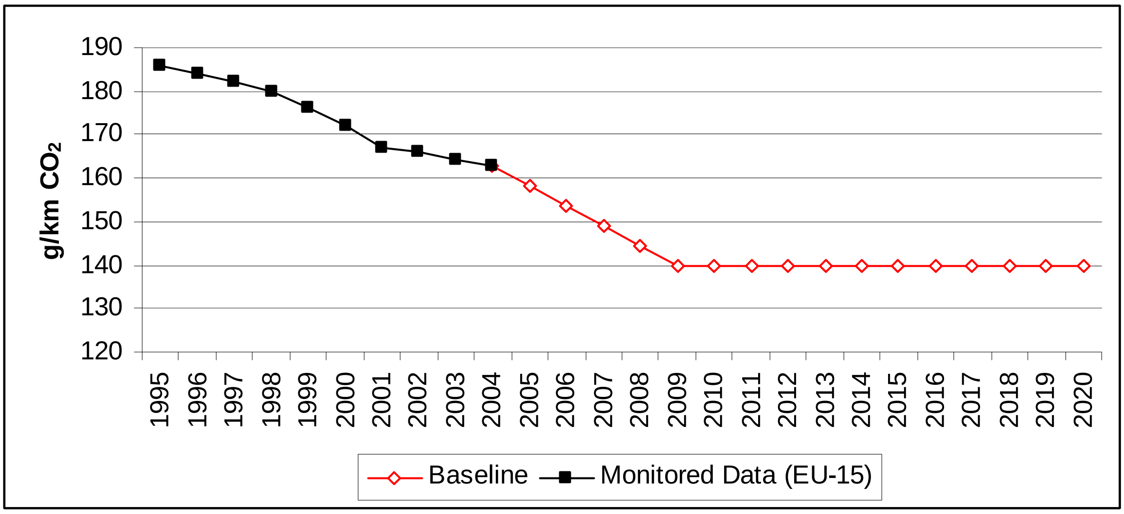
4.1.1. 1st step: baseline

As discussed in Section 1.4 the option of no policy change is not considered a viable way forward to meet the EU objective of 120 g CO_2/km by 2012. However this option provides a baseline to consider against options (2) and (3): the reference scenario (see **Figure 4**) is based on 140 g CO_2/km being achieved by 2008/09, inline with the industry's voluntary commitments, and maintained over the analysis period (2010-2020). This means that in the baseline the 2nd and 3rd pillars (labelling and taxation) of the existing strategy as currently implemented (existing measures) are considered as having no measurable impacts on the average CO_2 emissions of the new cars sold in the EU. This is inline with the findings of the Commission as reported in the annual monitoring Communications on the effectiveness of the strategy[21].

Figure 4: 1995-2004 monitoring of average new car sold CO_2 emissions, and TREMOVE baseline

[20] COM(2006) 848.

[21] See COM(2005) 269 and COM(2006) 463.



In light of growing concerns about the success of the voluntary approach[22], the Commission underlined on several occasions in the past that it was ready to consider all measures, including legislative ones, to ensure that the necessary CO_2 reductions are delivered. However, a "worst-case" scenario where the industry would fail to honour its commitments cannot be used as a baseline for the strategy review, since the objective is to assess the costs and benefits of moving from 140 g CO_2/km down to CO_2 reductions equivalent to reaching 120 g CO_2/km. Consequently, this impact assessment uses 140 g CO_2/km in 2008/09 as the baseline for calculations. It should, however, be noted that the impact assessment for the Commission's future legislative proposal will take into consideration the benefits and costs of different options as compared to the actual situation of average CO_2 emissions.

4.1.2. 2nd step: Building of the cost curve for passenger cars (M1)

This cost curve will be used both to model policy option (2) as well as to implement alternative targets for M1 in policy option (3) and its variants. Four scenarios have been run using the cost curve assumptions from [Task A] looking at 135, 130, 125 and 120 g CO_2/km by 2012. To reflect the potential impact of measures influencing demand on the compliance costs of a given target and the fact that costs may be lower than ex-ante estimates, alternative scenarios have been built for M1 vehicles: use of a different relative upsizing assumption (cost -19% by 2012), and – in addition – alternative cost curve building (-17% by 2012, or -33% once combined with relative upsizing assumption).

The costs considered for a measure are the costs for society, equivalent to the sum of consumer surplus, producer surplus and the marginal cost of public funding. This implies that the tax savings for the consumer (from fuel excise duties of the fuel saved) have to be compensated under a hypothesis of constant fiscal revenues for the public budget. The metric used is the net present value by 2010 of the sum of the cost to society over the period 2010-2020, with a discount rate of 4%.

22 See latest Commission annual monitoring Communication COM(2006) 463.

This process allows building a reference equivalent to g CO_2/km for the renewed strategy. The cumulated Well-to-Wheel (WTW) CO_2 equivalent emissions in the period 2010-2020 are used to reflect the long term effects of the policy measures envisaged[23]. For GHG other than CO_2, an equivalence relation will be used ($CO_2eq = CO_2 + 23 \times CH_4 + 296 \times N_2O$). While the reference equivalent, expressed in Mtons CO_2eq saved, will be used for the purpose of building option (3), the use of g CO_2/km will be maintained wherever possible for reasons of consistency, accuracy and compatibility with the Community objective.

4.1.3. 3rd step: Assessing the costs and reduction potential of other measures

For each measure identified in section 3.3, the scope for GHG abatement and the cost-effectiveness has been assessed using the model TREMOVE based on [Task A] data complemented by stakeholder input and available literature. The detailed assessment for each measure is provided in section 4.2. Ranking the measure by decreasing cost-effectiveness allows building a cost curve segment that can be combined with the M1 cost curve to determine the cost-optimal contribution of each individual measure to option (3).

The objective is to ensure that CO_2 reductions corresponding to reaching the Community objective of 120 g CO_2/km by 2012 are delivered. To that end, for the establishment of the short list of measures to be included in Policy Option 3, focus must be given to those options that are "*clearly measurable, with timetables for delivery, and identify the stakeholder responsible for delivering them. There should be a mechanism for monitoring progress and ensuring accountability*", inline with CARS21's final report recommendation n°7[24]. It is also necessary to avoid any double counting with existing measures.

Building on this and further to the consultation of stakeholders in the European Climate Change Programme working group, criteria complementary to cost-effectiveness have been used to screen potential contributing measures to option (3), such as measurability, monitorability, accountability, as well as political feasibility, affordability of cars, promotion of technical innovation and fairness.

4.2. Detailed analysis of the individual reduction measures

4.2.1. Options to reduce fuel consumption in passenger cars (M1)

The most promising/likely technological options at M1 vehicle level (from a large spectrum at the level of the engine, power train and vehicle) to be applied in the 2002-2012 period have been analysed in the [Task A] report, deriving cost curves that have been translated into input for TREMOVE. The assessment is based on six different cost curves (for small, medium and large petrol resp. diesel vehicles). Depending on the target-measure combination studied in the [Task A] report, the cost and abatement target per vehicle category is different. However, as already indicated in section 3.3.1, it should

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[23] The measures envisaged must however be feasible and deliver reductions in a shorter time horizon (2012), so as to allow for the achievement of the 120 g CO_2/km objective by 2012

[24] Available at http://ec.europa.eu/enterprise/automotive/pagesbackground/competitiveness/cars21finalreport.pdf

be noted that this assessment is aimed at providing an overall assessment for the car fleet as a whole, and that it cannot be used to draw conclusions at the level of individual car types or segments. The TREMOVE baseline includes the assumption that the 140 g CO_2/km target for average new car CO_2 emissions will be reached by ACEA, JAMA and KAMA following the least cost solution per association by 2008/9 as provided by [Task A]. Going beyond 140 g CO_2/km towards 120 g CO_2/km, the central hypothesis to assess the costs is based on the instrument referred to in [Task A] as "*application of a percentage reduction target at manufacturer level*"[25].

As highlighted by [Task A], the cost curve for M1-vehicles is very sensitive to the assumptions made on the relative upsizing, to the method for building the cost curve as well as to uncertainties in the cost assessment. Three alternative cost hypotheses were implemented in TREMOVE. The 1st hypothesis refers to the yearly 1.5% weight increase based on historic data and supported by ACEA. The 2nd cost hypothesis uses (as provided in [Task A] report section 3.11.3) - an alternative percentage of autonomous weight increase, that leads to a cost for reaching 120g by 2012 19% lower than the core hypothesis. The 3rd cost hypothesis refers to the alternative method for building the cost curve (as provided in [Task A] report section 3.11.2) providing a further 17% reduction. This leads to the definition of cost "bands" that can be expressed in total costs or in €/ton. Each additional reduction by 5 g CO_2/km leads to a cumulated Well-to-Wheel (WtW) CO_2 equivalent reduction of circa 100 Mt over the period 2010-2020.

Annex 2 provides more detailed explanations on the differences between the social cost-effectiveness calculated with TREMOVE and the ex-ante calculations provided by [Task A].

Table 3 - Societal costs, CO_2 savings and cost effectiveness of four different reduction scenarios for passenger cars (cumulated over 2010-2020)

Cost Hypothesis (see above)		135 g CO_2/km	130 g CO_2/km	125 g CO_2/km	120 g CO_2/km
1	M€	-5,024.0	-17,071.9	-32,884.3	-53,123.2
	Mt CO2	-99.7	-200.5	-301.5	-403.5
	€/ton CO2	50.38	85.15	109.07	131.66
2	M€	-320.8	-6,113.5	-15,138.2	-27,005.8
	Mt CO2	-98.1	-197.3	-296.5	-397.1
	€/ton CO2	3.27	30.99	51.06	68.01
3	M€	3,191.4	2,073.6	-1,873.3	-7,464.8
	Mt CO2	-96.9	-194.9	-292.7	-392.2
	€/ton CO2	-32.92	-10.64	6.40	19.03

25 This is used as a proxy to derive the possible overall costs of a given CO_2 target, but does not in any way prejudge of the type of instrument that would in fine be proposed to establish a fuel efficiency framework for light duty vehicles.

4.2.2. *Application of fuel efficient mobile air conditioning systems (MACs)*

The assessment of the cost-effectiveness of this measure is based on the additional fuel consumption of cars as a function of MAC systems' energy consumption (reflecting the use of more efficient MACs), as well as the cost differences between fuel efficient and conventional MACs and the market shares of fuel efficient systems. The scenario modelled corresponds to a compulsory introduction by 2012 (with 50% by 2010 and 75% by 2011) of fuel efficient mobile air conditioning systems (both improved R134a and new R744 systems) in new cars.

This would lead to an abatement of 17 Mt of WtW GHG emissions over the period 2010-2020, and a (negative) cost per ton of WtW CO_2 equivalent of -30 €, with the fuel price hypothesis retained for the baseline.

However, the actual implementation of the measure depends on the establishment of an agreed measurement procedure to qualify MACs' fuel efficiency, which is until now unavailable. A simplified test procedure has been developed to this end, but this procedure was found not to yield sufficiently reproducible and accurate results[26] to become part of the EU type approval system. An alternative could be to establish benchmarks for MACs' fuel efficiency, associated with caps and monitored at the EU level.

4.2.3. *Options to reduce vehicle and engine resistance factors*

CO_2 reductions can be achieved by reducing friction via three sub-measures: the use of low-resistance tyres (LRRT), tyre pressure monitoring systems (TPMS), and low-friction lubricants (LVL). These will induce on the one hand extra costs to manufacturers for original equipment and extra annual maintenance costs to consumers, and on the other it will provide fuel savings.

The assessment of the cost-effectiveness of these measures is based on an improved fuel consumption combined with increased cost purchase or annual maintenance costs, but would affect both new and existing cars, in the case of LVL and LRRT.

The scenario modelled corresponds to a compulsory introduction by 2012 (with 50% by 2010 and 75% by 2011) of the device in new cars (both new and existing cars, in the case of LVL and LRRT). The cost-effectiveness of the measure is minored by the fact that the devices would anyway penetrate the market in the absence of any measure (and have already done so to some extent). **Figure 5** provides an illustration of the baseline.

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[26] See docs #4 and #6 referenced in Annex 2.

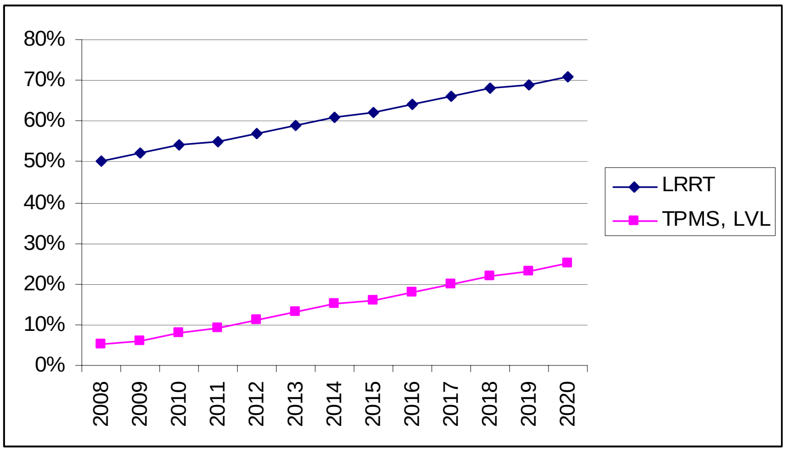

Figure 5 - Business-as-usual introduction of options to reduce vehicle and engine resistance factors as market share of new cars sold (source [Task A])

The assessment of the measure with TREMOVE gives the following results[27]:

- For tyre pressure monitoring systems greenhouse gas abatement costs are -64€/ton (negative), for a reduction potential of 42 Mt.
- The CO_2-abatement costs of low rolling resistance tyres are about 84 €/ton CO_2 equivalent. The abatement potential over the period 2010-2020 is 44 Mt.
- LVL GHG-abatement costs are higher at 130 €/ton CO_2 equivalent, with an abatement potential of 68 Mt.

Lower market penetration of the aforementioned technologies could result from alternative measures such as the application of labelling schemes, creation of consumer support tools such as product databases and purchase incentive programs. All of these should be combined with a necessary update of the relevant legislative framework.

Important issues identified regarding these technologies are the absence of the necessary standardisation and legislative framework that will support their introduction in the market and possible inconsistencies in relation to the EU vehicle test cycle: TPMS are not accounted for under the test cycle, and LRRT and LVL might be used during the test while different tyres/lubricants might be used in the cars actually sold.

There is furthermore a monitorability concern for TPMS, as it is difficult to assess to what extent drivers will actually follow the recommendations provided by the TPMS. This can be corrected by ensuring that the TPMS is fitted in such a way that it cannot be bypassed, and that the message given to the driver provides a strong enough incentive to act. Besides, the fact that TPMS may have a positive effect on safety is another incentive to promote such devices. Compared to gear shift indicators, it appears safe to assume that TPMS would be more likely to lead to a response by the driver as they would be activated less often and they relate to the fitness of the vehicle for driving.

[27] See Annex 2 for additional considerations on the calculation of the cost-effectiveness of LRRT and LVL.

4.2.4. Increased application of biofuels

The measure corresponding to a greater biofuels penetration is modelled evaluating the impact of an additional 1% of blended fuels and pathways, over the period 2005-2020 (the 1% is an illustrative figure which can then be up or down scaled for a given scenario, the assumption being that the costs will not vary very much as a function of the volume of biofuels sold). The cost-effectiveness is calculated based on hypothesis on the cost premium for biofuels and their WtW impacts, taking into account not only CO_2 but also CH_4 and N_2O.

The pathway included in the baseline is based on the [JRC2006] WtW study, and represents the likely developments of an EU-based biofuel policy (see **Table 4**). Imports of Brazilian ethanol, that presents higher WtW benefits, have not been taken into consideration.

CARS21 identified second generation (ligno-cellulosic) biofuels as a promising way to deliver CO_2 reductions in the road transport sector. In the short term the results of [Task A], based on the [JRC2006] WtW study, show that second generation biofuels are unlikely to represent more than a very small share of the biofuels market in the 2010-12 horizon. There are also some uncertainties as regards the time needed to overcome the technical challenges to move from demonstration projects to large scale production, and therefore the time needed to implement measures able to guarantee that second generation biofuels will be available in the time horizon (2012) of the strategy review.

Table 4 - WtW emission factors and pathways for TREMOVE biofuels baseline (source [JRC2006])

Fuel	**TtW CO_2 Emission factor kg/kg (fossile fuels)**	**WtT Emission factor kg/kg**				**Pathway baseline**
		CO_2	CH_4	N_2O	CO_{2eq} (1)	(% fuel)
Gasoline	3,17	0,54	0,000	0,000	0,54	n/a
Diesel	3,16	0,61	0,000	0,000	0,61	n/a
Ethanol		**1,392**	**0,003**	**0,001**	**1,899**	**100%**
Wheat, NG GT + CHP, DDGS to animal feed		*1,61*	*0,004*	*0,001*	*2,011*	*70%*
Wheat, NG GT + CHP, DDGS to heat & power		*0,89*	*0,001*	*0,002*	*1,638*	*30%*
Biodiesel		**0,543**	**0,003**	**0,002**	**1,328**	**100%**
Rape, glycerine as chemical		*0,58*	*0,003*	*0,003*	*1,479*	*80%*
Sunflower, glycerine as chemical		*0,38*	*0,002*	*0,001*	*0,722*	*20%*

Against that background, the additional replacement of a given 1% of fossil fuel use (in energy terms) by the use of biofuels is estimated to result in an overall GHG emission reduction for EU-15 of 56,0 Mt over the period 2010-2020, resulting of an increase of WtT emissions by 24,2 Mt, and a decrease of TtW emissions of 80,20 Mt.

Taking into account the crude oil price assumptions (€50/bbl), the most likely pathway for biofuels still triggers a cost premium. Cost/effectiveness would be situated between 57 and 330 €/t, with a central estimate of 158 €/t.

Already in 2001 the promotion of biofuels in road transport was identified as part of an EU-level package of measures[28] to help Member States meet their Kyoto obligations, going beyond the policies existing at the time which included the 120 g CO_2/km objective for new cars. This led to the adoption of the EU target of a 5.75% market share for biofuels by 2010[29], corresponding to CO_2 reductions in the range of 35-40 Mt by this target year. These were therefore clearly intended as complementary policies, the sum of which would contribute towards meeting the Kyoto target. As foreseen in the EU strategy for biofuels[30] adopted in early 2006, the Commission has examined "*how biofuel use could count towards CO_2 emission targets for car fleets*". Biofuels and vehicle improvements are two core elements of the EU's transport and climate change policy that must go hand in hand, and double counting of agreed targets must be avoided because it would otherwise not allow the EU to meet its 8% reduction target under the Kyoto Protocol[31]. Going beyond the 5.75% target by 2010, efforts to promote less carbon intensive fuels are being pursued. As part of its review of the fuel quality directive[32], the Commission has proposed the introduction of compulsory requirements aimed at the gradual decarbonisation of road fuels. Furthermore, the Commission has recently reported[33] on its review of the biofuels directive, and it will shortly adopt a proposal to revise this directive aimed at setting minimum standards for the share of biofuels in 2020 (10%) and at ensuring that the use of poor-performing biofuels is discouraged while the use of biofuels with good environmental and security of supply performance is encouraged. This would stimulate further expansion of biofuel use and the early introduction of second generation biofuels. For modelling purposes, the level of contribution from the fuel quality greenhouse gas reduction mechanism by 2012 (1% in 2011 and 2% in 2012) has been translated into an additional[34] biofuel share of 1.65%, which corresponds to 92 Mt CO_2 savings over the 2010-2020 period.

4.2.5. Options to reduce fuel consumption in light-commercial vehicles (N1)

The methodological approach followed for light-commercial vehicles (N1) is similar as the approach followed for passenger cars (M1) vehicles (see 4.2.1). Four levels of ambition are taken in consideration and included in TREMOVE based on [Task A] results.

Table 5 - GHG abatement and cost effectiveness of the four levels of ambition for N1 vehicles (source [TREMOVE])

Reduction against the	45 to 60 g	30 to 45 g	15 to 30 g	0 to 15 g

[28] As foreseen in the first phase of the European Climate Change Programme - COM(2001) 580.

[29] Directive 2003/30/EC of the European Parliament and of the Council of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport (OJ L 123, 17.5.2003).

[30] COM(2006) 34.

[31] On the basis of the first European Climate Change Programme, meeting the 120 g CO_2/km objective will deliver circa 110 Mt CO_2/year by 2010 compared to 1990; this represents 20% of the remaining overall reduction effort required to meet Kyoto (550Mt/year based on 2004 projections).

[32] COM(2007) 18 – modification of directive 98/70/EC of the European Parliament and of the Council of 13 October 1998 as amended relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EEC (OJ L 350, 28.12.1998).

[33] COM(2006) 845.

[34] The savings are accounted for the period starting in 2011 to avoid double counting with the existing 2010 biofuels target.

2012 baseline	CO_2/km reduction	CO_2/km reduction	CO_2/km reduction	CO_2/km reduction
€/t CO_2eq.	364	259	86	-74
Cumulated CO_2eq. 2010-2020	-32	-27	-24	-21

4.2.6. Fuel efficient driving

The total effect of mounting GSI systems on new vehicles is estimated at 38 Mt Cumulated CO_2eq. over the period 2010-2020, with a (negative) cost per ton of WtW CO_2 equivalent of -113 €, with the fuel price hypothesis retained for the baseline. In contrast to e.g. the options to reduce vehicle and engine resistance factors, no information was available on the likely baseline developments. There is evidence that the combined use of GSI and training or awareness campaigns would increase the cost-effectiveness of the measure. All in all, the above mentioned ratio of cost-effectiveness can therefore be seen as a central hypothesis.

The inclusion of eco-driving by training or awareness campaigns into option (3) is not possible due to the lack of monitorability and accountability that lead to high uncertainties regarding its actual CO_2 savings potential. It will therefore not be included in the present strategy as a quantified contribution to option (3). Member States are nonetheless invited to further promote eco-driving as a means to raise awareness about climate change impacts of car use.

4.2.7. CO_2 based taxation schemes for passenger cars

Although fiscal measures are an essential pillar of the current strategy, there are few detailed quantitative impact assessment of existing or planned concrete proposals, neither at member State nor at EU level.

Some studies have focused on an assessment of the contribution of fiscal measures to CO_2 abatement (see e.g. the [COWI] study where within certain boundary conditions, i.e. no vehicle downsizing, no change to the proportion of diesel vehicles sold, and revenue neutrality, the potential of restructured vehicle tax systems based on CO_2 emissions was estimated at 5% reduction across the EU-15 in emissions from new vehicles). However, the interest of fiscal measures lies mainly in triggering or facilitating profound changes in markets, such as downsizing or structural changes: taxes differentiated over the whole range of cars on the market, so as to gradually induce a switch towards relatively less emitting cars, would be an efficient way to reduce compliance costs for manufacturers.

It is moreover difficult to isolate the contribution of fiscal measures. For the UK[35] it has been assessed that the reforms to Vehicle Excise Duty (VED) and company car tax, are delivering important carbon savings, in the long run between 0.5 and 1.0 Mton CO_2 per year. However, it does not seem feasible to compare this fuel efficiency improvement, according to monitoring data, with other countries that have different taxation systems, that have not undertaken any fiscal reform or that have even decreased the fiscal burden on car drivers. Overall, it appears difficult to reach any conclusion on these grounds.

[35] HM Revenues and Customs, Report on the Evaluation of the Company Car Tax, Reform Inland Revenue, 29 April 2004, http://www.hmrc.gov.uk/cars/cct_eval_rep.pdf

A simple simulation with TREMOVE has been performed, implementing the same fuel consumption improvement corresponding to 120 g CO_2/km, but with an impact on vehicle price proportional to the CO_2 emission levels. The overall impact on CO_2 from passenger transport is very small, as what is observed is a transfer of transport demand and hence fuel consumption from larger to smaller cars. To some extent, this reflects the limitations of the current version of TREMOVE for the modelling of taxation, since the scenario modelled is very basic. But this outcome also gives indications that any fiscal reform should either trigger a decrease in the overall demand (this could be achieved by increase fuel or vehicle excise duties), or focus on providing price signals in goods with a strong substitution potential (e.g. relative fuel consumption or emissions, in the same vehicle category).

While taxation is not modelled individually as a separate measure in the present impact assessment, it is taken into account under the second variant of option (3), where an alternative assumption in the costs of delivering a given CO_2 target is made (see Box 1). This alternative reflects the fact that the adoption of ambitious measures to drive consumer demand towards more fuel efficient cars, and notably taxation, could result in a reduced relative upsizing, and therefore lower compliance costs at a given CO_2 reduction target.

4.2.8. Options for improved energy or CO_2 labelling

Consumer information, as the second pillar of the current CO_2 and cars strategy, is implemented through the car labelling Directive[36] which requires Member States to ensure that a label with CO_2 emissions and fuel consumption is affixed on all new cars offered for sale or lease in the EU. A review of the potential measures that could be taken to improve the effectiveness of the Directive has been carried out, and submitted to stakeholders. The most promising measures lie with a further harmonisation of the label, the introduction of energy efficiency classes, the widening of the Directive's scope to cover also light-commercial vehicles (N1) and the inclusion of information on annual running costs and tax levels. Labelling impacts indirectly on CO_2 emissions via consumer information, resulting in potential medium-long term indirect impacts on car purchasing behaviour due to an increased awareness about the impact of car use on CO_2 emissions and climate change.

In addition to consumer information, the way in which cars are marketed may also need to be adapted, so as to focus less on the dynamic performances of vehicles. To guarantee a level playing field, there is a need for coordinated action amongst the industry. Car manufacturers should consider adoption a voluntary agreement on an EU wide code of good practice regarding car marketing and advertising aimed at the promotion of sustainable consumption patterns.

Consumer information through labelling or sustainable marketing is an instrument that can be used as part of a package of measures, in order to facilitate their implementation by raising consumer awareness about e.g. fuel saving technologies, rather than a measure that would *per se* reduce CO_2 emissions. It is as a result not modelled separately in the

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[36] Directive 1999/94/EC to the European Parliament and Council of 13 December 1999 relating to the availability of consumer information on fuel economy and CO_2 emissions in respect of the marketing of new passenger cars (OJ L 12, 18.1.2000).

present impact assessment, but is indirectly reflected under the second variant of option (3).

4.3. Building the Policy Options

For the measures considered under options (2) and (3) that have been quantitatively assessed with TREMOVE, an analysis of the marginal cost and effectiveness (reduction potential) of the inclusion of each measure has been performed, including the lowest and highest bound of the M1 and biofuels cost estimates (see Table 6).

The following overall conclusions can be drawn:

- The **marginal** abatement costs for reaching a new vehicle sales average of 120 g/km in 2012 range from 118 to 198 €/ tonne. A lower ambition level such as 130 g/km would place the range between 58 and 120 €/tonne.

- The results for M1 vehicles are sensitive to the assumptions made on the autonomous weight increase and to various assumptions made in relation to uncertainties in the cost assessment. The more extensive use of economic and consumer information instruments, combined with regulation, would be a critical success factor for keeping the abatement costs near the lower bound, while a conservative business-as-usual scenario would trigger the use of the upper bound of the cost range.

- The number of different pathways for the production of biofuels, and the uncertainty on production costs, result in a wide-ranging cost-effectiveness, as indicated in section 4.2.4, ranging between 57 and 330 €/t, with a central estimate of 158 €/t. As part of the review of the fuel quality directive, the Commission has recently proposed the establishment of a greenhouse gas reduction mechanism for transport fuels over the 2010-2020 period. In view of the 2012 time horizon of the present strategy review, the savings delivered under the above mentioned mechanism as in place in 2012 (1% in 2011 and 2% in 2012, then constant until 2020) have been taken into account. Based on the impact assessment of the fuel quality review[37], these savings would be equivalent to the savings delivered by an additional[38] biofuel share of 1.65%, which corresponds to circa 92 Mt CO_2 savings over the 2010-2020 period.

- **T**he full application of the most cost-effective measures of option (3) other than M1 vehicles improvements (GSI, TPMS, MAC and N1 up to 15g CO_2/km), should be included in the policy option as they would deliver a total of 115 Mt with negative marginal abatement cost. The building of a cost-effective package including these measures, M1 until 130 g CO_2/km and LRRT, would deliver 333 Mt CO_2 equivalent, which is lower than the CO_2 reductions equivalent to the achievement of the 120 gCO_2/km objective with M1 measures only (i.e. (Option (2)). Moreover, as mentioned above, some measures considered present higher uncertainties as to their actual delivery of CO_2 savings, despite a very favourable cost-effectiveness (e.g. GSI). Therefore to ensure that the full environmental benefits of the 120 g CO_2/km are delivered, Option (3) should target a higher abatement, and thus it is necessary under

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37 SEC(2007) 55.

38 The savings are accounted for the period starting in 2011 to avoid double counting with the existing 2010 biofuels target.

this approach to recourse to decarbonised fuels, mainly through biofuels. The abatement potential of Option (3) would then reach 426 Mt CO_2 equivalent, which is higher savings than the ones corresponding to the achievement of the Community objective of 120 g CO_2/km.

Table 6 - Marginal cost-effectiveness analysis of the option (3) measures (source TREMOVE and Task A)

Measure	**CO_2 eq WtW Mt**		**Cost-effectiveness €/t**	
GSI	-36.3		-113	
N1-15g	-20.4		-75	
TPMS	-41.5		-64	
MAC	-16.7		-30	
M1 step 140g - 135g	-98.1 (B)	-99.7 (A)	3 (B)	50 (A)
Biofuels 1.65%	-92.5		57 -158	
M1 step 135g – 130g	-99.2 (B)	-100.8 (A)	58 (B)	120 (A)
N1-30g	-24.1		81	
LRRT	-44.2		84	
M1 step 130g – 125g	-99.2 (B)	-101.0 (A)	91 (B)	157 (A)
M1 step 125g – 120g	-100.6 (B)	-102.0 (A)	118 (B)	198 (A)
LVL	-68.10		130	
N1-45	-26.6		252	
N1-60	-32.0		356	

Other measures such as taxation and labelling would help reducing the cost for CO_2 abatement, through structural changes in the demand leading to the purchase of more fuel-efficient vehicles.

Taking into account the three policy options identified in section 3 and the results of the above mentioned detailed analysis of the measures that could contribute to option (3), two variants for option (3) have been considered:

- Variant 3A: The policy measures identified through the cost-effectiveness screening (namely GSI, MAC, N1 up to 15g CO_2/km reduction compared to the baseline, TPMS, LRRT and biofuels), are added to the achievement of 130 g CO_2/km by M1 vehicles.

- Variant 3B: based on variant 3A but considering in addition a widespread implementation of measures to influence consumer demand (taxation and consumer information). There is no direct estimation available of the likely impact of these non-technical measures on the cost-effectiveness of the technical measures included in variant A, but as mentioned in Box 1, achieving a lower autonomous weight increase than 1.5% p.a. between now and 2012 is related to the success of possible complementary measures aimed at influencing consumer purchase behaviour. For modelling purpose, an average abatement of 19% on the M1 cost curve has been implemented in this variant.

The modelling of the policy scenarios with TREMOVE[39] delivers the bulk of the information needed for the assessment of environmental and economic impacts. This is complemented by an analysis of the macro-economic and sectoral impacts of different levels of cost for the society and for car industry in particular, performed with PACE-T and FORCAR respectively. This analysis of the policy scenario is provided in the following sections.

4.4. Environmental impacts

The impact of all scenarios on transport demand would remain limited (**Table 7**). Option (2) triggers a small decrease in passenger transport demand, while the Options 3A and 3B correspond to a small increase in passenger transport, because the increase in vehicle purchase price and annual maintenance cost is overlapped by the fuel savings, leading to a decrease in passenger transport generalised cost.

Table 7 - Impact of the Policy options on transport demand – EU25 (Source: TREMOVE)

	% change vs Baseline	Option 2	Option 3A	Option 3B
Vehicle.km small Passenger cars	2015	-1.01%	0.06%	0.63%
	2020	-1.12%	0.04%	0.58%
Vehicle.km medium/big Passenger Cars	2015	-0.13%	0.13%	0.27%
	2020	-0.27%	0.18%	0.31%
Vehicle.km Light Duty Vehicle	2015	-0.20%	0.13%	0.26%
	2020	-0.24%	0.20%	0.30%

Policy Option 2 leads to an abatement of 403 Mt WtW CO_2 equivalent over the period 2010-2020, corresponding to an abatement of 6% for road transport over the period compared to the baseline. Policy options 3A and 3B lead to a somewhat greater abatement, respectively 429 and 422 Mt, which is necessary to ensure the full achievement of the 120 g CO_2/km objective, taking into account the uncertainties of some of the measures considered (e.g. GSI). For the cheaper Variant 3B, there is a smaller abatement due to a rebound effect related to the greater increase in transport demand.

[39] Policy option 2 corresponds to TREMOVE model run D23. Policy options 3A and 3B are based on model run D28 (also available on www.tremove.org) including 1.65% biofuels on top of the baseline by 2012 and – for 3B – a sensitivity analysis on M1 abatement costs.

Regarding conventional pollutant emissions (see **Table 8**), while Option 2 triggers a – although small – decrease in SO_2, PM and NO_X emissions, Options 3A and 3B lead overall to a somewhat lower abatement due to increase in traffic.

Table 8 - Impact of the Policy options on pollutant emissions – EU25

	Option 1 (Base case)		Option 2 (% change vs Base case)		Option 3A (% change vs Base case)		Option 3B (% change vs Base case)	
	2015	2020	2015	2020	2015	2020	2015	2020
CO_2 exhaust (Mt)	860.9	897.1	-3.88%	-6.67%	-4.87%	-7.04%	-4.87%	-7.04%
CO_2 well_to_tank (Mt)	142.6	151.9	-3.01%	-5.05%	-1.66%	-3.31%	-1.66%	-3.31%
NMVOC exhaust (Kt)	1136.5	895.1	0.00%	-0.05%	0.00%	-0.05%	0.00%	-0.05%
NOx exhaust (Kt)	2150.7	1924.6	-0.06%	-0.16%	-0.04%	-0.11%	-0.04%	-0.11%
PM exhaust (Kt)	122.3	113.9	-0.09%	-0.25%	0.04%	-0.01%	0.04%	-0.01%
SO_2 exhaust (Kt)	18.1	18.8	-1.15%	-1.96%	-1.00%	-1.66%	-1.00%	-1.66%

4.5. Economic impacts

The impact of the policy options on vehicle sales (see **Table 9**) remains also limited, with option 2 having a negative impact on both gasoline and diesel cars.. Options 3A and 3B have a positive impact, with an increase in the sales of gasoline vehicles offsetting the decrease in the sales of diesel vehicles. However, this evolution is linked with the actual policy scenario implemented in TREMOVE, based on Task A data, where the abatement target per vehicle category is calculated exclusively based on the marginal abatement curves. While this does not question the overall results of the assessment which focuses on the overall light-duty vehicle market evolution, this points to the need to define an instrument taking into account the structure of the car markets, and specificities of various segments in relation to their ability to deliver affordable CO_2 reductions and fuel efficiency improvements.

Table 9 - Impact of the Policy options on vehicle sales compared to the baseline – EU25 (Source TREMOVE)

% change vs Baseline	Option 2		Option 3A		Option 3B	
vehicle category	2012	2020	2012	2020	2012	2020
Gasoline (M1+N1)	0.1%	-0.1%	0.3%	0.5%	0.5%	0.9%
Diesel (M1+N1)	-0.3%	-0.6%	-0.2%	-0.4%	-0.2%	-0.4%
Total (M1+N1)	-0.1%	-0.3%	0.1%	0.1%	0.2%	0.3%

The effects of the policy options on welfare indicators (see **Table 10**) show that there is a wide scattering between the scenarios leading from almost positive (gain to society) to negative (loss to society) values depending essentially on the fix resource costs assumed to reach the 120 g CO_2/km equivalent emission target for new passenger cars. Under option 2, the consumer surplus (-17 €bn) is worsened by the marginal cost of public funding (-36 €bn), leading to an overall welfare loss (externalities excluded) of -53 €bn. In Policy option 3A, the welfare loss due to fix resource cost is much lower in absolute value (-49 €bn compared to -98 €bn for Option 2). This compensates for the lower fuel savings and the cost of biofuels, and triggers a gain in consumer surplus (+7 €bn). However, the marginal cost of public funding still overlaps this gain, and the overall welfare effect is a loss of -23 €bn. In policy option 3B, the welfare loss due to fix resource cost is even lower, resulting to a net welfare loss of -10 €bn.

Table 10 - Welfare Analysis of the Policy options – EU25

Net present value 2010-2020, M€, difference with basecase (Option 1)	Option 2	Option 3A	Option 3B
Consumer Surplus *(including transport demand from business)*	**-17,124**	**6,871**	**34,356**
• fix resource costs	-98,384	-48,987	-37,885
• variable resource costs	39,434	16,481	16,584
• taxes	41,545	39,458	41,188
• other effects	280	-81	-142
Sum of cost of public funds (general taxation)	-35,999	-30,152	-29,985
Sum welfare	**-53,123**	**-23,281**	**-10,239**

The comparison of this welfare loss with the overall GHG abatement over the same period gives a value for GHG abatement in €/ton. At this stage, it is worth taking into account the fact that the cost estimates selected for the policy option modelling were conservative. As mentioned above (section 3.3.1), a detailed analysis will have to be performed regarding the future instrument to reduce CO_2 emissions and its impacts, e.g. at the vehicle or segment level. In particular, the costs of technological options for M1 do not take into account neither synergies in the integration of systems, nor technologies likely to appear between 2006 and 2012 thanks to innovation. Moreover, cost estimates are established for large scale production at a 2012 horizon, but do not account for learning curves and economies of scale beyond that date as technologies penetrate the market on a wider scale, and ex-ante cost estimates have in the past proven to be much higher than actual compliance costs. These alternative assumptions would result in lower cost, and a rebate of 17% in fix resource costs can here again be considered as an alternative estimate.

This leads to a cost per ton of CO_2 ranging between 6 €/ton for Option 3B with alternative cost assumptions, to 132 €/t for Option 2.

Table 11 - Cost-Effectiveness of GHG Abatement 2010-2020

Cost per ton of CO_2 equivalent	Option 2	Option 3A	Option 3B
Cost estimates	132 €/ton	54 €/ton	24 €/ton
Alternative costs estimates	*84 €/ton*	*31 €/ton*	6 €/ton

A macroeconomic analysis has been carried with the dynamic CGE model PACE-T (see Annex 2), which has a special focus on the passenger transport sector. The results of this analysis suggest very small changes in all scenarios compared to the baseline development. Transport demand, GDP and real consumption are slightly affected with a downwards trend. These findings imply that increased purchase are more than compensated by the decreases of fuel costs due to lower fuel consumption.

Regarding the competitiveness aspects, it is interesting to consider the situation in other parts of the world as regards fuel efficiency requirements. The EU is not the only region considering ambitious fuel efficiency targets. From an absolute perspective, the EU objective of 120 g CO_2/km is, with the Japanese top-runner approach currently being revised, the most ambitious in the world. But Japan has recently announced that it intended to achieve fuel efficiency improvement of 20% by 2015. Besides absolute values do not account e.g. for regional car fleet variations. For example, Californian cars are much bigger and powerful than European vehicles, and thus emit higher levels of CO_2. But a comparison of the regulation adopted in 2004 by the state of California (now followed by 10 other US states) with the EU strategy shows similar relative ambition levels: the California rule sets a 30% reduction requirement over the 2009-2016 period (7 years), compared to a 35% reduction over a longer (1995-2012) period (17 years).

As regards specifically the competitiveness implications on carmakers of carbon constraints, two main determinants must be taken into account: the "carbon intensity of profits" (the degree to which profits are derived from relatively high-carbon emitting vehicles) and the quality of management decisions as regards lower-carbon technologies. Based on the results of a study on ["*The impacts of climate change on competitiveness and value creation in the automotive industry*"] show that amongst the 10 leading automotive companies, those that are in the best competitive position with regards to a tightening of CO_2 /fuel efficiency requirements at a 2015 horizon are the three most selling European carmakers and the three most selling Japanese carmakers, while the US manufacturers are in a more difficult situation[40]. It is noteworthy that the same geographical repartition applies to fuel efficiency requirements, where Japan and the EU objectives are much more ambitious than the US requirements. It thus appears that the positive opportunities created by carbon constraints to develop fuel efficient technologies ahead of competitors outweigh the risks induced by higher manufacturers costs and related loss of market share.

A more detailed sectoral impact assessment is not provided at this stage. The impact on specific car segments and production location will depend on the instrument selected for the implementation of the revised strategy, which will be subject to a separate impact assessment. In their 2004 European Competitiveness Report[41], the Commission services paid particular attention to the situation of the automotive industry, and notably underlined that based on the performance on the global automotive market the EU industry was competitive, although it had to face major challenges such as comparatively higher labour costs and poorer productivity than its US and Japanese competitors. The report also stressed that world-wide demand to make vehicles safer and more environment-friendly will continue, and that competitiveness was also dependent on a coherent and cost-effective regulatory framework.

Next to the calculated employment and distribution effects, stronger regulation leads to additional expenditures in research and development (R&D). The incentive to invest into research and development will be a medium and long term consequence which should overall lead to reduced production costs of advanced technologies, and research efforts should be further supported through the EU research framework programmes.

4.6. Social impacts

- Employment

The analysis of the structure of the automotive industry shows that manufacturers already have started to establish production facilities outside of the EU. While there are many drivers to such industrial decisions, the cost level and flexibility of labour, which may in

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[40] The study also highlights that manufacturers focusing on executive/premium cars appear to be in an unfavourable position but because of the type of products they offer, they will be able to pass through the costs of fuel efficient technologies to their customers.

[41] SEC(2004) 1397.

some cases be partially offset by a lower productivity, and the proximity of the production facility to the market, are considered as primary determinants, while other aspects such as the level of environmental or safety requirements are considered less relevant.

Another aspect that should be taken into account from an employment perspective is the fact all manufacturers, worldwide (including e.g. Japanese and Korean), will be subject to the EU CO_2 requirements when selling cars in the EU. Therefore EU requirements would not penalise more directly EU carmakers in the competitive situation on other markets, including emerging markets. On the contrary, the introduction of ambitious legislation would likely promote research and development, most of which would be done in the EU as far as EU carmakers are concerned.

Against that background, the three options under consideration have no perceptive impacts on employment as a whole in the EU.

- Public health

Less CO_2 emissions from passenger transport by road will contribute to reducing climate change and its impacts on the society, such as increased incidence of death or illness due to higher temperature variations, pressure on Governments and insurance systems due to extreme weather events and impacts on ecosystems and natural resources. Some of the measures foreseen will contribute to reduced CO_2 emissions and enhanced road safety (e.g. tyre pressure monitoring systems), and may thus contribute to reducing the number of injuries and fatalities linked to car accidents.

4.7. Comparing the options

Based on the detailed analysis of the measures and policy options investigated in the previous sections, the following assessment of the various scenarios analysed for the three options has been established:

Table 12 – Overview of the options

	Option 1 (no policy change)	**Option 2**	**Option 3A**	**Option 3B**
CO_2 reductions	-	= (reference scenario) (403 Mt CO_2)	++ (424 to 429 Mt CO_2)	+ (417 to 422 Mt CO_2)
Cost-effectiveness	n/a	132 €/t	32 to 54 €/ton	6 to 24 €/ton
Measurability	☺ (based on directive 80/1268/EEC)	☺ (based on directive 80/1268/EEC)	☺ (need to take account real use of GSI, and need for measurement procedure for	☺ (idem as Option 2A)

	Option 1 (no policy change)	Option 2	Option 3A	Option 3B
			MAC and LRRT)	
Monitoring	☺ (decision 1753/2000/EC)	☺ (decision 1753/2000/EC)	☺ (need to adapt decision 1753/2000/EC to cover N1, and set up monitoring for LRRT, MAC, TPMS and GSI)	☺ (idem as Option 2A)
Accountability	☺ (stakeholder responsible clearly identified: car manufacturers)	☺ (stakeholder responsible clearly identified: car manufacturers)	☺ (stakeholders responsible clearly identified: car manufacturers, fuel and tyre industry, automotive suppliers)	😐 (stakeholders responsible clearly identified: car manufacturers, fuel and tyre industry, automotive suppliers but lack of certainty concerning the implementation taxation measures)

Based on this assessment, options (3A) or (3B) seem the most promising, in view of their better cost-effectiveness, and higher overall CO_2 reduction at a 2020 horizon, compared to option (2). Essentially, options 3A and 3B present the same level of ambition for the various measures under consideration (130 g CO_2/km for M1 vehicles in 2012, -15 g CO_2/km compared to the baseline for N1 vehicles, GSI, TPMS, LRRT, MACs and biofuels), but their impacts is different due to the impact of consumer demand measures taken into account under option (3B). **Clearly this latter option is the most cost-effective, at 24 €/ton**, but is subject to the active implementation of measures to influence consumer demand, and in particular taxation. In view of the constraints to which taxation is subject at the EU level, Member States have a clear responsibility in ensuring that option (3B) is being implemented, which would be reflected by a reduction in the relative upsizing of cars compared to historic trends and thus lower compliance costs for manufacturers in the implementation of the fuel efficiency framework that would be proposed in 2007. Finally, the inclusion of an additional longer term objective of -30 g CO_2/km for light-commercial vehicles (N1) to be delivered at a 2015 horizon has a limited impact on the additional costs to the society.

5. MONITORING AND EVALUATION

In 2010, a review of the status of implementation of the proposed renewed strategy and the potential of further measures to move beyond the EU objective of 120 g CO_2/km should be carried out. This will notably include an assessment of the progress made by Member States in their national policies to promote fuel efficient cars and of the development of advanced (second generation) biofuels.

ANNEX 1: PROCEDURAL ISSUES AND CONSULTATION OF INTERESTED PARTIES

In preparing the review of the CO_2 and cars strategy, the Commission has extensively consulted interested parties between September 2005 and September 2006. Consultations were carried out both by way of direct exchanges with stakeholders including the general public, and by way of external expertise.

The consultation process comprised three consultation processes, as follows:

(4) Direct consultation of interested stakeholders (external expertise)

Two complementary studies were carried out in support of the preparation of the impact assessment: [Task A] focused on the costs and CO_2 reduction potential of various measures that could contribute to the renewed strategy, and task B investigated the socio-economic implications of possible packages of measures. Under [Task A], detailed specific stakeholder consultations were carried out, and input was received *inter alia* from car manufacturers associations (ACEA, JAMA and KAMA), from suppliers to the auto industry (CLEPA), from the lubricant industry (ATIEL), from the tyre industry (BLIC/ERTMA), the oil industry (Europia). In addition questionnaires were sent to Member States in relation to vehicle taxation, car labelling and public procurement. The results of these consultations have been used to establish the [Task A] report, and are subsequently taken into account in the present impact assessment.

(5) Stakeholder working group under the European Climate Change Programme

On 24 October 2005, the Commission organised a conference to launch the second stage of the European Climate Change Programme. On this occasion, a dedicated workshop was held in order to seek the views of stakeholders on the draft of a mandate for a working group on reducing CO_2 emissions from light-duty vehicles, and to call for expressions of interest regarding participation in the group. The general objective of the Working Group was to assist the Commission services in preparing the review of the Community strategy to reduce CO_2 emissions from light-duty vehicles, and specifically provide a stakeholder consultation forum giving assistance in the preparation of the impact assessment of the future strategy. Further to this workshop the mandate was finalised[42], and the working group was established taking into account the applications for membership received.

The working group met five times between December 2005 and September 2006, and the outcome of the meetings and submissions by working group members are publicly available[43]. Input from stakeholders was used by the contractors in the preparation of the [Task A] report, and by the Commission services in preparing the impact assessment of the renewed strategy.

(6) Web based public consultation

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42 See http://ec.europa.eu/environment/co2/pdf/mandate_eccp_c02_cars.pdf

43 See http://forum.europa.eu.int/Public/irc/env/eccp_2/library?l=/light-duty_vehicles&vm=detailed&sb=Title

Cars being an important part of the everyday life of European citizens, it was decided to carry out an online consultation of the general public, with a view to seeking the views and opinions of individuals on passenger road transport's contribution to climate change and possible future ways to reduce it. The minimum standards for consultation (COM(2002)704) have been respected and the questionnaire[44] was made available during 10 weeks between mid-June and mid-August 2006. A total of 1215 entries were received and the results from this consultation (see Annex 3) were taken into account in the revision of the strategy, notably as regards the need to better inform consumers about the fuel efficiency of their cars (see 4.2.8).

[44] See http://ec.europa.eu/environment/co2/co2_home.htm

ANNEX 2: REFERENCE DOCUMENTS AND ADDITIONAL CONSIDERATIONS ON THE MODELLING FRAMEWORK

Reference Documents

(1) [Task A] "Review and analysis of the reduction potential and costs of technological and other measures to reduce CO_2 emissions from passenger cars", final report, Contract n° SI2 408212 by TNO for DG Enterprise and Industry, October 2006, available at http://ec.europa.eu/enterprise/automotive/projects/report_co2_reduction.pdf

(2) [IEEP 2004] "Service contract to carry out economic analysis and business impact assessment of CO_2 emission reduction measures in the automotive sector" Final Report http://ec.europa.eu/environment/co2/02858/sec02858_en.pdf& Annexes

(3) [Task B] "Service Contract in Support of the Impact Assessment of Various Policy Scenarios to Reduce CO2 Emissions from Passenger Cars", Contract: N° 070501/2004/392571/MAR/C1 by Centre for European Economic Research (ZEW) for European Commission (DG Environment), October 2006. (available at http://ec.europa.eu/environment/co2/co2_studies.htm)

(4) [TREMOVE] "Service contract for the further development and application of the TREMOVE transport model - Lot 3", Service Contract 070501/2004/387327/MAR/C1 by KU Leuven and Transport and Mobility Leuven for European Commission (DG Environment), December 2006 (available at http://www.tremove.org/index.htm). The independent reviews of the model performed over the last 3 years are available at http://ec.europa.eu/environment/air/models/tremove.htm)

(5) [JRC2006] JRC/CONCAWE/EUCAR Well-to-Wheel study, as updated in 2006 http://ies.jrc.cec.eu.int/wtw.html

(6) [TNO MAC] Development of a procedure for the determination of the additional fuel consumption of passenger cars (M1 vehicles) due to the use of mobile air conditioning equipment available at http://ec.europa.eu/environment/co2/pdf/a_16174.pdf

(7) Review of the commitment of car manufacturers to reduce CO_2 emissions from M1 vehicles available at http://ec.europa.eu/environment/co2/pdf/a_11742.pdf

(8) Options to integrate the use of mobile air conditioning systems and auxiliary heaters into the emission type approval test and the fuel consumption test for passenger cars (M1 vehicles) available at http://ec.europa.eu/environment/co2/pdf/tno_mac_fc_first_study.pdf

(9) Measuring and preparing reduction measures for $C0_2$ emissions from N1 vehicles available at http://ec.europa.eu/environment/co2/pdf/a_9482_final%20report.pdf

(10) Report on the effectiveness of the car fuel efficiency labelling directive 1999/94/EC, and options for improvement: Final Report http://ec.europa.eu/environment/co2/02858/sec02858_en.pdf& Annexes

(11) [COWI] "*Fiscal measures to reduce CO_2 emissions from new passenger cars*", COWI, January 2002 – see http://ec.europa.eu/environment/co2/pdf/cowi_finalreport.pdfhttp://ec.europa.eu/environment/co2/02858/sec02858_en.pdf

(12) Contribution from stakeholders (See Annex 1 and [Task A] report)

(13) ["*The impacts of climate change on competitiveness and value creation in the automotive industry*"], Sustainable Asset Management and World Resources Institute, http://www.sam-group.com/changingdrivers/default.cfm

(14) [IEEP 2006] "Improving the knowledge base on car purchasing decision mechanisms and the environmental impact of company car taxation", Institute for European Environmental Policy (IEEP; UK/Belgium), contract for the European Commission's DG Environment, October 2006, available on http://ec.europa.eu/environment/air/models/tremove.htm

Modelling Framework

The policy scenarios to reduce CO_2 emissions from passenger cars are based on the measures analysed by Task A, complemented when needed by additional information from the reference documents mentioned above. The objective of Task B was to assess the economic, environmental and social aspects of the scenarios, to support the Impact Assessment undertaken under the procedures of the Commission.

The assessment of the several scenarios was done in comparison with a baseline scenario (TREMOVE 2.43b) which has been defined by the European Commission and implemented into the models.

The effects on the transport sector were quantified with the transport emission model TREMOVE, and the model runs have been carried out by the consultant in charge of the development of the TREMOVE model (K.U. Leuven / Transport and Mobility Leuven), and by the services of the Commission (DG Environment, Unit C5 Energy and Environment).

The outcome of TREMOVE is a calculation of the cost-effectiveness of various policy scenarios, comparing the welfare cost of the measures with the changes in emissions (no external cost valuation is performed in the context of the present impact assessment). Any comparison between the ex-ante cost-effectiveness calculation performed by Task A in the table presented in the executive summary of the final report and the calculations presented in Task B must take into account (1) the hypothesis on costs and mark-up (see below) and (2) the demand effect modelled by TREMOVE, as the fuel efficiency improvements and the related increase in car retail cost savings lead to a chain of effect on overall (passenger road) transport demand, variation in car sales and stock (including shifts between categories).

On the macroeconomic level, ZEW used the dynamic general equilibrium model PACE-T to simulate the impacts of the relevant regulation measures on the macro-economy as well as the individual sectors and trade flows of the European countries.

It is worth mentioning that the macro-economic and sectoral analysis of policy scenarios (performed respectively by PACE-T and FORCAR) does not mirror the detailed cost-effectiveness analysis performed with TREMOVE. Instead, it considers the range of scenarios possible looking at the two major changes that affect transport demand and through this channel the macroeconomic variables, namely a decrease in fuel consumption and an increase in total costs per car type related to fuel efficiency improvements.

Starting for a core scenario reaching 120g/km by 2012 with an increase in vehicle purchase costs corresponding to the highest range of the cost sensitivity analysis, the analysis identifies 2 alternative scenarios: the 1st one with a lower decrease in fuel consumption (corresponding to a target of 130g/km), and the 2nd one keeping the fuel efficiency target but implementing a lower increase in vehicle purchase cost, corresponding to the lowest range of the cost sensitivity analysis.

Moreover, preliminary TREMOVE runs have been performed using the draft final report from task A and the IEEP report “Service contract to carry out economic analysis and business impact assessment of CO2 emissions reduction measures in the automotive sector” (IEEP/TNO/CAIR, 2004). These scenarios refer exclusively to measures targeting passenger cars, but provide useful insight for the analysis of macroeconomic and sectoral effects.

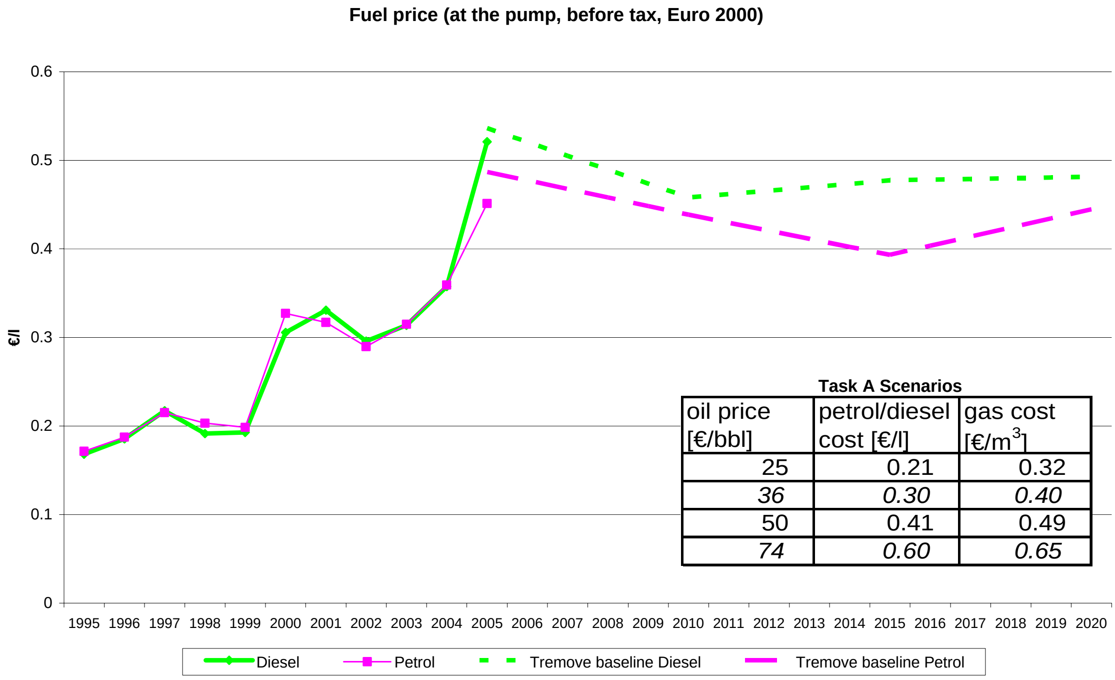
Comparison with Task A: mark-up and fuel prices

Two essential aspects must been taken into account when comparing the results from Task A and the results from TREMOVE.

Firstly, the costs considered as part of the Commission's impact assessment are the resource costs, including research and development and economies of scale but excluding additional manufacturer and dealer margin. This ensures that the costs taken into account reflect only the CO_2 reduction measure under consideration, and is inline with previous impact assessment exercises in the automotive field (e.g. EURO 5). This approach however was not followed by the contractor in Task A.

Secondly, the TREMOVE baseline includes a central hypothesis on fuel price – consistent with the PRIMES scenarios used for the mid-term review of Common Transport Policy in the ASSESS study[45]. Using constant Euro 2000, the forecasted fuel price for the period 2005-2020 experiments small variations in the band 0.4 / 0.5 €/l. To compare with the four cost/effectiveness values provided by Task A, one should therefore use an intermediate value (1/4) between 50 and 74 €/bbl to be consistent with the TREMOVE baseline.

[45] http://ec.europa.eu/transport/white_paper/mid_term_revision/assess_en.htm



oil price [€/bbl]	petrol/diesel cost [€/l]	gas cost [€/m³]
25	0.21	0.32
36	*0.30*	*0.40*
50	0.41	0.49
74	*0.60*	*0.65*

An example can be provided for the cost of reaching 120g with M1. The cost/effectiveness provided by Task A is 181€ at 50 €/bbl and 132€ at 74 €/bbl. This would give an intermediate value of 170€/t. The removal of the mark-up (16%) would translate into a circa 30% impact on cost-effectiveness (as explained page 81 of Task A final report). This would give 130 €, comparable to the 136 € given by the TREMOVE simulation (which furthermore takes into account the demand effects, contrary to the ex-ante calculations made by Task A).

Scenarios for Tyres and Lubricants

Two scenarios were defined by Task A for LRRT and LVL: Scenario 1 concerned only new cars, while in scenario 2 the technologies were applied to the whole fleet. However, only scenario 1 was modelled with TREMOVE for Task B report. Later on, in order to be fully consistent with additional policy considered for inclusion in the future Communication, additional runs (D33 to D35)[46] have been performed by the services of the Commission, including scenario 2 for LVL and LRRT.

Task A had concluded that the cost-effectiveness of the 2nd scenario would be higher, due to the fact that the percentage reduction in fuel consumption is applied on higher absolute fuel consumption. However, the modelling with TREMOVE has given opposite results. This is due to the fact that the hypothesis provided by Task A gives the same annual maintenance cost for all cars, thus disregarding the fact that older cars have a lower annual cost due to their lower mileage (tyres and lubricants are replaced less frequently).

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46 The following runs have been performed: D33 = 125g M1 + GSI + TPMS + N1 15g + LRRT2; D35 = 125g M1 + GSI + TPMS + N1 15g + LRRT2 + MAC; D34 = 130g M1 + GSI + TPMS + LRRT2 + MAC + N1 15g + LVL2. Following the same methodology explained in Task B report, the calculation of the cost effectiveness of LRRT scenario 2 is given by the comparison between D33 and D26, while LRRT is given by the comparison between D35 and D34, minus the cost and effectiveness of the step 130g/125g given by the difference between scenarios D23 and D24.

In terms of effectiveness, this lower mileage of older cars is actually taken into account, compensating their higher average fuel consumption. All in all, very roughly, this gives for scenario 1 ex- tax fuel saving around 18 €/year/vehicle, compared with 16 €/year for scenario 1, while costs are 20 €/year/vehicle.

The table below gives the resulting cost effectiveness:

	Task A with similar fuel price hypothesis	TREMOVE Scenario 1	TREMOVE Scenario 2
LRRT	59	18.9	83.7
LVL	98	91.0	129.9

ANNEX 3: RESULTS OF THE PUBLIC CONSULTATION

Review of the EU strategy to reduce CO_2 emissions and improve fuel efficiency from cars

Report on the Public Consultation June - August 2006

In line with the Commission's commitment to transparent and interactive policy-making, this document aims at providing an overview and general impression of the feedback provided to the Commission in the context of a public consultation. The statements and opinions expressed in the document do therefore in no way necessarily reflect those of the Commission.

1. Summary

1.1. General remarks

A public consultation on the review of the EU strategy to reduce CO_2 emissions and improve fuel efficiency from cars was held from 12 June to 21 August 2006 in preparation for a Communication from the Commission to the Council and European Parliament. An online questionnaire available in English, French and German was designed to gather the anonymous views and opinions of the general public on passenger road transport’s contributions to climate change and possible future ways to reduce it. The standard Commission internet tool for Interactive Policy Making was used. The objective was to allow as many as possible to express their views, but since the consultation was based on self-selection of those who wished to respond to the questionnaire, the views expressed by respondents cannot be regarded as representative of the views held by the EU population.

1.2. Results of the consultation

A total of 1215 responses were received, with a 2:1 male/female respondents' ratio. The largest number of respondents lived in the UK, followed by France and Germany. 77% of respondents owned a car and 23% did not. From the responses, these cars seem to be fairly consistent with the average EU fleet in terms of their size distribution and fuel consumption. However, there are indications that the sample of respondents may be more informed/concerned about environmental issues than the average citizen.

There was a large degree of agreement that road transport should make further efforts to mitigate climate change and to improve security of energy supply, but also that the responsibility for the reduction of CO_2 emissions from cars should be shared by various stakeholders (i.e. not only the car industry, but also the fuel industry, consumers, public authorities). Particularly strong support was voiced for the inclusion of light commercial vehicles in efforts to reduce CO_2 emissions, as well as for efforts to raise consumer awareness about CO_2 emissions from cars.

In terms of approaches to reduce the CO_2 emissions from cars, the questionnaire asked for the degree of support for seven different approaches: improving car technology; fiscal measures to support low CO_2 emissions; better consumer information on the fuel efficiency of cars, and of certain car components; promotion of alternative fuels; eco-driving; and support for more efficient tyres and lubricants. A majority of respondents considered all of these approaches as worthwhile by ticking the option "As soon as possible". Within this option, the improvement of car technology comes out top, followed by tax differentiation, consumer information about cars and the promotion of alternative fuels. Relatively lower urgency is expressed for the promotion of eco-driving and the promotion of efficient tyres and lubricants, with the least urgency for improving consumer information about the efficiency of components.

In exchange for an annual fuel cost reduction of €150, some 70% would be willing to pay more for the vehicle; half of these by no more than €1,000, another 22% by €1,000 to €1,500, with almost 20% above €1,500.

Somewhat less than half of all respondents also provided general comments. From these comments, strong support emerges for either binding regulatory measures or fiscal measures on CO_2 from cars, as well as for new technology. Many other comments highlighted the importance of other measures in transport policy as well in order to reduce CO_2 from transport, chiefly public transport and non-motorised transport as well as biofuels, a reduction of transport demand, instruments of urban transport planning and policy, and fuel taxation.

2. Introduction

A public consultation on the review of the EU strategy to reduce CO_2 emissions and improve fuel efficiency from cars was held from 12 June to 21 August 2006[47] in preparation for a Communication from the Commission to the Council and European Parliament to be adopted at the end of 2006. The consultation was carried out in line with the Commission's policy of good governance, transparency and stakeholder involvement and using the standard Commission internet tool for Interactive Policy Making.

An online questionnaire available in English, French and German was designed to gather the anonymous views and opinions of the general public on passenger road transport's contributions to climate change and possible future ways to reduce it. The objective was to allow as many as possible to express their views, but since the consultation was based on self-selection of those who wished to respond to the questionnaire, the views expressed by respondents cannot be regarded as representative of the views held by the EU population.

To facilitate the analysis, some questions were structured and allowed an answer from a number of presented options. The consultation was aimed at giving a voice to members of the public on road transport and climate change, and not at providing a representative survey or opinion poll. However, it should be borne in mind that self-selection of the potential respondents may have introduced a bias towards certain views and ideas and the results should be interpreted accordingly.

This document does not in any way reflect the position of the European Commission. It merely attempts to summarise the comments received from members of the public.

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[47] To compensate for the fact that the consultation partly took place during the summer period, the minimum consultation time of 8 weeks was raised to 10 weeks.

3. Results of the consultation

3.1. Background information about participants

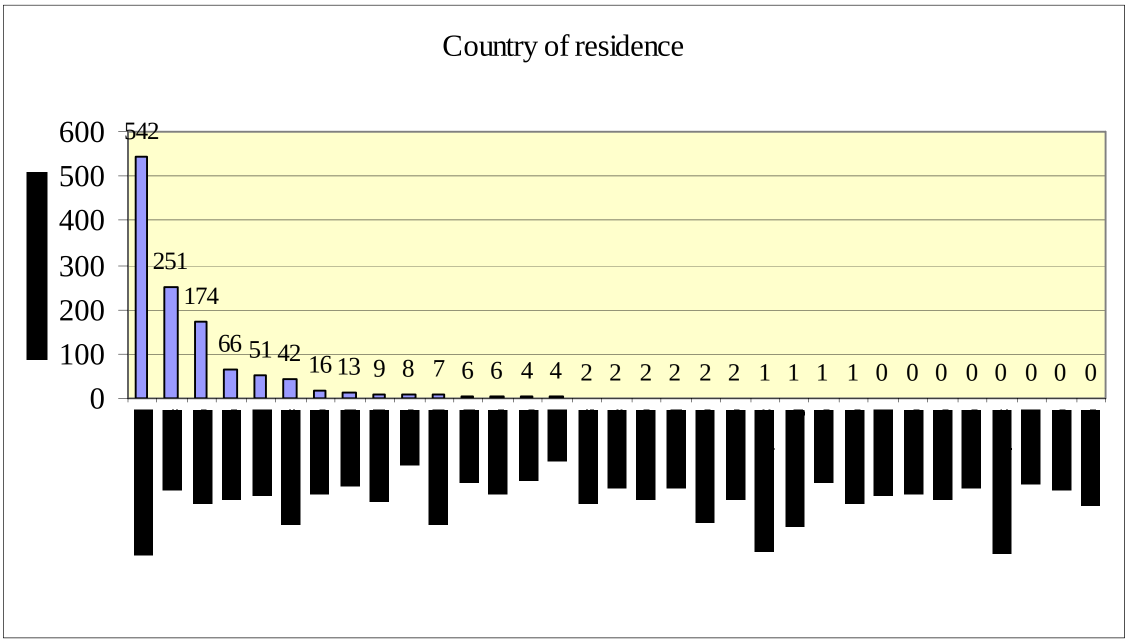

Figure 9 Number of respondents per country of residence

1215 submissions were received, with a 67%/33% male/female respondents ratio. The largest number of respondents lived in the UK, followed by France and Germany. This may have been partly due to the fact that the questionnaire was available in English, French and German but also because these are the larger Member States. The dominant age group was 30-39 (34%), followed by 40-49 (24%) and 18-29 (21%), with the remaining 21% from age 50 and higher. Thus, almost 80% of all respondents were below 50 years old.

77% of respondents owned a car and 23% did not. For comparison, the motorisation rate in the EU-25 is 468 per 1000 population[48]. Looking at the car fleet represented by those who own a car (Figure 10), almost two thirds use petrol, almost one third diesel, and 5% other fuels such as biofuels or natural gas. Half of the cars are of medium size, over one quarter are small, while the remaining, larger or more luxurious categories are making up 3-6% each (Figure 11).

48 For the year 2003. Source: EU Energy and Transport in Figures – Statistical pocketbook 2005. European Commission, Directorate-General for Energy and Transport.

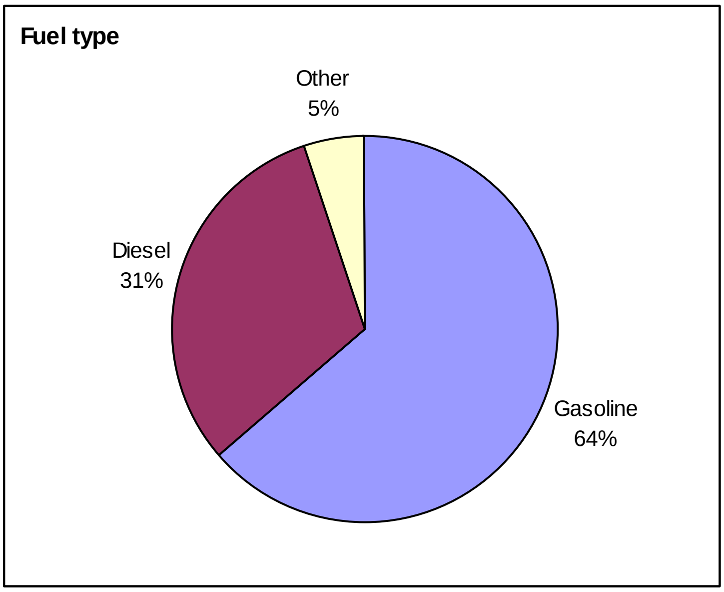

Figure 10

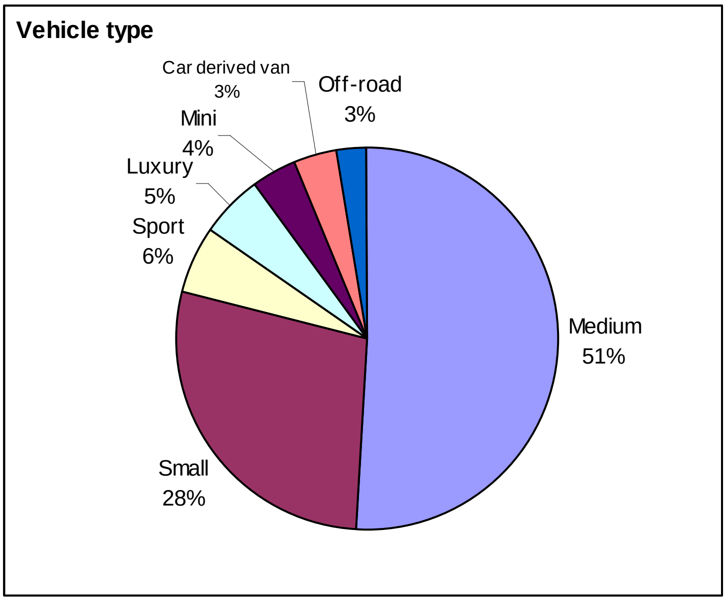

Figure 11

The fuel consumption as indicated by those respondents who did supply this information was predominantly five to seven litres per 100km (35%) and seven to nine litres (20%), see Figure 12. Using straightforward assumptions[49], the average CO_2 emissions as implied by the respondents would then be around 177g/km. Looking at the monitoring

[49] Fuel consumption as shown on the figure, assuming an even spread of values within each fuel consumption category and a constant petrol to diesel split as found above. A fuel consumption of one l/100km corresponds to 24g/km of CO_2 for petrol, and 27g/km for diesel.

data[50], this value would correspond to the newly sold vehicle fleet of 1999, or – allowing for higher consumption in real world driving[51] - some time after that. The reported fuel consumption thus seems to be broadly consistent with the average fleet in the EU.

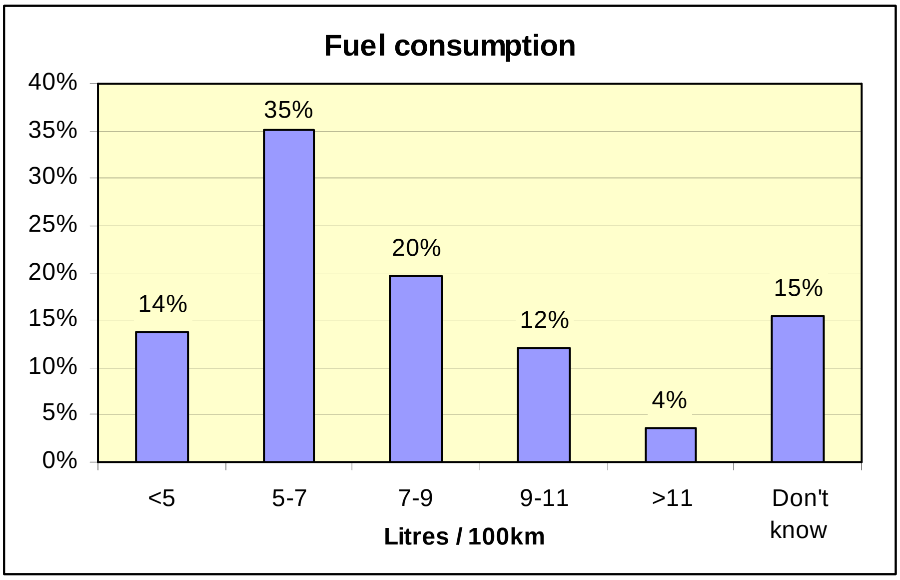

Figure 12

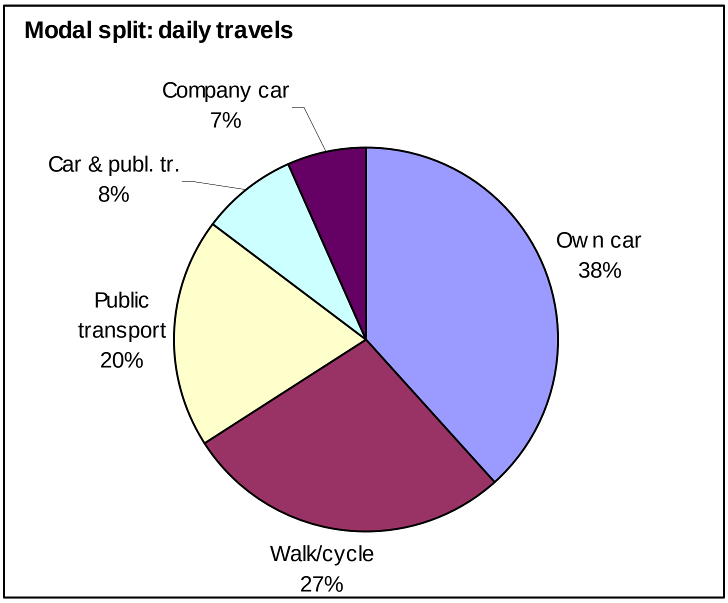

Figure 13

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50 The average CO_2 emissions from newly sold cars in 1999 were 176g/km for EU-15. Source: Sixth annual Communication on the effectiveness of the Strategy to Reduce CO_2 Emissions from Cars - COM(2006) 463.

51 The fuel consumption reported in the annual monitoring reports relates to the so-called NEDC test cycle.

For daily trips such as going to work (Figure 13), cars are being used in a little more than half of all cases (53%), mostly using an own car (38%), a company car (7%) or combining the car with public transport (8%). Non-motorised transport accounts for a quarter of all daily trips as reported, with 20% taken up by public transport (bus/tram/train).

The questionnaire invited the respondents to rank how important they felt that certain criteria were in buying a car, ranging from 1 (unimportant) to 6 (very important). The criteria were as follows:

- Vehicle type (e.g. SUV, sedan, hatchback)
- Number of seats
- Vehicle size (exterior, interior, boot space…)
- Fuel consumption
- Engine power
- Brand image/prestige
- Take back of end of life vehicle
- Design
- Safety standards
- Low emissions of CO2
- Low emissions of other pollutants
- Comfort
- Noise
- Vehicle price
- Reliability
- Alternative fuels compatibility (e.g. biofuels, natural gas)
- Cost of insurance
- Fuel used
- Maintenance/repair
- Tax
- Resale value

- Particulate filter (for diesel cars)

Looking at how many people gave the highest rank (6=very important) to the various criteria, a picture emerges where four criteria are clearly perceived as more important than the rest. These are fuel consumption, low CO_2 emissions, reliability, and low pollutant emissions. Brand image/prestige is the criterion identified by the smallest number of people as very important. Looking in turn at what people think is the least important criterion, brand image/prestige is identified by a strong majority as unimportant, while it appears that most other criteria are seen as important to a certain degree so there is only a comparatively small number of people ranking any of the other criteria as unimportant.

The strong emphasis on fuel consumption as the top criterion is not entirely surprising in view of the current high fuel prices, both experienced at the pump and extensively reported on in the media. The almost equally high emphasis on low CO_2 emissions can be explained by assuming a wide awareness among the population that CO_2 emissions are coupled to fuel consumption. However, an alternative explanation is that the sample was not fully representative of the average car buyer. The hypothesis of a self-selected audience with above-average knowledge of and concern for the environment is strengthened by the strong ranking of pollutant emissions as a criterion for the buying decision. It must also be noted that the observed profile of responses sits oddly with the realities of the car market, where image and prestige are all-important while environmental considerations are often reported as being of minor importance to the average customer. For example, a study on the effectiveness of the labelling Directive[52] found that "*Fuel economy and environmental impact are in general no major factor in vehicle purchase decisions*". Specifically on the weak role of prestige and brand image, the reason for the observed behaviour may be an unrepresentative sample of respondents or a lack of honesty on this particular criterion.

The rest of the criteria achieve a variety of middle-ranking results as shown in Figure 14. They are not discussed in further detail here.

[52] Study on the effectiveness of Directive 1999/94/EC relating to the availability of consumer information on fuel economy and CO_2 emissions in respect of the marketing of new passenger cars. September 2004. http://ec.europa.eu/environment/co2/report/final_report.pdf

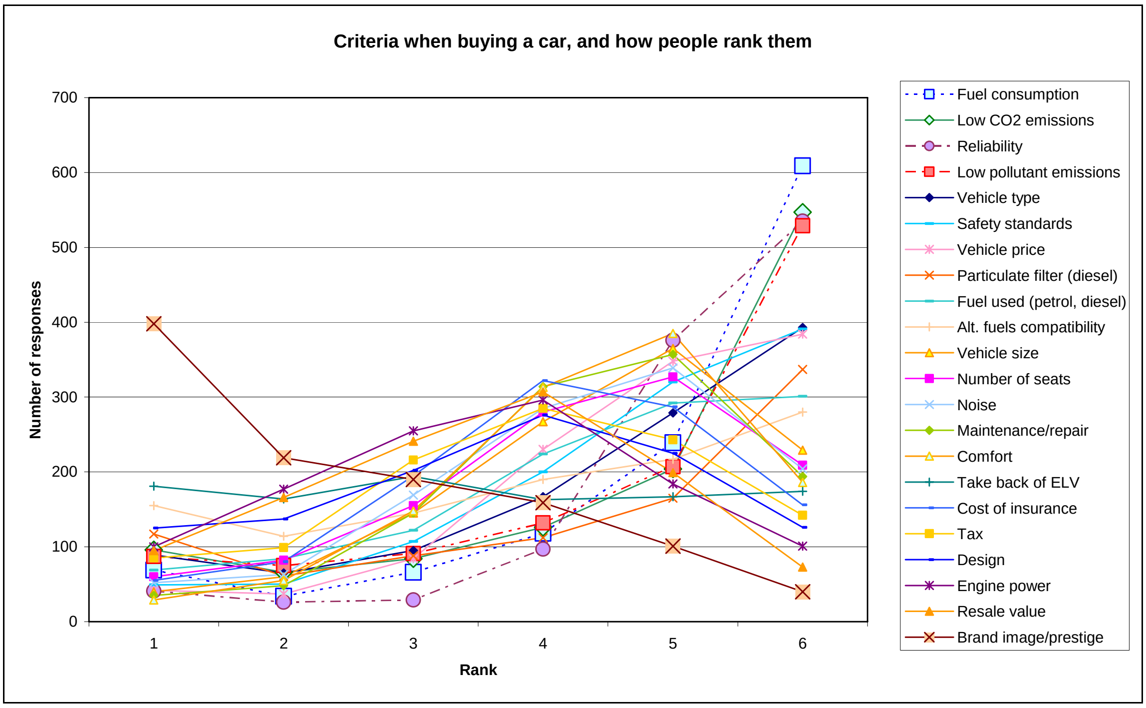


Figure 14

The preferences for more power versus higher efficiency was probed by referring to a hypothetical situation in which the respondent was purchasing a new car of the same type and price as their current car, and giving the alternative of either purchasing a car as powerful as the current one but 20% more fuel efficient, or a car as fuel efficient as the current one but 20% more powerful. The response showed a strong preference (86%) for higher efficiency. Again this result seems at odds with recent trends in new car purchases, where the average (ACEA) car sold over the period 1995-2004 experienced a surge in power of +28% while CO_2 emissions decreased by a mere 12.4%, which would tend to indicate that power has been a strong selling point of cars, to some extent due to consumer preferences, and to some extent due to manufacturers' offer.

3.2. Awareness about climate change

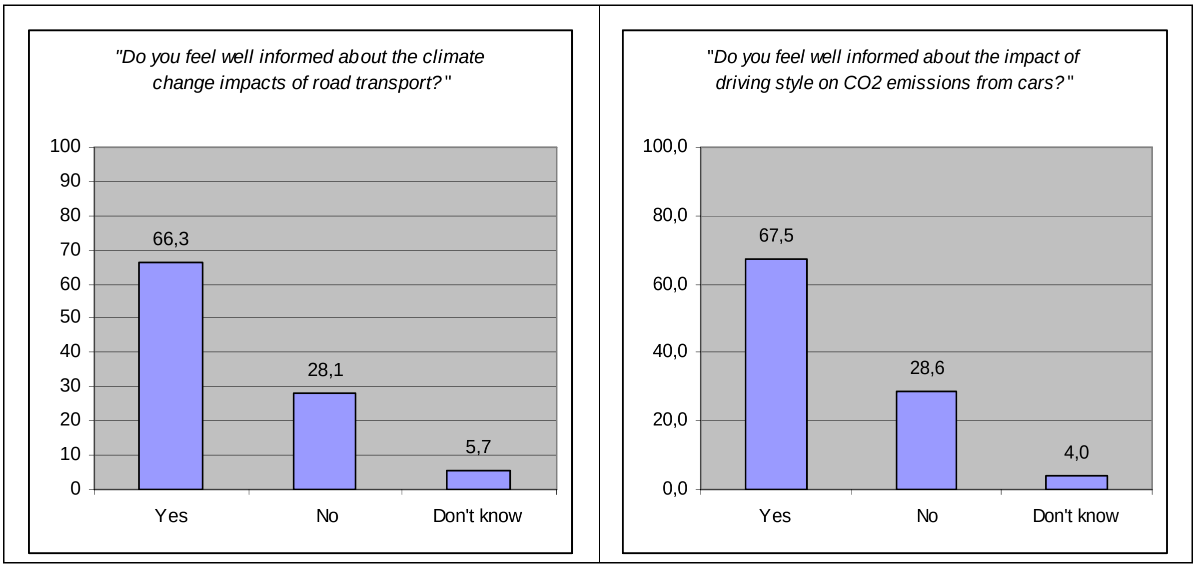


Figure 15 - Climate change impacts of road transport	Figure 16 - Impact of driving style on CO_2 emissions

Circa two thirds of respondents felt well informed about the climate change impacts of road transport, and of the impact of driving style on CO_2 emissions from cars (see Figure 15 and Figure 16). In order to test people's awareness of the orders of magnitude involved, one question asked "*How much CO_2 would you think a car emits if it consumes 6 litres of fuel per 100 kilometres?*". About half of all respondents picked the correct response (about 150 g CO_2/km), while 29% responded "*don't know*" (see Figure 17).

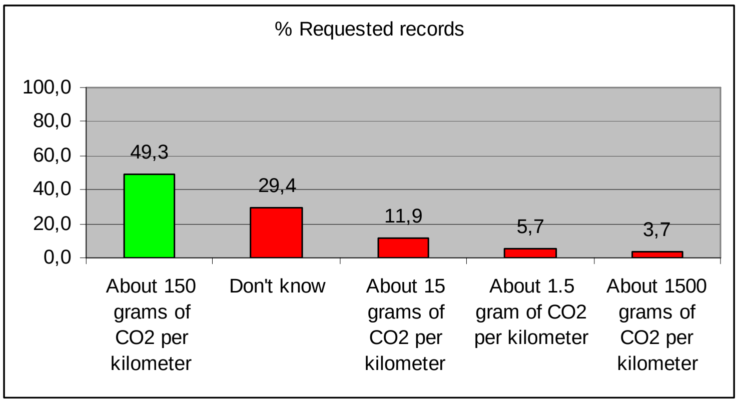


Figure 17 - How much CO_2 would you think a car emits if it consumes 6 litres of fuel per 100 kilometres?

69% of respondents stated that they were aware of the existing Community strategy to reduce CO_2 from cars. Two thirds of respondents feel well informed about the impacts of driving style and the use of air conditioning on CO_2 emissions (Figure 18).

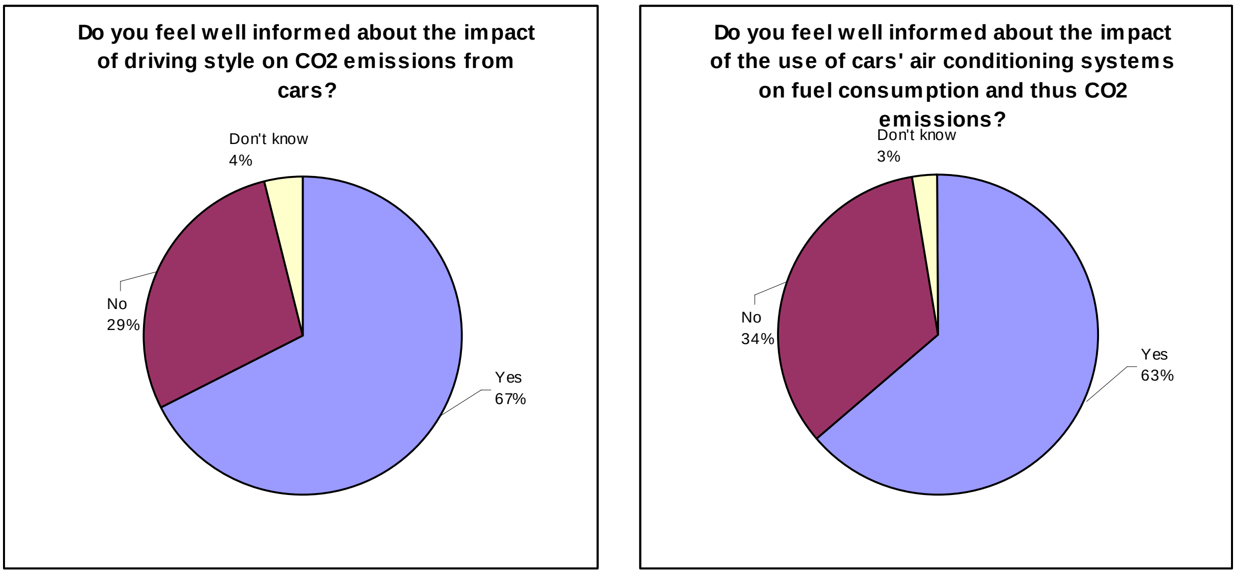


Figure 18

3.3. Policy objectives

In this section of the questionnaire, people were asked to indicate to what extent they agreed with certain policy objectives.

Figure 11 shows that there was a large degree of agreement that road transport should make further efforts to mitigate climate change and improve security of energy supply (e.g. by reducing fuel consumption and/or varying the fuels used) (90% either agree or strongly agree). There was also pronounced agreement that the responsibility for the reduction of CO_2 emissions from cars should be shared by various stakeholders (i.e. not only the car industry, but also the fuel industry, consumers, public authorities…) (87% either agree or strongly agree), although for that second question the support was not quite as enthusiastic (66% strongly agree, as opposed to 77% with the first question).

The question whether CO_2 reduction efforts should include also light commercial vehicles (e.g. delivery vans) achieved the strongest agreement of all questions in this section (95% either agree or strongly agree, see Figure 19, left). Despite their own relatively high level of awareness about CO_2 emissions from cars, the respondents also overwhelmingly support efforts to improve the consumer awareness about the CO2 emissions of their cars (89% either agree or strongly agree, see Figure 19, right).

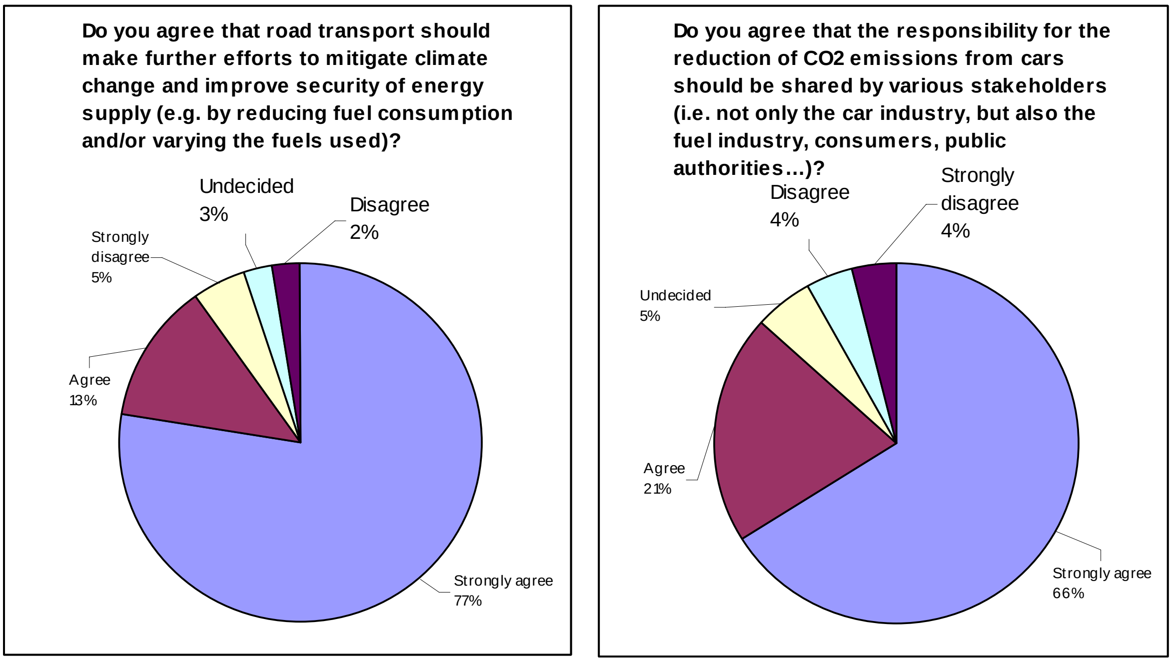
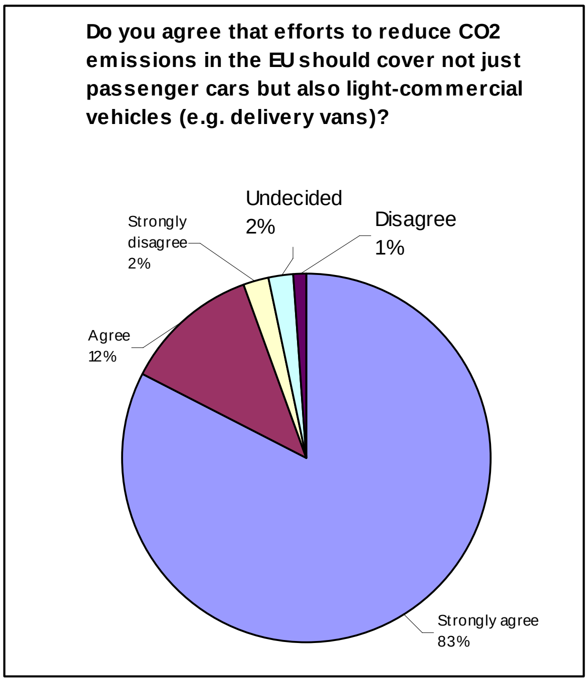


Figure 19



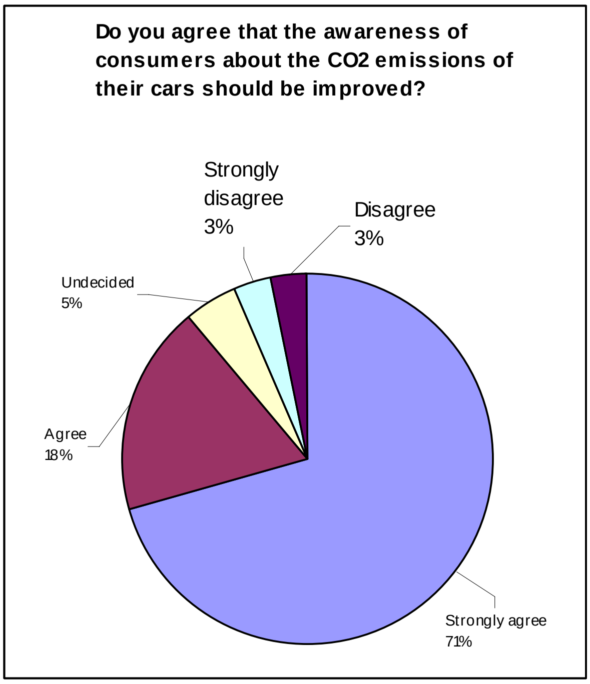


Figure 20

3.4. Approaches to reducing CO_2 emissions from road passenger transport

In this section, people were asked to rate various approaches to reducing the CO_2 emissions from road passenger transport. They were also asked how much they were willing to pay for this. The possible approaches identified on the questionnaire were as follows:

- Gradually improve car technology for example through legislation or voluntary efforts by the industry?
- Reduce car taxes for cars that emit less CO2 and increase them for cars that emit more, in order to promote fuel efficient cars?
- Better inform consumers when they are buying a car about the fuel efficiency and CO2 emissions of the car?
- Better inform consumers, when they are buying a car, about how much the components on the car influences the fuel consumption and CO2 emissions (such as tyres with high or low rolling resistance, different types of lubrication oil)?
- Promote the use of alternative fuels, like bio-fuels or natural gas which lead to less CO2 emissions
- Teach "eco-driving" (driving in a way that uses less fuel) as part of the training for obtaining a driving licence, and through campaigns for experienced drivers
- Promote the purchase of more eco-friendly tyres and engine lubricants, which would have a positive impact on fuel consumption and CO2 emissions?

The pattern of the responses overall is such that all these options are considered worthwhile doing. The two possible negative response types (not so interesting / not a good approach at all) did not draw much support for any of the options. However, some options are clearly identified as more urgent than others. The improvement of car technology comes out top, with 70% of respondents saying that this should be done as soon as possible. It is followed by tax differentiation, consumer information about cars and the promotion of alternative fuels. Relatively lower urgency is expressed for the promotion of eco-driving and the promotion of efficient tyres and lubricants, with the least urgency for improving consumer information about the efficiency of components, which just 55% of respondents feel should be done as soon as possible. The order of preference is practically inverse in the category "worth examining". This means that most respondents who did not consider a certain option as an urgent priority still thought that it would be worthwhile pursuing.

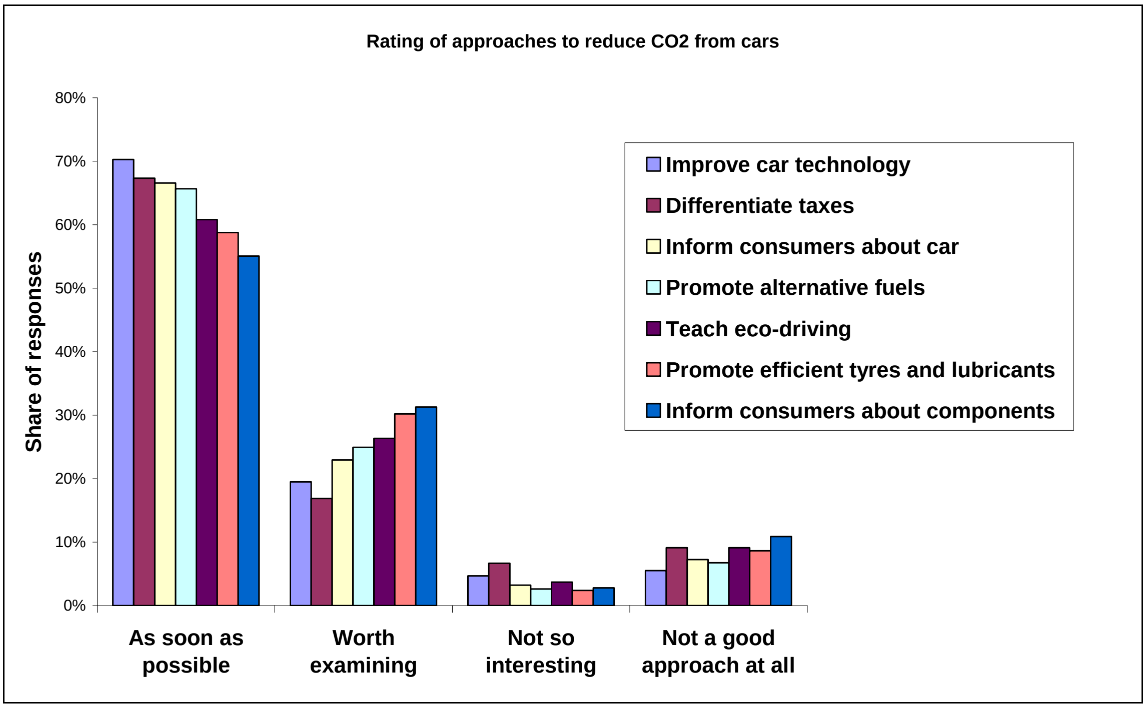


Figure 21

The last two questions in this section concerned the willingness of consumers to pay more for a vehicle in return for a certain reduction in the cost of fuel of €150 each year. It can be seen in Figure 14 that some 70% would be willing to pay more in principle for this. Of those who gave an indication how much this would be, 50% would be willing to pay no more than €1,000 (Figure 21), with a majority of some 40% willing to pay between €500 and €1,000. Another 22% would be willing to pay between €1,000 and €1,500, with almost 20% willing to pay more than €1,500.

These responses can be used to deduct de facto discount rates, using assumptions about the time horizon considered for the fuel savings. Assuming a long-term time horizon[53], the sum of €1,000 corresponds to the net present value of the stated amount of annual

[53] 14 years, taken to be the average lifetime of the car.

fuel saving if the discount rate is assumed to be slightly less than 12%.Therefore, half of those who provided a response seem to apply an implied discount rate of less than 12% under these assumptions. This is at odds with the usual notion of consumer myopia which would imply much higher discount rates, but it is consistent with the high rating for fuel consumption as a criterion for vehicle purchase expressed by the respondents, as shown above. For the largest group of respondents (between €500 and €1,000), the implied discount rate is around 18%[54]. For the second-largest group (between €1,000 and €1,500), it is below 8%.

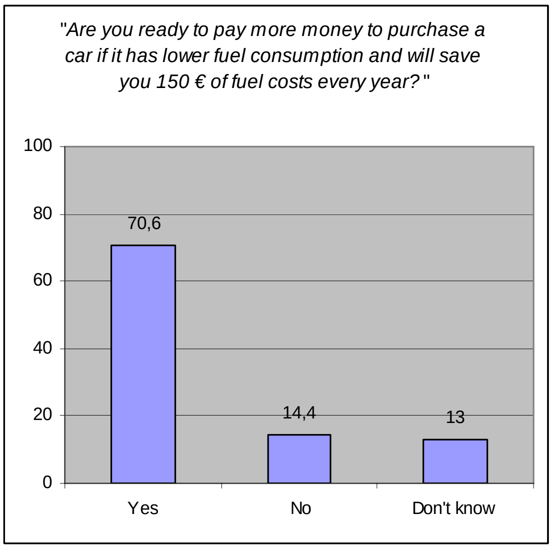


Figure 22 Willingness to pay for a more fuel efficient car

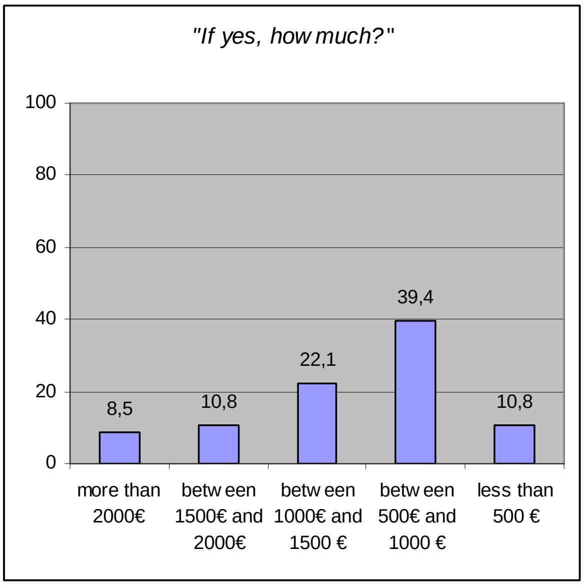


Figure 23 - If willing to pay more for a fuel efficient car, how much?

3.5. Additional comments

The questionnaire allowed for the free formulation of additional comments. Somewhat less than half of all respondents made use of this possibility. Individual comments often contained more than one argument. In the detailed lists below, groups of equal or similar arguments are shown if these arguments were made more than two times.

Comments that concern cars directly, including the car market and the way it is regulated

This group of remarks relates directly the subject of the questionnaire itself, CO_2 from cars. There were a large number of comments that demanded regulatory action (44), and almost as many that wanted to see more pronounced fiscal instruments (38). Support for new technologies and research was also strong (33, and 29 for hybrids).

The table shows the number of times a particular argument has been made.

44	Binding CO2 standards for cars or other regulatory action needed
38	Fiscal instruments should be more developed: tax large cars / SUVs more strongly; tax fuel more or by carbon content

54 Assuming a price increase of € 750, and assuming an annual saving of € 150 over 14 years.

33	Support or develop new propulsion technologies such as hydrogen fuel, electric vehicles, new vehicle concepts, undertake more research
29	Support for hybrid technology
9	Cars are not as bad as thought, other modes are worse; cars are singled out unfairly
5	Ban the sale of high consuming cars

Comments on wider transport issues and fuels

Many respondents also commented that CO_2 emissions of the transport system overall needed attention, either in addition or instead of CO_2 from cars. Indeed the largest number of comments on any single issue (61) was the proposal for more support for public transport. Biofuels received expressions of support (38) but also critical remarks (11). Non-motorised transport (cycling and walking, 35) and transport demand management (27) were advocated frequently. Urban transport policy and the instruments available to it received considerable attention too (21). A number of responses (18) favoured fuel tax as an alternative to vehicle tax, or gave conditions on how to tax fuel.

61	More support needed for public transport and rail, including higher investment
38	Support for biofuels and renewable energy; also through fiscal measures
35	Support for non-motorised transport (cycling and walking); combined with public transport
27	Reduce the demand for transport; also for freight; support local production
21	Use various instruments of urban transport policy, including urban planning; company transport plans; urban road charging
18	Higher fuel tax / energy tax / fuel tax on C basis, instead of vehicles tax
15	Support for 2 wheelers
12	Educate drivers and their children; the public; raise awareness; driver training
11	Action is urgent
11	Critical view of biofuels, doubts on well-to-wheel effectiveness, concern about side effects
10	Consumers won't pay more for green cars, must coerce or give incentives
10	Must also look at other pollutants, air quality
9	Ban / restrict SUVs from cities or from city centres
8	Maintain old cars better, producing new ones consumes too much energy; look also at emissions from car production
7	Reduce CO2 emissions from aviation - in addition to or instead of cars
7	Support car sharing / car pooling
7	Need a new transport policy / approach to transport overall
6	Concern about impact on vintage car collectors
6	Include other transport modes / other vehicles / other sectors as well
4	Tackle industry / power generation instead

4	Ban all car transport in cities / city centres
4	Support efficient cars rather than penalise inefficient ones – social implications; affordability
4	Support telecommuting, videoconferencing
3	Ban car advertising
3	Speed limits, speed limitation of cars to 120 / 130 km/h

Other comments

A number of critical remarks was received on the questionnaire itself (35). In addition, some respondents from the UK (14) complained that litres per 100 km was an unsuitable unit for them and they would need miles per gallon instead.

35	Various critiques of the questionnaire: biased; unintelligible; not sufficiently publicised; too restrictive; superficial; method of cost question unclear; leading questions
14	Complaints from UK respondents that they were used to miles per gallon and could not cope with l/100km

A certain number of respondents questioned the existence of climate change, or the contribution of CO_2 to it, or the contribution of cars to CO_2.

25	Solar activity / water vapour is the cause of climate change; climate change not man-made; climate change doesn't exist
14	Question evidence that transport is causing climate change, or that anything can be done about climate change
3	keep energy and CO2 separate as CO2 is the wrong issue