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COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT

Accompanying the document

Strategy for

Reducing Heavy-Duty Vehicles Fuel Consumption and CO2 Emissions

{COM(2014) 285 final}
{SWD(2014) 159 final}

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Acronyms and definitions

ACEA	Association des Constructeurs Européens Automobiles (the European Association of Automotive Manufacturers)
Carbon footprinting	Method or scheme to assess the carbon content (footprint) of a product or service.
CH_4	Methane. By-product of conventional fuel engines' combustion that has a higher global warming potential than CO_2 (25 fold over 100 year horizon). Conventional fuel engines however emit only very small quantities of methane.
CNG	Compressed Natural Gas
CO_2	Carbon dioxide. The main gas with global warming effect emitted by conventional fuel engines. The combustion of 1 litre of diesel fuel emits about 2.65 kg CO_2.
ETS	Emissions Trading Scheme. The EU emissions trading scheme (carbon market on which tons of CO_2 are being traded among participating entities) does not currently include road, waterways and maritime transport emissions (aviation emissions have been included as of 1.1.2012).
ETD	Energy Taxation Directive (2003/96/EC). The Commission proposed in 2011 a revision of the ETD (COM(2011) 169/3) with the aim of rebalancing fuel prices and including a carbon price in fuel taxation.
Euro VI	HDV exhaust gas and PM emission standards (Regulation (EC) 595/2009). Euro VI – and previous generations of Euro standards - have been adopted on grounds of environmental public health policy considerations and are not meant to address emissions with global warming effects.
GHG	Greenhouse gases: gases that have a global warming effect.
GWP	Global Warming Potential. The intensity of global warming effect of a gas, usually measured as a ratio of its GWP compared to the GWP of CO_2 over a defined time horizon (e.g. 100 years).
HDV	Heavy-Duty Vehicle, i.e. trucks, coaches and buses (vehicles of more than 3.5 tons).
ITS	Intelligent Transport Systems facilitating vehicle fleet management with the support of IT and e-connections, including satellite transmission.
LDV	Light-Duty Vehicle, i.e. cars and vans.
LPG	Liquefied Petroleum Gas is a by-product of the hydrocarbon fuel chain. Its use in transport increases resource efficiency.
N_2O	Nitrous Oxide. By-product gas of fuel combustion with a high GWP (298 fold that of CO2 over 100 year horizon). Conventional fuel engines however emit only very small quantities of N_2O.
OEM	Original Equipment Manufacturer: the main truck and bus manufacturers of complete vehicles, tractors and chassis/cabin unfinished vehicles
PM	Particulate matters, which constitute an important pollutant emitted by diesel fuel engines.
TPMS	Tyre Pressure Monitorting Systems. TPMS are mandatory for cars, but not vans and HDVs
Tailpipe emissions	(see below TTW emissions)
TTW emissions	"Tank-to-wheel" –or tailpipe- emissions that occur throughtout the drive cycle of vehicles.
WTW emissions	"Well-to-wheel" emissions = TTW + upstream "well-to-tank" emissions attached to the fuel production

Introduction

1. Road transport contributes some 19% to the EU's total emissions ("tank-to-wheel" emissions[1]) of carbon dioxide (CO_2), the main greenhouse gas. Producing the fuel consumed by road transport ("well-to-tank" emissions)[2] adds about a further 14% to these emissions, bringing them to 22.8% of total EU emissions. Greenhouse gas emissions from road transport increased by 29% during the period 1990 to 2007 but have since fallen on the back of high oil prices, increased efficiency of passenger cars and slower growth in mobility (by 6% between 2007 and 2011). Heavy-Duty Vehicle (HDV) CO_2 emissions represent about one quarter[3] of road transport CO_2 emissions. This is some 5% of total EU greenhouse gas (GHG) emissions. In view of regularly increasing freight volumes in the EU (except in 2008-2009 due to the economic crisis), these emissions have been rising in spite of some improvements in vehicle fuel consumption and CO_2 performance.

2. In order to tackle road transport emissions, the European Commission has implemented a strategy on Light-Duty Vehicles (LDVs) with an objective of limiting average CO_2 emissions. Regulations (EC) 443/2009 and (EU) 510/2011 set out mandatory CO_2 emission standards for the new passenger car and light commercial vehicle fleets respectively. It was however not considered possible to apply identical CO_2 emission rules to HDVs, as those introduced for LDVs, in view of (i) HDVs' characteristics, i.e. being a wide range of vehicles customised to end-users' needs, and (ii) the absence of a common measurement methodology for these emissions. Hence there is a lack of knowledge on exact HDV CO_2 emissions.

3. The main drivers of HDV CO_2 emissions are overall transport demand which is linked to economic activity, the modal split for freight and passenger transport between road, rail, air and waterways, the fuel carbon content, technological change influencing vehicle performance, and the *modus operandi* of the HDV fleet. Over the long-term freight transport is expected to continue to grow and emissions to contribute an increasing share of transport and overall GHG emissions. The 2011 *Roadmap to a Single European Transport Area*[4] ("the Transport White Paper") has set a long term objective of overall EU transport GHG emissions reductions of about 60% in 2050 (vs 1990 their level). Without action HDV CO_2 emissions are expected to remain about 36% above their 1990 level in 2050, which is incompatible with the overall reduction objective. Consequently they need to be addressed and curbed.

4. Furthermore, Japan, the US and Canada have already legislated and China is considering action on how to measure and curb HDV CO_2 emissions. Measuring and curbing HDV fuel consumption and CO_2 emission may have significant industrial consequences and the EU

[1] Tank-to-wheel –often referred to as tailpipe emissions- are assessed without taking into consideration upstream emissions (i.e. well-to-tank) that occur in the production and distribution of fuels, as opposed to well-to-wheel emissions that take the latter into consideration.

[2] Source: EEA, "Towards a resource efficient transport system", 2010, p 15 with well-to-tank and tank to wheel data in life-cycle analysis of passenger cars. The proportions for well-to-tank and tank-to-wheel for HDVs are assumed to be identical. Available under http://www.eea.europa.eu/publications/towards-a-resource-efficient-transport-system

[3] Estimated at 26.6% of total EU GHG emissions by AEA-Ricardo in "Lot1" Report, Reduction and Testing of GHG emissions from Heavy Duty Vehicles, February 2011, p 170.
Available under http://ec.europa.eu/clima/policies/transport/vehicles/docs/ec_hdv_ghg_strategy_en.pdf

[4] COM/2011/144 final
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0144:FIN:EN:PDF

needs to act in order to keep its HDV manufacturing industry in the lead. In this context EU HDV manufacturers are eager to obtain more predictability on the future policy requirements applying to EU HDV CO_2 emissions.

5. In June 2007 the Council invited the Commission to "*to develop and implement policy instruments and measures to reduce greenhouse gas emissions from those [HDV] vehicles*"[5]. The Commission announced in its April 2010 Communication on "*A European strategy on clean and energy efficient vehicles*"[6] - and subsequently confirmed in the Transport White Paper - that it would propose a strategy targeting fuel consumption and CO_2 emissions from HDVs.

6. The present Impact Assessment underpins this strategy and to this effect examines the possible policy options for addressing EU HDV CO_2 emissions from both passenger and freight transport. Before possible legislative action considered in the present Impact Assessment can be implemented, more specific, focussed Impact Assessments would be carried out in due course supporting each legislative proposal.

1. PROCEDURAL ISSUES AND CONSULTATION OF INTERESTED PARTIES

1.1. Organisation and timing

7. The present Impact Assessment work was launched in September 2011. It was elaborated by DG Climate Action in collaboration with the Secretariat General and DGs ENTR, MOVE, ENER, ENV, RTD, TAXUD and JRC.

8. The draft Impact Assessment report was discussed with members of the Inter-Service Group on CO_2 emissions on 1 October 2012 and 4 December 2012. A first version was sent to the Impact Assessment Board on 21 December 2012. Following a discussion in the Board on 30 January 2013 and a request from the Board, a revised version was submitted to the Board on […March 2013].

1.2. Consultation and expertise

External expertise

9. A study by Faber and Maunsell in 2008, *"Reducing Greenhouse Gas Emissions from Heavy Duty Vehicles: the Role of the European Commission Policy Instrument Recommendations*" examined the road transport industry GHG emissions and policy options to address these emissions[7].

10. This study was followed in 2011 by a report from *AEA and Ricardo* "*Reduction and Testing of GHG Emissions from Heavy-Duty Vehicles- Lot 1: Strategy*". This report examined the main HDV market characteristics in the EU, technologies available to reduce HDV emissions, and the likely uptake of these technologies in three different scenarios. It also reviewed some of the main policy options that could address these emissions[8].

11. In December 2011 TIAX, in a report commissioned and financed by the International Council for Clean Transportation (the ICCT), *"European Union Greenhouse Gas Reduction Potential for Heavy-Duty Vehicles"*, reviewed the AEA/Ricardo estimates in the

5 http://register.consilium.europa.eu/pdf/en/07/st11/st11483.en07.pdf
6 COM(2010)186 final, p 6, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0186:FIN:EN:PDF
7 http://ec.europa.eu/clima/policies/transport/vehicles/heavy/docs/hdv_ghg_faber_maunsell_en.pdf
8 http://ec.europa.eu/clima/policies/transport/vehicles/docs/ec_hdv_ghg_strategy_en.pdf

above report on the potential for HDV CO2 emission abatement and costs associated to the main technological improvements expected to be available until 2030, and proposed revised estimates on the potential for each of eight categories of HDVs and as a whole.[9]

12. A study on *Marginal abatement cost curves for Heavy Duty Vehicles*[10] was carried out by CE Delft for the Commission in the second quarter of 2012. CE Delft reviewed the above mentioned AEA-Ricardo and TIAX emission abatement and cost estimates, and estimated cost curves, both from an end-user perspective, and societal perspective.

13. Another study by CE Delft on *Market Barriers to Increased Efficiency in the European On-road Freight Sector*[11] carried out for the ICCT was completed in October 2012, and its findings were discussed in a workshop on 15 October 2012 in Brussels.

Stakeholder meetings

14. A first stakeholder meeting was held on 22 February 2012 to discuss the potential and ways for reducing HDV CO_2 emissions as well as to sound out participants on their favoured policy options for curbing emissions. A second stakeholder meeting took place on 3 July 2012 to discuss the outcome of the public consultation (see below), progress with the development of a simulation tool to measure HDV CO_2 emissions and emission abatement cost curves prepared by CE Delft. Policy options of the present Impact Assessment were presented by the Commission and discussed with stakeholders on this occasion (for more details see annex 2).

On-line public consultation

15. An on-line public consultation on road vehicle emissions was carried out between 19 September and 9 December 2011 (12 weeks)[12]. A total of 3,233 replies were received which includes 137 stakeholder organisations. As regards HDVs particularly, stakeholders and citizens overwhelmingly supported the need for a strategy for reducing HDV greenhouse gas emissions. While most citizens agreed that additional regulation, as opposed to non-regulatory measures, was needed for this purpose, stakeholder organisations and enterprises agreed (46%) or partly agreed (36%) that such regulation was needed. Respondents overwhelmingly considered that if the Commission proposes a HDV greenhouse gas reduction strategy, it should cover all HDVs (see annex 1).

1.3. Results of the consultation of the Impact Assessment Board

16. The Impact Assessment was first discussed in the Impact Assessment Board on 30 January 2013. The Board asked for the submission of a revised version with clarifications on emission drivers (see revised section 2.2), the need for action (see revised introduction and whole section 2) and market barriers to the uptake of innovation improving vehicle efficiency (see revised section 2.5). It requested measurable and time-related objectives (see revised objectives section 3.2 with timeline and indicators) and an intervention logic based on identified underlying drivers of CO_2 emissions (see "problem tree" end of section 4 and new section 6.3 on intervention logic). The Board requested options to be focussed on policy choices with a clarified sequencing (see revised section 4). It suggested further clarifications on options' impacts, notably social and economic impacts (see revised section 5), including administrative costs (see indicative assessment under 5.1 and new annex 12).

9 http://ec.europa.eu/clima/policies/transport/vehicles/heavy/docs/icct_ghg_reduction%20_potential_en.pdf
10 http://ec.europa.eu/clima/policies/transport/vehicles/heavy/docs/hdv_2012_co2_abatement_cost_curves_en.pdf
11 http://www.theicct.org/market-barriers-increased-efficiency-european-road-freight-sector
12 Summarised in Annex 1.

In line with Board requests, DG CLIMA subsequently re-submitted the present revised version. The Board on 17 April 2013 approved this Impact Assessment, suggesting further clarifications on market barriers, the current need for a strategy, objectives, as well as a clear identification of short and long term options. Such clarifications have been introduced in the text.

2. PROBLEM DEFINITION

2.1. General context

2011 Low Carbon Economy and Transport Roadmap objectives

17. To avoid the most dangerous impacts, the EU has a stated objective of limiting global climate change to a temperature increase of 2ºC above pre-industrial levels. The Copenhagen Accord[13] included a reference to this objective. This was further confirmed within the United Nations Framework Convention on Climate Change (UNFCCC) in the decision in the 16th Session of the Conference of the Parties to the UNFCCC[14]. In order to have a likely chance to limit long term global average temperature increase to 2°C or less compared to pre-industrial levels, global emissions need to peak by 2020 and be reduced by at least 50% globally by 2050 compared to 1990.

18. The EU has established a binding legal framework[15] to reduce greenhouse gas (GHG) emissions. This Climate and Energy Package sets out for the EU binding reduction targets for 2020 and includes a fully-fledged set of policies to deliver this. The Council has approved[16] the EU target of 80-95% by 2050 compared to 1990 in the context of reductions that are necessary, according to the IPCC[17], by developed countries as a group, with the aim of keeping average global temperature rise below 2° as compared to pre-industrial levels. The European Commission *'Roadmap for moving to a competitive low carbon economy in 2050'*[18] (hereinafter 'the Roadmap') looked beyond the 2020 objectives and set out a plan to meet the 2050 long-term target.

19. In March 2011 the Commission also adopted the *'Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system'* (hereinafter the 'Transport White Paper')[19] which outlines the main challenges facing transport, including scarcity of oil in future decades, volatility of oil prices and the need to drastically reduce GHG emissions. It sets out a future transport strategy within a frame of achieving a 60% reduction in transport GHG emissions by 2050 (compared to 1990).

13 UNFCCC, 2010, Decision 2/CP.15, Copenhagen Accord

14 UNFCCC, 2010, Decision -/CP.16, Outcome of the work of the Ad Hoc Working Group on long-term Cooperative Action under the Convention

15 Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020, OJ L 140, 5.6.2009, p. 136–148 , http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009D0406:EN:NOT

16 Council Conclusions on EU position for the Copenhagen Climate Conference (7-18 December 2009) 2968th Environment Council meeting, Luxembourg, 21 October 2009

17 Inter-governmental Panel on Climate Change (IPCC)

18 COM/2011/0112 final

19 COM/2011/144 final, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0144:FIN:EN:PDF

2.2. Description of the main drivers of HDV CO_2 emissions

20. HDVs are defined as freight vehicles of more than 3.5 tonnes (trucks)[20] or passenger transport vehicles (buses, coaches)[21] of more than 8 seats. The AEA-Ricardo report[22] estimated the EU truck fleet at around 6.5 million vehicles in 2008. The HDV fleet is heterogeneous with very dissimilar vehicles that have different uses and drive cycles. It can be segmented into six categories of trucks (see more details in annex 5 table 1) and two categories of passenger vehicles: buses and coaches[23]. Most fleet operators are SMEs and even micro-enterprises, with 81% of the truck fleet owned by enterprises having less than 10 trucks (see Annex 6).

21. Contrary to cars and vans' emissions that were measured and monitored under existing type-approval legislation even before the recent introduction of CO_2 emission limits, HDV CO_2 emissions are not measured and recorded. The market lacks transparency in this respect and this knowledge gap (see section 2.5) is a bottleneck that needs to be addressed. HDV CO_2 emissions are not subject to EU legislation other than the future measurement – as of 1.1. 2014 - of CO_2 emissions from engines under Regulation (EC) No 595/2009 (Euro VI). One should further note that each tightening of exhaust gas and particulate matters (PM) standards triggers losses in fuel consumption and CO_2 efficiency that tend to neutralise energy efficiency improvements on new HDV models (also see section 3.5 below).

HDV CO_2 emissions' main drivers

22. The main drivers of HDV CO_2 emissions are (a) *transport demand* which is linked to economic activity, (b) *modal split* among road, rail, air and waterways, (c) the *fuel carbon content*, (d) the *uptake of technological change* influencing vehicle performance and (e) the *modus operandi of HDV fleets* that influences fuel consumption and CO_2 emissions. Since 1995 HDV transport has grown due to a combination of moderate GDP growth, modal shift with an ever increasing relative share of road transport, rather stable vehicle fuel consumption - HDV fuel and CO_2 performance only slightly improved over this period - and limited decarbonisation of fuel. This has led to increased emissions. Historical series do not allow for a precise calculation of fuel consumption and CO_2 emissions associated with this increase; from 1990 to 2010 HDV CO_2 emissions are estimated to have grown by some 36%[24]. The 2008-2009 crisis interrupted the steady growth in road freight transport and the sector has not yet fully recovered from this sharp drop.

23. (a) ***Overall transport demand*** has steadily increased over the recent decades, at a pace that was until recently –before the 2008-2009 crisis- more rapid than GDP growth, mainly due to the large increase in freight transport, the main source of emissions. Versus its 2000 level freight transport for inland modes had grown in 2008 by 19% in the EU, GDP by 16% and the population by only 3% [25]. While the relationship between transport activity

20 According to international classifications, N2 and N3 vehicles used for the carriage of goods and having a maximum mass between 3.5 tonnes and 12 tonnes (N2) or exceeding 12 tonnes (N3).

21 According to international classifications, M2 and M3 vehicles used for the carriage of passengers and comprising more than eight seats in addition to the driver's seat and having a maximum mass not exceeding 5 tonnes (M2) or exceeding 5 tonnes (M3).

22 Already quoted report available under : http://ec.europa.eu/clima/policies/transport/vehicles/docs/ec_hdv_ghg_strategy_en.pdf

23 For more details, also see AEA-Ricardo report "*Reduction and Testing of GHG Emissions from Heavy-Duty Vehicles- Lot 1: Strategy*", pp57-72, available under: http://ec.europa.eu/clima/policies/transport/vehicles/docs/ec_hdv_ghg_strategy_en.pdf

24 Odyssee-Mure database, available under: http://www.odyssee-mure.eu/.

25 Source: Eurostat

and GDP trends is not irrevocable and may slowly change over time (see next section), this macro-economic driver of CO_2 emissions is beyond the scope of the present sector specific strategy.

24. (b) ***Modal share and shift***. Road freight transport, the main component, has had the most steady growth and increasingly high relative share among the main transport modes. From 1995 to 2009 road freight volumes increased by 31%, with the modal market share (in volume) of road freight in total freight transport (including maritime transport) increasing from 42% to 47%. Conversely HDV passenger transport (bus, coaches) activity remained almost constant over the 1995-2009 period (+3% in volume), around a volume of 500 billion kilometres[26]. A breakdown of the evolution of the transport modes' relative share is provided in Annex 6 (tables 7 and 8). EU policies aim at re-balancing transport to less carbon intensive modes, in particular rail. Modal share and shift has been addressed by the *Marco Polo* programme to support inter-modality. The revised *Union guidelines for the development of the trans-European transport network*[27] foresee clear climate change mitigation criteria in the programming of EU funding for new infrastructure. These policies are expected to result in a slow reversal of the trend that led to an increasing share of road transport. The Transport White Paper has further foreseen a number of actions[28] that will influence modal shares, notably through the development of multimodal transport. While options in the present Impact Assessment may also have indirect modal shift effects, the primary purpose of an HDV CO_2 emissions strategy will not be addressing modal shift.

25. (c) ***Fuel carbon content***. The fuel carbon content is another factor influencing HDV CO_2 emissions. Diesel fuel remains the main fuel used in road transport, with a share estimated[29] around 64%, a proportion that is even significantly higher in the case of HDVs. Low carbon fuels (mainly bioethanol, biodiesel, LPG and CNG) have a limited penetration of some 6% altogether (2010) in road transport: EU existing legislation[30] favours the use of renewable energy in transport and has set quantitative targets to this effect that are currently being reviewed[31]. The recent "*Clean Power for Transport*" Commission initiative and the revised TEN-T guidelines, supported by the Connecting Europe Facility, further support the development of alternative fuel infrastructure[32,33,34]. In 2011 the Commission

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26 Source: Eurostat

27 Regulation (EU) No 1315/2013 of the European Parliament and of the Council of 11 December 2013 on Union guidelines for the development of the trans-European transport network and repealing Decision No 661/2010/EU Text with EEA relevance

28 Transport White Paper, actions 1 "internal market of rail services", 5 "a suitable framework for inland navigation", 7 "multimodal transport of goods", 23 "zero-emission urban logistics 2030", 35 multimodal freight corridors. See http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0144:FIN:EN:PDF

29 Source: Eurostat

30 Directive 2009/28/EC1 on the promotion of the use of energy from renewable sources (the "Renewable Energy Directive") established mandatory targets to be achieved by 2020 for a 20% overall share of renewable energy in the EU and a 10% share for renewable energy in the transport sector. At the same time, an amendment to Directive 98/70/EC2 ("the Fuel Quality Directive") introduced a mandatory target to achieve by 2020 a 6% reduction in the greenhouse gas intensity of fuels used in road transport and non-road mobile machinery.

31 COM(2012)595, http://ec.europa.eu/energy/renewables/biofuels/doc/biofuels/com_2012_0595_en.pdf

32 Commission Communication COM(2013)17 "Clean power for transport: a European alternative fuels strategy", and proposed Directive COM(2013)18 on the deployment of alternative fuels infrastructure. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2013:0018:FIN:EN:PDF

33 Regulation (EU) No 1315/2013 of the European Parliament and of the Council of 11 December 2013 on Union guidelines for the development of the trans-European transport network and repealing Decision No 661/2010/EU

34 Regulation (EU) No 1316/2013 of the European Parliament and of the Council of 11 December 2013 establishing the Connecting Europe Facility, amending Regulation (EU) No 913/2010 and repealing Regulations (EC) No 680/2007 and (EC) No 67/2010

proposed[35] a *revision of the "Energy Taxation Directive"*[36] that would restructure the current energy tax system. The proposed revision is: (i) to rebalance the charge between different fuels, including renewable energies, in an objective manner (based on energy content and CO_2 emissions); and (ii) provides a framework for CO_2 taxation in the internal market, putting a price on CO_2 emissions which are not covered in the Emissions Trading Scheme.

26. *(d)* ***Vehicle performance.*** One specific challenge lies with the fact that, according to data from industry, individual new HDV fuel consumption and CO_2 emissions performance, after a steady improvement until the mid-1990s, stabilised and did not materially improve further in the last decade. This may be due to a number of reasons: the need for new models to comply with increasingly stringent exhaust gas emission standards that trigger energy efficiency losses (see section 3.5 on trade-offs below), but also market barriers to the penetration of innovation due the business model of the HDV transport sector (see section 2.5 below). Thus, in spite of fuel representing a significant share of HDV transport operating costs (20 to 30%), this did not translate in recent years into reduced fuel consumption and CO_2 emissions. This remains an area with considerable scope for further action. Given the slow rate of renewal of the HDV fleet (with an average lifetime superior to 11 years), actions to improve new vehicle fuel consumption and emissions will inevitably have delayed impacts on the whole HDV fleet emissions.

A number of EU policies already support improved vehicle energy efficiency, in particular:

- EU *R&D programmes* geared at improving HDV fuel efficiency and reducing CO_2 emissions. Under the 7th Framework Programme improving HDV fuel efficiency and reducing CO_2 emissions was included in the "Green Car Initiative". Support to clean and efficient vehicles is expected to figure in the proposed "Horizon 2020 - Framework Programme for Research and Innovation"[37].

- *Directive 2009/33/EC*[38] *on the promotion of clean and efficient road transport vehicles* requires public administrations and public undertakings purchasing road transport vehicles to take into consideration operational lifetime energy and environmental impacts.

- The type approval legislation[39] on weights and dimensions recently introduced an allowance (50 cm) for aerodynamic devices fixed at the rear of new trucks/trailers. In line with this, the Commission has recently proposed[40] a revision of Directive 96/53/EC on weights and dimensions of vehicles in international traffic that goes further by proposing a new set of allowances that should support solutions to improve the aerodynamics of HDV.

27. (e) ***Operation of the HDV fleet.*** A number of factors in the operation of the HDV fleet can influence fuel consumption and CO_2 emissions: the maintenance of vehicles, driver performance that can be improved with training, capacity utilisation that relies a series of factors that can be micro-economic (quality of management, use of IT tools) but also regulatory with constraints put on HDV transport by cabotage limitations as foreseen under Regulation 1072/2009/EC. Action has already been taken to address a number of these factors and will need to be continued:

- *Improved logistics and fleet management*. The recent Directive 2010/40/EU on the deployment of Intelligent Transport Systems (ITS) will contribute to accelerating the

35 COM(2011) 168/3.
36 Council Directive 2003/96/EC of 27 October 2003 : Restructuring the Community framework for the taxation of energy products and electricity, OJ L 283, 31.10.2003, p 51.
37 http://ec.europa.eu/research/horizon2020/index_en.cfm?pg=h2020
38 OJ L120/5, 15.5.2009
39 Regulation EC 661/2009 and Directive 2007/46/EC
40 COM(2013) 195 final

development and deployment of ITS in the field of road transport and for interfaces with other modes of transport[41].

- While not including carbon pricing, EU *road user charging legislation* contributes to improving transport efficiency and lowering fuel consumption and CO_2 emissions. The new European framework law[42] approved in 2011 (Directive 2011/76/EU which is a revision of the Eurovignette Directive of 1999) aims at reducing pollution from road freight transport and making traffic flow smoother by levying tolls. The revised Eurovignette Directive will have to be transposed by October 2013 into national legislation and start thereof producing its effects.

2.3. Expected trends under no policy change assumptions suggest a stabilisation of CO_2 emissions

Baseline scenario assumptions

28. Under the business-as-usual or baseline scenario of the Commission PRIMES-TREMOVE model (hereunder referred to as "baseline"), finalised early 2012, based on no policy change assumptions, the EU population is expected to slowly grow until 2030, and remain broadly stable between 2030 and 2050. GDP growth, after a post crisis resumption, is expected to slowly decrease from some 2.2% in the present decade down to 1.45% in 2040-2050, in line with the 2009 Ageing Report assumptions. Energy import price assumptions, based on the world energy PROMETHEUS model, anticipate regular increases of oil prices from USD 85.2 per barrel oil equivalent (boe) in 2010 to USD 127.6 / boe in 2050 (in 2010 prices).

29. HDV fuel efficiency is assumed to improve by close to 1% annually over the period 2015-2030: this is a reversal versus latest fuel efficiency trends that have been influenced by the regulatory introduction of several generations of new 'Euro' exhaust gas pollutant standards, leading to some fuel efficiency losses (see below section 3.5 on trade-offs) and an overall standstill of HDV fuel consumption performance in the recent years. In the assumed absence of new and more stringent exhaust gas pollutant standards (the baseline scenario is prepared on a no-policy change basis) a resumption of regular vehicle fuel efficiency improvements appears realistic, even without policy actions to curb fuel consumption and CO_2 emissions.

30. As the Commission PRIMES-TREMOVE model is a modelling tool that is widely used by Commission services in policy planning and impact assessment exercises, with details publicly available (see links in annex 4), the present Impact Assessment will not present the detailed model's characteristics.

31. Existing policies have been embedded in the baseline scenario. As foreseen in the Transport White Paper, a number of policy reviews and new initiatives shall reinforce the current transport policy framework but have not been quantified in the baseline as their impacts are currently being assessed and cannot be pre-empted:

    (i) the Transport White Paper also identifies the "elimination of the remaining restrictions on cabotage" as a means of making road transport more efficient and more competitive, including by increasing loading factors of vehicles;

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41 In addition to this, R&D support to the development of ITS is being provided under the current 7th Framework Programme and will be continued under the next Financial Perspective for 2014-2020.

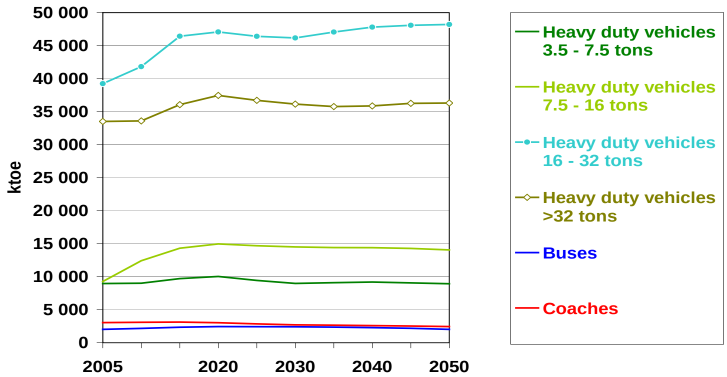
42 Directive 2011/76/EU, OJ L269/1, 14.10.2011, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:269:0001:0016:EN:PDF

(ii) A *review of road user charging legislation* aims to promote a more systematic use of distance related road charging reflecting infrastructure and external costs based on the polluter-pays and user-pays principles;
(iii) an E-freight initiative;
(iv) A *carbon foot-printing initiative* is under preparation to support improved transparency and end-user information on the CO_2 impact of freight and passenger transport;
- (v) A recast of the driving licence directive in 2012 included *eco-driving requirements* for truck drivers' examinations and further efforts are planned to implement these provisions; and
(vi) The Transport White Paper also announced a *strategy for near "zero-emission urban logistics"* providing guidelines to better monitor and manage urban freight flows. In December 2013 the Commission put forward specific recommendations for coordinated action between all levels of government and between the public and the private sector in urban logistics area, urban access regulation area, deployment of intelligent transport system (ITS) solutions and urban road safety area.

32. While the primary objectives of these actions are varied (see more detailed account of these legislative reviews or initiatives under Annex 3) they shall directly or indirectly also contribute addressing climate change objectives43.

Baseline scenario main results

Figure 1 : Energy use (*) of heavy duty vehicles in baseline scenario

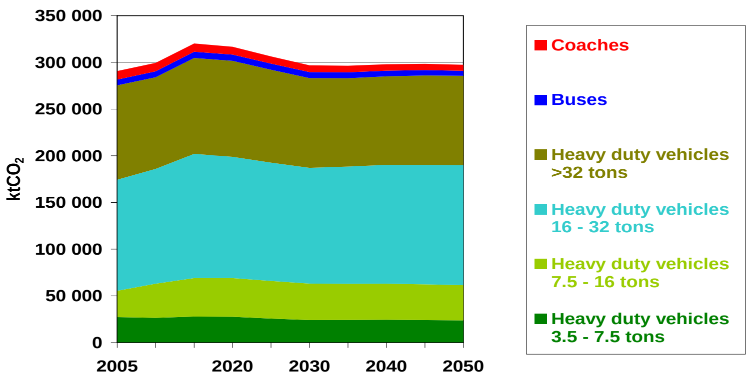


33. Total transport activity is projected to continue to grow in the next 40 years. Even though some decreases were observed recently as a consequence of the economic crisis, the recovery is reflected by transport activity returning to its long-term positive trends. However a certain degree of decoupling can be observed in the baseline model results vs. GDP trends, with road transport growing at slower rates. This is in line with recent trends observed in some Member States44. In term of modes, notwithstanding the EU policy to promote less carbon intensive modes such as rail transport, road transport is overall expected to maintain its dominant role in both passenger and freight transport within the

43 The assessment of these various actions' impacts is currently being prepared in ad hoc Impact Assessments.
44 Prf. Alan McKinnon found that a significant decoupling took place took place in the UK already in the early 2000s decade and investigated the possible explanations for this change. "*The Decoupling of Road Freight Transport and Economic Growth: an exploratory analysis"*. Logistics Research Centre, October 2006. http://www.mcrit.com/transvisions/documents/decoupling/Decoupling%20of%20Road-tonne-km%20and%20GDP.pdf

EU, with a rather moderate shift of relative percentage shares from road to rail in the case of freight and a more pronounced one from road to air as regards passenger transport (see annex 4 – Table 5).

Figure 2 : **HDV CO2 emissions (*) in baseline scenario**



Source: European Commission.
(*) tailpipe = "tank-to-wheel" energy use and emissions (i.e. excluding upstream "well-to-tank" emissions)

34. As regards HDVs, three factors are anticipated to moderate the modelled accounted growth of CO_2 emissions that has been observed in the past:
- the above mentioned decoupling between road transport activity rates and GDP;
- HDV efficiency improvements;
- and increased use of bio-fuels[45] with the full implementation of Directives 2009/28/EC[46] which foresees that the share of energy from renewable sources in the transport sector must amount to at least 10 % of final energy consumption in the sector by 2020. This model-based analysis was however carried out before the recent review[47] in October 2012 by the Commission of the EU bio-fuels policy that led to a proposed limitation to 5% for food-based bio-fuels. As a result, taking into account the latter an increase in CO_2 emissions by few percentage points versus the modelling results may be expected.

35. As a result:
- the use of energy by HDV transport is expected to grow only marginally in view of HDV efficiency improvements over the period 2010-2030 (Figure 1);
- and CO_2 emissions would remain broadly constant over the programming period assuming an increased share of bio-fuels in the EU, also as a result of a full implementation of Directives 2009/28/EC and 2009/30/EC (Figure 2).

36. While this reversal of previous growth trends may contribute to curbing HDV CO_2 emissions, this baseline scenario should be seen against the desired contribution of transport to reducing EU CO_2 emissions. The 2011 Transport White Paper objective set an overall reduction of EU transport emissions of 60% by 2050 versus 1990 levels. As regards specific modes including road and HDVs in particular no quantitative policy objective was

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45 While tailpipe (tank-to-wheel) emissions would normally not be expected to be affected by assumptions made on the use of bio-fuels – the latter only have a bearing on full well-to-wheel CO_2 emissions taking into account upstream fuel production modes-, nevertheless pursuant to Commission Decision of 18 July 2007, p 24, (OJ 31.8.2007 L229) and IPCC 2006 Guidelines, the accounting rule used in the baseline scenario PRIMES-TREMOVE for bio-diesel, bio-gasoline and other liquid bio-fuels and bio-gas is a zero % CO_2 emission factor, see http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:229:0001:0085:EN:PDF

46 OJ L140/16 5.6.2009, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:EN:PDF

47 COM(2012)595, http://ec.europa.eu/energy/renewables/biofuels/doc/biofuels/com_2012_0595_en.pdf

set. While detailed official historical statistics of CO_2 emissions from HDVs within the road transport sector are not available, estimates suggest that between 1990 and 2010 the CO_2 emissions of heavy duty vehicles increased by around 36%. Against this background, one can roughly estimate CO_2 emission baseline levels with respect to 1990: in both, 2030 and 2050, at around +35% (tailpipe emissions, i.e. "tank-to-wheel") of their 1990 level.

37. This implies that under the baseline –no policy change- scenario HDV transport overall would not contribute to curbing transport CO_2 emissions[48] and that its CO_2 emissions would remain significantly above 1990 emission levels. The ***main conclusion of this modelling exercise is that the baseline scenario cannot be considered sustainable*** in view of EU policies to curb GHG emissions, and of the Transport White Paper's sector-specific objectives.

38. Sensitivity analysis conducted on the Primes-Tremove baseline (see annex 4), while confirming that long term simulation results are sensitive to modelling assumptions, does not put into question this above core conclusion.

Opportunity losses in case action is not taken to curb EU HDV CO2 emissions

39. The EU automotive industry currently has a leading position on the HDV market. The major European manufacturers account for over 40% of total global production[49]. While the EU-based production of HDVs represents a much lower share of world production (some 12%-14% depending on the year), the worldwide signalling role of EU standards is considerable. This was demonstrated in the case of EU exhaust gas emissions and PM standards that have been adopted by numerous large emerging economies, notably China, India, Russia, and Indonesia.

40. European manufacturers have an interest in remaining in a leading position as regards HDV CO_2 emissions measurement, and possibly thereafter standards, to increase market transparency and to lead in terms of energy efficiency. They have therefore engaged in an ambitious co-operative exercise with the Commission on the development of a simulation tool, VECTO, to determine HDV emissions (see annex 7). If standards were eventually to be introduced, manufacturers would need to plan R&D for the next generations of vehicles complying with new requirements. Should such standards have a similar world-wide impact, as in the case of exhaust gases and PM, European manufacturers could benefit from considerable economies of scale and first mover advantage.

41. Without EU action, a number of opportunities for curbing HDV CO_2 emissions would be wasted, and the current leadership of the EU automotive industry in the HDV market could be affected. While EU initiatives have already been taken or set out in a number of areas such as vehicle design, management of transport operations, the internalisation of external costs, fuels and purchase decisions[50], a comprehensive EU strategy to curb HDV CO_2 emissions is needed.

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48 The Impact Assessment accompanying the 2011 Transport White Paper in particular assumed that HDVs could achieve a 40% in energy efficiency improvement by 2050 (vs. 2005 levels) in a decarbonisation context. http://ec.europa.eu/transport/strategies/doc/2011_white_paper/white_paper_2011_ia_full_en.pdf

49 Source: AEA–Ricardo report (already quoted), notably pp 26-27, based on statistics from the International Organisation of Motor Vehicle Manufacturers (OICA). Available on : http://ec.europa.eu/clima/policies/transport/vehicles/docs/ec_hdv_ghg_strategy_en.pdf

50 See section 4.2.1 below on the baseline option, which takes stock or recent EU initiatives in the areas of energy taxation, public procurement, R&D support, Intelligent transport systems, incentivising alternative fuels, and road user charging.

2.4. The scope for HDV improved fuel efficiency and reduced CO_2 emissions

HDV technical improvements leading to lower fuel consumption and CO_2 emissions

42. Two recent studies have provided useful insight to assess the scope for curbing HDV CO_2 emissions in Europe. The AEA-Ricardo report assessed possible future emissions under three scenarios:
- a "business-as-usual" scenario, to a large extent based on the 2010 TREMOVE model baseline (with no policy change), with however an important deviation. While the 2010 Commission TREMOVE baseline assumes a "natural" rate of new HDVs' fuel efficiency improvement of 1% per year, AEA-Ricardo's "business-as-usual" scenario, in view of recent developments, reduced this annual improvement to a lower value of around 0.5%;
- a "cost effective" scenario with technology payback of about two years;
- a challenging scenario that assumes a higher degree of incentivisation to adopt new fuel efficient technologies.

43. Under the "business-as-usual" scenario, it was assumed that emissions would continue increasing from 2010 to 2030 (by 15%) in spite of some progress in vehicle efficiency, mainly due to increased traffic and HDV fleet. Against this "business-as-usual" scenario the AEA-Ricardo report found that emissions could potentially be reduced by 6.2% in the "cost-effective" scenario and 14.5% under the "challenging" scenario (i.e. bringing them only slightly below 2010 levels). This study however did not examine a number of means to cut emissions such as fossil fuel savings, weights and dimensions adjustments, and the rolling out of ITS technologies.

44. The 2011 TIAX study reviewed the findings of the AEA-Ricardo study along the eight vehicle categories HDVs of the AEA-Ricardo study. As the latter, it assessed a large spectrum of possible technological improvements, with:
- fuel consumption and CO_2 emissions benefits associated to each technology;
- and the incremental investment costs required case-by-case.
Technical improvements in a number of areas can contribute to improved fuel consumption and reduced CO_2 emissions: aerodynamics; light-weighting; tyres and wheels; transmission and driveline; engine; hybridisation; and management.

Applied to new vehicles, new state-of-the-art technologies would by 2030 allow for substantial benefits in percentage terms compared to the estimated performance of "baseline" vehicles defined as those due to be commercialised in the EU as of 2014 and meeting Euro VI standards. These benefits would broadly range between 30% and 50% for new vehicles, depending on the vehicle category (See Figure 1 in annex 11). The benefits of their roll-out for the whole fleet would be slower to materialise but still substantial, between 25% and 28% by 2030 (see Table 1 in annex 11, TIAX assessed reductions were broadly in line with the ones assessed by AEA-Ricardo).

45. The above assessment concludes that, in spite of an expected HDV fleet growth in the EU of close to 30% over the period 2010-2030, emission levels could be substantially reduced by 2030, with CO_2 emissions cut by 22% (versus business-as-usual levels, as defined in the Lot1 report) if only technologies with a payback period of a maximum of 3 years are introduced in the HDV fleet[51]. Without this 3-year payback constraint fuel consumption

[51] The EAE-Ricardo "business-as-usual" (b-a-u) reference scenario in their 2011 "Lot1" report (already quoted) differs from the Reference "baseline" scenario of the present Impact Assessment. By 2030, HDV emission levels in the AEA-Ricardo b-a-u would have increased by 12% above their 2010 levels. This figure can hence not be strictly compared to the present baseline assumptions.

reduction and emission cuts would potentially be larger, estimated at some 28% below business-as-usual levels.

Improved fleet operation leading to reduced HDV fuel consumption and CO_2 emission

46. Technological improvements are not the only ones that can lead to reduced HDV fuel consumption and CO_2 emissions. Other factors to be taken into consideration mainly relate to the operation of HDVs such as fleet maintenance, driving performance, capacity utilisation/optimisation. According to the International Road Transport Union (IRU) HDV fuel consumption can be reduced by 30% by 2030 due to improved HDV performance (10%), fleet management with the support of ITS tools (10%) and drivers' improved training and performance management (10%). While the first of these figures does not match with more ambitious HDV abatement potential assessed by AEA-Ricardo and TIAX, these IRU objectives tend to confirm a specific potential that lies with HDV operation. Such factors would complement EU initiatives in support of more energy efficient fleet operation that have been embedded in the baseline scenario.

Cost benefit analysis

47. Based on cost estimates from TIAX[52], a cost benefit analysis was carried out by CE Delft to examine the economic sustainability of technical improvements that can improve HDV performance. CE Delft produced two types of marginal abatement cost curves, from an end-user perspective (economic sustainability of technical improvements leading to fuel savings and reduced emissions) and from a societal perspective (eliminating from the latter tax distributional effects that play an important role given the high degree of taxation of fuel). Results are summarised in table 2 in Annex 11, with the detailed cost curves for each category also attached in Annex 11.

48. These results confirm a considerable discrepancy of potential for CO_2 abatement according to vehicle categories: according to this analysis urban and municipal delivery, as well as construction vehicles, and also buses, which have the common feature of low-speed drive cycles with a high proportion of "stops and starts" can be equipped in a cost effective way with hybrid technologies. Long haul vehicles that have the highest annual mileage could as well, even though hybrid would at the present stage not be cost effective for them, benefit from a combination of technologies to improve aerodynamic and rolling resistance, as well as the best state-of-art diesel engine improvements. Sensitivity tests carried out suggest that these results are relatively robust: due to the shape of the cost curves breakeven levels do not vary materially with different assumptions e.g. on the rate of return or even oil price developments. Conversely results would change significantly if CE Delft assumptions taken from the TIAX report on the magnitude of emission abatements and related costs change significantly.

49. One should further take note of the recent experience with cars, for which cost curves were estimated prior to the introduction of the EU Regulation on CO_2 emission limits in 2009, and recently (2012) reviewed: initial cost estimates turned out in the latter review to have been over-estimated, with a number of costs falling sharply once products and technologies

52 CE Delft reviewed TIAX estimates: it retained most abatement estimates, and adjusted a number of the TIAX findings.

mature with industrial mass series and increased competition[53]. This suggests significantly higher cost effective emission abatements.

50. Due to the shape of cost curves, benefits estimated from an "end-user" perspective or societal one are broadly similar: only very few technical upgrades would not be worth investing in from a societal perspective while they are profitable from an end-user (the fleet operators) perspective. This leads to the important conclusion that the incentive structure for end-users is broadly also the one to take into consideration from a societal perspective.

Scope for further policy action

51. Comments made by OEMs suggest that the above abatement values may have been overestimated, notably due to several factors: the baseline to take into consideration (Euro VI HDVs) may actually perform better than assumed in these analysis; combining several technology packages is complex and may not result in abatement benefits simply by adding them up; and as regards conventional diesel engines, the scope for reduced emissions would be lower than assumed as there is a performance limit that cannot be surpassed.

52. The exact amount of emission reductions that could be targeted for HDVs cannot be set at this stage :
- the exact values of HDV fuel consumption and CO_2 emissions remain to be assessed in a way that is agreed with stakeholders, and the on-going project of establishing the VECTO simulation tool is expected to address this gap;
- a further review would be needed screening the degree of maturity of techniques and, for those technical upgrades that are still under development, the timeline necessary for rolling them over on the market.
Once a track record of actual emissions is available for new HDVs registered on the EU market (as foreseen under option 1.ii), the potential for emission abatements should be re-assessed and revised cost-curves re-established, with the benefit of knowledge gained by the time on latest technology developments and the evolution of production costs.

53. At this stage, the above studies and analysis lead to the conclusion that ***there exists a considerable potential for curbing new HDV CO_2 emissions*** with technical upgrades on vehicles, which can even be further topped up with improved driving and fleet maintenance and management. While more shall be needed over the long term, the magnitude of estimated emission abatements by 2030 appears broadly consistent with the Transport White Paper quantitative objectives set for 2050. This points to existing market barriers to the uptake of a number of promising technologies.

2.5. Market barriers to cost effective technology uptake

54. Possible reasons for the lack of uptake by HDV freight transport of all state-of-the-art cost effective technologies are complex and linked to the interaction of different business models of the main actors, OEMs and HDV fleet operators, but also of other actors such as

[53] "*Support for the Revision of Regulation EC/443/2009 on CO2 emissions from cars*" study by TNO, CE Delft, AEA, Ricardo, IHS Global Insight, Ökopol and Transport & Mobility Leuven, pp 43-46, available on the DG CLIMA website,
http://ec.europa.eu/clima/policies/transport/vehicles/cars/docs/study_car_2011_en.pdf
The study reviewed in section 2.5 previous cost curves prepared in 2006 and 2009 with the latest ones of 2011 and found that both costs and the potential for abatements made in earlier years turned out ex-post, based on latest information available and estimates, to have been underestimated.

component manufacturers, body and trailer manufacturers, shippers and financing companies (banks, leasing companies). The AEA-Ricardo report already pointed to a three-year amortisation of investment costs by transport operators, which is significantly below the average lifetime of vehicles (around 11 years for trucks, 15 years for buses) and limits the uptake of innovation: this may be due to the difficulty of long-term planning in micro-enterprises and rapid renewal of the large enterprises' fleets.

55. Market barriers have been investigated in a recent study by CE Delft[54]. The study's findings[55] suggest that :
- European companies are aware of innovations that can deliver significant fuel savings and CO_2 emissions reductions (table 2 below); however few respondents to CE Delft's enquiry believed that these technologies were cost effective;
- OEMs, while offering fuel saving technologies as options, do not in many cases offer them as standard on basic vehicles (table 1);
- only a minority of manufacturers offer systematic training which could reduce fuel consumption and emissions (table 1);
- European HDV operators do not appear as pro-active in improving the technical fuel-efficiency of their new trucks as they are in improving the operational fuel-efficiency of their existing fleet through various measures such as tyre control, axle alignment or effective fuel consumption monitoring. For instance, full skirts on the side of the body/trailer, easy to install at low cost, are not purchased in more than 70% of cases; and tyre pressure monitoring systems (TPMS), although easily accessible on the market at low cost, are not being installed in a majority of cases;

Table 1. The offer of fuel saving technologies by OEMs and body builders.

Technology	Not offered	Optional	standard
Aerodynamics			
Trailer rear end taper	67%	33%	0%
Boat tail	100%	0%	0%
Box skirts	0%	100%	0%
Cab side extension of gap fairings	0%	100%	0%
Full gap fairing	33%	67%	0%
Full skirts	0%	100%	0%
Roof deflector	0%	100%	0%
Material substitution			
Light weighting	0%	100%	0%
Tyres and wheels			
Automatic tire inflation on truck	33%	67%	0%
Automatic tire inflation on trailer	0%	100%	0%
Low rolling resistance tyres on truck	0%	33%	67%
Low rolling resistance tyres on trailer	0%	67%	33%
Transmission and driveline			
Transmission friction reduction	100%	0%	0%
Engine efficiency			
Improved diesel engine	0%	0%	100%
Hybridization			
Hybrid engine	33%	67%	0%
Management			
Training and feedback	0%	67%	33%
Predictive cruise control	0%	100%	0%

Source: CE Deflt

54 Market Barriers to Increased Efficiency in the European On-road Freight Sector, CE Delft, 2012, available on: http://www.theicct.org/market-barriers-increased-efficiency-european-road-freight-sector

55 41 transport companies, 6 shippers, 3 logistics service providers, and 3 OEM truck manufacturers.

Table 2. Overview of transport companies' awareness and implementation of different fuel-saving technologies

Technology	Not aware	Aware	Planned/ Implemented
Aerodynamics			
Trailer rear end taper	18%	82%	27%
Boat tail	56%	44%	11%
Box skirts	33%	67%	11%
Cab side extension of gap fairings	27%	73%	55%
Full gap fairing	25%	75%	33%
Full skirts	30%	70%	10%
Roof deflector	17%	83%	67%
Material substitution			
Light weighting	18%	82%	45%
Tyres and wheels			
Tyre Pressure Monitoring Systems (TPMS)	8%	92%	42%
Automatic tire inflation on truck of trailer	45%	55%	9%
Low rolling resistance tyres	9%	91%	55%
Tyre management	11%	89%	56%
Engine efficiency			
Improved diesel engine	8%	92%	83%
Hybridization			
Dual-mode hybrid	56%	44%	0%
Parallel hybrid	67%	33%	0%
Other			
Speed limiters	9%	91%	64%

Source: CE Deflt

- in spite of fuel efficiency being ranked first among purchase criteria by transport companies when acquiring a new truck, the lack of uptake of fuel saving technologies is linked to the truck purchase process where hardly any transport company uses available data to evaluate technologies or compare trucks. This is made more difficult by the absence of a commonly agreed methodology to measure fuel consumption;
- financial constraints may play an important role as well, with a large share of truck purchasing companies having recourse to borrowing and leasing. Lending institutions were reported as not taking fuel efficiency into account when providing loans for the purchase of new trucks, a situation that implies split incentives;
- split incentives exist whenever decision making on HDV purchase is separated from the benefits of fuel-saving technologies. One such split-incentive example is when shippers purchase and make investment decisions regarding fuel-saving technologies on trailers (e.g., tyre and aerodynamic features), but transport companies that own the tractors and operate the trailers would receive the potential benefits. Another split-incentive example is when transport companies operate under an open book contract, under which they can bill the shipper for the actual fuel consumption. However, few companies operate exclusively with open book contracts.

56. The most obvious findings of this study will have to be addressed in the policy responses, with a clear priority given to the most important market barriers, notably the inability of HDV transport operators to precisely assess fuel saving and CO_2 reduction effects of various technical upgrades already offered – in spite of being well aware of the existence these upgrades - and to compare the various HDV manufacturers' offers in this respect, most likely due to the absence of a commonly agreed methodology to measure fuel consumption and emissions.

57. Questions related to market barriers will be further investigated, notably bearing in mind the lack of response of SMEs and micro-enterprises which represent the largest share of the transport sector (see Annex 6, table 10) to the CE Delft enquiry that led to these results.

2.6. Voluntary unilateral commitments may help but are insufficient to significantly curb emissions

58. ***Transport operators***, and, more broadly, actors in the logistics chain can influence fuel consumption by assessing the footprint of transport and taking action to reduce it by various means such as driver training, quality control of vehicles, fleet use and vehicle load optimisation with improved IT management tools. A number of schemes have been established at a national level or Europe-wide, such as for instance the Green Freight Europe[56] scheme. These initiatives can contribute to reducing transport fuel consumption further, on top of savings possible with vehicle technology. The International Transport Union has set objectives of reducing significantly fuel consumption and CO_2 emissions by 2030 by some 20% with such means. The Commission announced support in the Transport White Paper to transport foot-printing (see annex 3). Such reductions, even though appreciable, remain far from the ambitious 2050 targets set by the Transport White Paper and, even if achieved, would have to be topped up by other means.

59. ***HDV manufacturers*** have also made some announcements and notably pledged in 2008[57] to reduce new truck CO_2 emissions by 20% by 2020. This undertaking was not monitored in the absence of a commonly agreed measurement methodology. It signals efforts to be made over the medium term, without binding obligation. Past similar undertakings from car manufacturers have failed in reaching significant car emission abatements. Basing an EU HDV $C0_2$ emission strategy on such declarations would be hazardous.

2.7. International experience in measuring HDV emissions and setting standards

60. Japan introduced in 2007 a fuel consumption rule for HDVs based on best vehicle performance. The US introduced legislation on HDV CO_2 emissions in 2011, followed by Canada. China also recently made first steps in this direction (see annex 9). The US (and Canadian) target engine and chassis-cabin CO_2 emissions, implemented via simplified performance values and manufacturers' declarations. The US Environment Protection Agency intends more ambitious legislation, focussing on the measurement of whole vehicle emissions, which would converge with the approach followed by the Commission's proposed VECTO tool.

2.8. Who is affected and how?

61. Major stakeholder groups affected include the general population, freight and passenger transport operators, logistics companies, HDV manufacturers, automotive component suppliers and fuel suppliers.

62. The EU ***population*** is increasingly affected by climate change through the increased climate variability and more frequent extreme weather events, and their related impacts. Reduced CO_2 emissions from HDV transport would thus benefit the overall population.

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56 http://www.greenfreighteurope.eu/

57 The pledge covered "modern truck" emissions expressed per tonne-kilometre, http://www.acea.be/index.php/news/news_detail/commercial_vehicle_manufacturers_push_fuel_efficiency_and_environmental_pro

63. ***Buyers of HDVs***, be it companies for their own use, logistics operators or transport operators of freight and passengers services are affected as CO_2 emissions are strictly proportional to fuel consumption that represents a high share of their operating costs.

64. ***Vehicle manufacturers*** would be directly affected by the obligation to comply with a new legislative framework to monitor or reduce CO_2 emissions.

65. ***Component suppliers*** would also be affected by increasing demand for advanced fuel saving technologies and are expected to benefit from this higher demand.

66. ***Fuel suppliers*** would also be affected by policies to lower HDV CO_2 emissions as they are likely to see lower demand for transport fuels in the future as a result of reduced HDV fuel consumption and CO_2 emissions.

67. All ***end-users of freight transport***, i.e. industry and trade sectors in the economy, and eventually consumers, would benefit from lower fuel consumption in transport provided overall transport costs, including the cost of HDVs, does not increase more than the related decrease in (fuel) operating costs. In the same way, all passenger clients from bus and coach transport services would benefit from lower bus and coach fuel consumption provided the overall operating cost of passenger transport, including amortisation of HDV equipment cost, is reduced.

68. Finally ***Member States***, in their capacity of tax authorities, would be affected by lower fuel consumption as their excise and VAT tax revenues on fuel would decrease. Conversely they would benefit from VAT collected on higher value HDVs.

2.9. Does the Union have the right to act?

69. ***Legal basis***

The EU has already acted in this area when it adopted Regulations (EC) 443/2009 and (EU) 510/2011. These Regulations were based upon the Environment chapter of the Treaty and in particular Article 175 (i.e. 192 TFEU). In the same way, the EU treaty provides the legal basis for acting on HDV fuel consumption and CO_2 emissions. The Single Market also provides grounds to act at EU level rather than at Member State level so as to ensure common requirements across the EU and thus minimise costs for manufacturers as well as distortion of competition among transport operators based in different Member States.

70. ***Subsidiarity**: **test of necessity and EU added value***

EU action is necessary in order to avoid the emergence of barriers to the Single Market in the automotive sector and because of the transnational nature of climate change. The absence of action at the European level could result in a series of national schemes to reduce CO_2 emissions of HDVs. This would be of particular disadvantage to vehicle manufacturers and component suppliers as, while the HDV market is currently Europe-wide, differing ambition levels and design parameters would require a wide range of technology options and vehicle configurations, diminishing the economies of scale. Un-harmonised action across the EU would increase the cost of compliance by manufacturers that may hold differing shares of the vehicle market in different Member States and would therefore be differently impacted by national legislation. Such market fragmentation would also affect consumers who would not benefit from lower costs and economies of scale that an EU wide policy would deliver.

71. ***Proportionality analysis***

According to EU climate and energy legislation[58], all sectors of the EU economy should contribute to achieving GHG emission reductions, including HDV road transport which is currently not subject to legislation regulating its GHG emissions. Particular attention is being further given in the present Impact Assessment to proportionality aspects of each possible means of policy intervention, that are assessed for each option when examining compliance with the policy objective of efficiency (see below section 3.2 and relevant sections of the options' assessment).

3. OBJECTIVES

3.1. General objectives

72. The Treaty foresees that environmental protection must be built into all policy areas and action to reduce climate change is specifically foreseen within the Treaty as an environmental objective. The transport sector is the second largest GHG emitting sector in the EU. In view of these factors, further action is needed and since HDVs account for a significant share of transport emissions and unlike cars and vans are not yet subject to regulation. The general objective of this initiative is to contribute to meeting climate goals by reducing CO_2 emissions in the HDV sector, in line with the objectives of the Roadmap and the Transport White Paper.

3.2. Policy objectives

73. Specific objectives of the various policy options to be assessed include:

74. Objective 1 "effectiveness" in curbing emissions : effectively contributing to reducing HDV fuel consumption and CO_2 emissions in the EU in a significant way in view of the overall objective to reduce transport GHG emissions by 60% in 2050 (compared to their 1990 level); and contributing to reducing economy-wide CO_2 emissions by a certain date, the latter being relevant in assessing instruments which have a scope beyond the HDV sector, such as the ETS;
- the relevant quantitative *indicators* for this policy objective will be (i) HDV fuel consumption and (ii) CO_2 emissions;
- the *timeline* for this objective is a medium- and long-term one as a number of preliminary short-term steps are required to address the identified knowledge gap.

75. Objective 2 "efficiency": in a cost effective and proportionate way for stakeholders and society contributing to reducing EU HDV fuel consumption and CO_2 emissions in the EU;
- the relevant *quantitative indicators* for this policy objective will be (i) administrative costs for the EU and Member States' administrations; (ii) costs and benefits for the HDV manufacturing industry; and (iii) costs and benefits for HDV fleet operators;
- the *timeline f*or this objective is a short-, medium- and long-term one, that should be assessed *ex-ante* before issuing legislation and evaluated *ex-post* following the introduction of relevant legislation.

76. Objective 3 "predictability": providing EU industry, transport operators, public sector and consumers with a clear and coherent vision on the policy framework and likely regulatory developments as regards HDV CO_2 emissions, thereby facilitating decision making and investment planning;
- *indicators*: this objective can only be monitored by thorough contact with the relevant

[58] Recital 2 of Decision n°406/2009/EC and recital 3 of Directive n°2009/29/EC.

stakeholders;
- the *timeline* for this objective is permanent : a strategy can upfront contribute to a more predictable regulatory environment, that will progressively be clarified as action is taken.

3.3. Operational objectives

77. The above objectives can only be assessed through a precise understanding of the GHG emissions from the HDV transport sector. However, these emissions are not currently monitored. Therefore, introducing requirements for monitoring, reporting and verification of GHG emissions from the HDV freight and passenger transport sector is an operational objective that must be achieved by the policy options under consideration. Operational objectives will thus consist in :
- *monitoring, reporting and verifying* EU-wide CO_2 emissions of new HDVs;
- for the *longer-term, beyond 2020, setting a quantitative constraint* on CO_2 emissions from HDV transport to achieve emission reductions. The latter operational objective is a long-term one as it can only be achieved with the support of long term policy instruments that are being considered in the present Impact Assessment.

3.4. Consistency with horizontal objectives of the European Union

78. The above objectives are consistent with the low carbon economy objectives of the Council of the European Union and the European Parliament[59] and more particularly objectives pursued under :
- the European Strategy on Clean and Efficient Vehicles (COM(2010)186);
- the Roadmap for Moving to a Competitive Low Carbon Economy (COM(2011)112);
- the White Paper on a Roadmap to a Single European Transport Area (COM(2011)144);
- the Energy Roadmap 2050 (COM(2011)885)[60];
- and, overall, the EU 2020 Strategy on a Smart, Sustainable and Inclusive Growth[61].

3.5. Trade-offs and synergies between sustainability goals

79. ***Synergies.*** Synergies between the objective of reducing HDV CO_2 emissions and the objectives of a sustainable energy and transport policy pursued under the above mentioned policy initiatives are strong: reducing HDV CO_2 emissions will at the same time reduce energy consumption, contribute to reduce energy dependency, curb the environment footprint of road transport and make it more sustainable over the long term. It will also shift added value to the manufacturing sector and contribute to growth in the EU. It will contribute to the establishment a more sustainable growth model in the EU.

80. ***Trade-offs***. Conversely there are specific trade-offs between on the one hand the objective of reducing HDV CO_2 emissions and, on the other hand, environmental and public health objectives pursued with the reduction of exhaust gas emissions and particulate matter under type approval regulations Euro V and more recently Euro VI (coming into force on 1.1.2014)[62]. The introduction of such standards in the 1990s and their regular revision over the recent years led to losses in fuel efficiency and CO_2 emissions performance, in such a way that it interrupted the previous trend of improved vehicle fuel and CO_2 performance, which as a result has broadly stagnated over the last 15 years. The report by AEA and

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59 See in particular Council Conclusions of the 20 February 2007, http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/envir/92864.pdf
60 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0885:FIN:EN:PDF
61 European Commission Communication of 3.3.2010, ftp://ftp.cordis.europa.eu/pub/etp/docs/europe2020_en.pdf
62 Regulation EC 595/2009, OJ L188/1, 18.7.2009.

Ricardo Consultants[63] estimated that the foreseen upgrade from Euro V to Euro VI emission standards as of 2014 would – if not compensated by additional technical improvements as this has been regularly the case when previous standards were adopted- result in an increase of fuel consumption and CO_2 emission by some 3%.

4. POLICY OPTIONS

Baseline: no policy change, implement already existing or already proposed policy actions that will contribute curbing CO2 emissions

81. The main baseline assumptions and features have been described in section 2.3 above (including embedded policies that were identified in section 2.2) and in more detail in Annex 4 on the modelling framework.

Methodology

82. The main methodological aspects of the present assessment are presented in annex 12.

Discarded option: additional tax on fuel for HDV Transport.

83. The current Commission proposal on a revised Energy Taxation Directive, which, as indicated above, is part of the baseline scenario, is the current reference. It foresees the inclusion of carbon pricing in the fuel excise duties. As the proposal is still under discussion, an alternative involving additional taxes for specific sectors seems unlikely in the short term.

4.1. Option 1 (short-term): Improve knowledge, comparability and accountability of HDV CO_2 emissions

(i) Determination of HDV engine-only fuel consumption and CO_2 emissions

84. From 1 January 2014 all new HDVs will be subject to the measurement of engine CO_2 emissions under the Euro VI Regulation. Those emission values would be relevant for identifying the engine performance in terms of fuel consumption and CO_2 emissions but would not be indicative of the performance of the complete vehicle. The data could hence be certified and reported. This option would require (i) an adaptation (through comitology) of the relevant type approval legislation to include information on CO_2 values for certification, and (ii) the adoption of a Decision (ordinary legislative procedure) on the reporting of engine CO_2 emissions. The authorities in charge of implementing this option would be registration and type approval authorities in Member States.

(ii) Determination of HDV full vehicle fuel consumption and CO_2 emissions

85. The absence of baseline on actual HDV CO_2 emissions is an impediment to further possible policy actions: HDV fuel consumption and CO_2 emissions are currently not recorded. For this reason the Commission is establishing a simulation tool ("VECTO", see annex 7) customised to measuring HDV fuel consumption and CO_2 emissions. A test phase starting in autumn 2012 is expected to be completed in May 2014.

86. Upon the completion of this simulation tool, this option consists in the certification of HDV (whole vehicle) fuel consumption and CO_2 emissions as calculated by the simulation tool, with the necessary proofs and checks, and the reporting of those emissions from new

[63] See section 3.2.1 page 117, http://ec.europa.eu/clima/policies/transport/vehicles/docs/ec_hdv_ghg_strategy_en.pdf

vehicles entering into service. Certification is expected to increase end-user information and awareness, facilitate comparability and stimulate competition among manufacturers in meeting best state-of-the-art performance standards. This action requires (i) an adaptation (through comitology) of the relevant type approval legislation to include the methodology for determining whole vehicle CO_2 emissions for the purposes of certification of new vehicles by Member States, and (ii) the adoption of a new Decision (ordinary legislative procedure) on the reporting of HDV CO_2 emissions. The authorities in charge of implementing this option would be registration and type approval authorities in Member States.

87. Actions foreseen under option 1 are primarily meant to address vehicle performance (driver d/ identified in section 2.2) and the "knowledge" gap market barrier that has been identified. The main addressees of these actions are vehicle manufacturers.

4.2. Option 2 (medium- to long-term): Include Road Transport CO_2 emissions in the EU Emissions Trading Scheme

88. The EU ETS is a cap-and-trade scheme established in 2005 for a range of industrial activities. Under such a scheme, emissions are capped. To meet this cap, economic actors with favourable cost reduction options are financially incentivised to implement them, while economic actors with unfavourable cost reduction options for their CO_2 emissions prefer to buy emissions allowances on the market, thus becoming net buyers on the market. The EU ETS was recently (as of 1.1.2012) extended to cover aviation CO_2 emissions. It could also conceivably be extended to new sectors. This option requires an amendment of Directive 2003/87/EC establishing the ETS.

89. It should be noted that the CO_2 component of energy taxation under the proposed Energy Taxation Directive would not be levied for installations under EU ETS. Including road transport in the EU ETS would therefore be an alternative to taxing the CO_2 emissions under the Energy Taxation Directive. It should be pointed out, that the inclusion of the transport sector in the EU ETS is an alternative to the proposal for the revision of the Energy Taxation Directive which is currently under discussion and which extends CO_2 taxation to sectors not covered by the EU ETS.

90. The Impact Assessment carried out for the revision of the ETS directive[64] considered different methods to include road transport in the EU ETS. Under a 'downstream' approach, individual owners of vehicles would be liable for compliance. Under an 'upstream' approach fuel suppliers would be defined as participants under the EU ETS. The above mentioned Impact Assessment concluded that it was too early to take a decision on these options. It seemed likely, however, that the upstream approach would be administratively less complex and have considerably lower transaction costs, as including some 1 million HDV transport operators EU-wide, most of which are micro-enterprises (see Annex 6, table 10) with a fleet of less than 10 vehicles, would be a real challenge. Under an upstream approach it would be challenging to specifically include the HDV sector, rather than the road transport sector as a whole, as fuel suppliers cannot at present monitor to whom the fuel is sold: targeting HDV consumption only, without other vehicles being included, would raise compliance issues with considerable risks of fraud.

91. In the recent *Report on the state of the carbon market* in 2012 [COM(2012)652 final], the expansion of the scope of ETS to other sectors is one of six (non-exhaustive) structural

[64] COM 2008 (16) Final

measures identified by the Commission, which could solve the structural supply-demand imbalance in the carbon market. It is therefore one of several options for ETS under consideration and development, and could impact policy making for HDVs in the longer term.

92. Provisionally, this Impact Assessment will take the upstream inclusion of the entire road transport sector into EU ETS as the option to be considered. As with the other options, the effectiveness, efficiency and predictability of this option will be assessed, however not only from the perspective of the HDV sector itself, but also from an overall climate policy perspective. Considering the links it creates with other sectors, further studies would however be required to fully assess, in a quantitative way, the possible design and *modus operandi* of this option.

93. Inclusion within the ETS would contribute addressing emission drivers (c) on the carbon content of fuels and indirectly also (e) on the operation of HDV fleets that were identified in section 2.2. The main addressees of this option would be fuel suppliers (directly) and HDV operators (indirectly).

4.3. Option 3 (medium- to long-term): Introduce legislation setting mandatory HDV CO_2 emission ceilings

94. Setting CO_2 emissions ceilings or fuel consumption targets has been the EU chosen approach on cars and vans. A pre-requisite to such an option is the possibility to measure, certify and report emissions: this implies that Option 1 is a prerequisite to Option 3.

(i) Option 3.i: set performance ceilings on engine-only CO_2 emissions of new registered vehicles

95. Following the full entry into force of the Euro VI Regulation in January 2014, HDV engine emissions are being measured[65]. Subject to the prior establishment of a reporting scheme, engine CO_2 emission standards would be introduced in the following years. This option requires the adoption of an EU Regulation under ordinary legislative procedure.

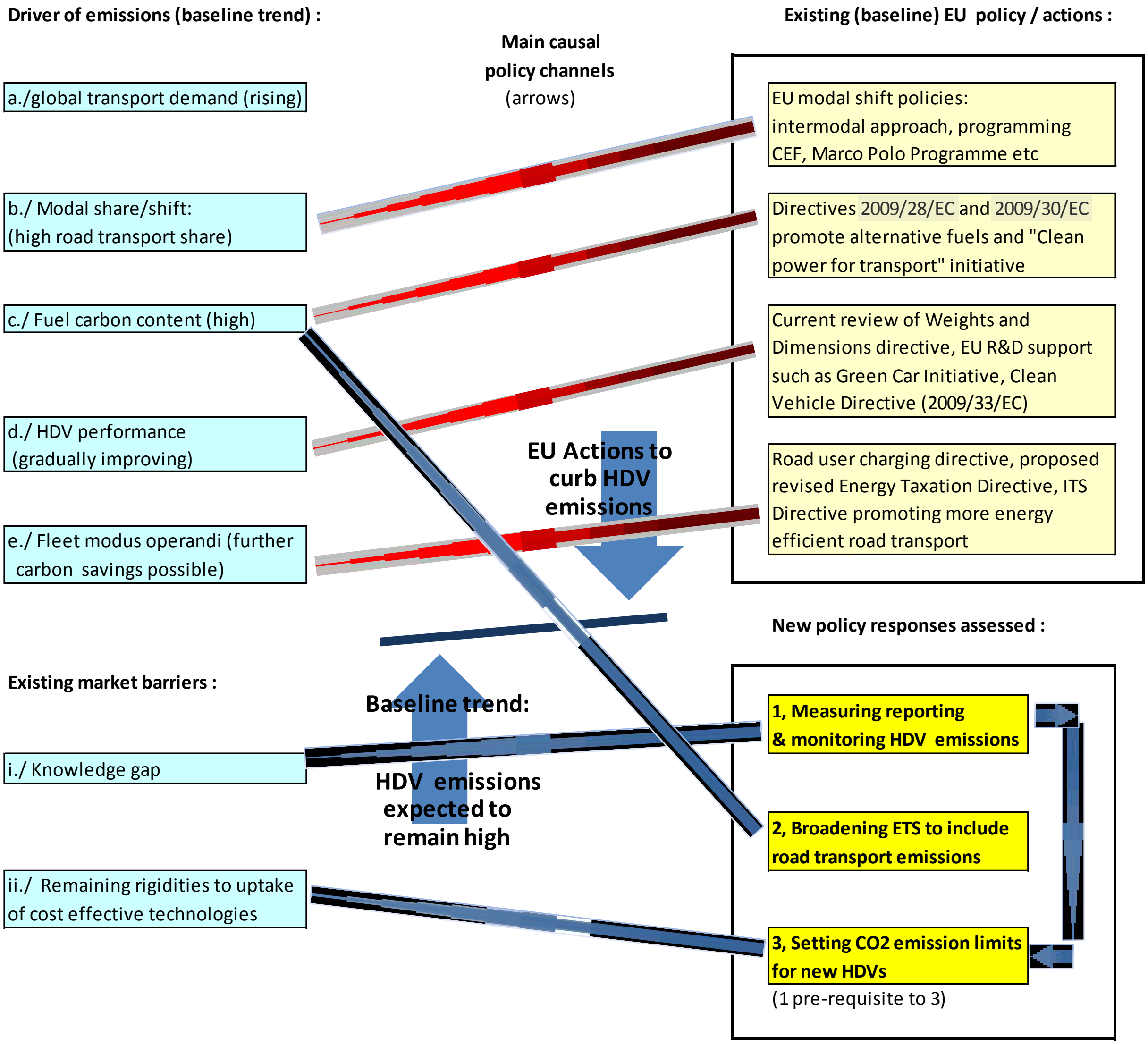
(ii) Option 3.ii : set performance ceilings on HDV whole vehicle CO_2 emissions of new registered vehicles

96. To reap the full benefits of available technologies a regulatory approach establishing emission standards/ceilings could, in the same way as for cars and vans, accelerate the roll out of more energy efficient HDVs on the market, that would emit less CO_2. This option requires the adoption of an EU Regulation under ordinary legislative procedure. Prior to this, the simulation tool under development will have to become fully operational, and option 1.ii be implemented.

97. Option 3 addresses the uptake of technological innovation to increase vehicle performance (driver (d) of HDV emissions identified in section 2.2). It is expected to provide a strong response to existing market barriers. First, in complement with option 1, by further increasing awareness and enhancing transparency and comparability among new models, thereby addressing the identified knowledge gap. And second, by setting emission limits that become industry performance targets, addressing core residual rigidities in the uptake technological change leading to energy savings. The main addressees of this action are vehicle manufacturers.

65 The date of entry into force of the Euro VI Regulation is 31st December 2012 for new engines and 31st December 2013 for all engines (new vehicles only).

Problem tree: addressing HDV CO2 emissions



5. IMPACT ANALYSIS OF POLICY OPTIONS

98. The baseline scenario has been assessed (see section 2.3) and considered unsustainable in view of the EU policy objectives to curb emissions in general and more specifically in the transport sector. Other options will be assessed against this baseline.

99. Option 1 can only address short-term transparency and knowledge needs while options 2 and 3 are key medium- and long-term components of a comprehensive strategy. Given long-term policy goals, these must be considered as well. However a full assessment of option 2 is only possible once the current Carbon Market Report consultation of stakeholders, and a series of studies, is completed. Option 3 can only be realised upon the successful implementation of option 1. While an assessment of its potential impacts has been carried out, a full re-assessment of this option is necessary before deciding whether to introduce emission limits.

5.1. Option 1 assessment: Improve knowledge, comparability and accountability of HDV CO_2 emissions

Option 1(i) Determination of HDV engine-only fuel consumption and CO_2 emissions

100. Following the entry into force in 2014 of the Euro VI Regulation, engine CO_2 emission values will be measured and can hence be collected and monitored. This option is limited in scope: engines are only one component of the vehicle, and engine-only emissions recorded with the agreed test cycles under the Euro VI Regulation only partly reflect full vehicle on-road emissions.

101. In terms of ***effectiveness***, this option, while raising awareness of engine performance – provided the necessary methodology[66] can be established for this-, is not expected to directly and materially affect vehicle performance beyond the engine itself. It will thus not capture the bulk of HDV CO_2 emissions. It could indirectly play a role in establishing a track-record enabling manufacturers to compare all HDV engines' performance in relation to their respective power, thereby stimulating competition to align production on best performing engines. Increased transparency and competition may translate into a few percentage points fuel efficiency and CO_2 savings.

102. In terms of ***efficiency***, this option will have a low marginal (additional) cost. The additional costs involved are: (i) administrative costs related to establishing a methodology and amending the relevant type-approval Regulation; (ii) administrative costs of reporting the measured emissions at national level, and (iii) administrative costs related to the adoption and implementation of an EU reporting legislation.

103. As regards ***predictability*** of the regulatory environment affecting stakeholders' decision making, this option is expected to provide guidance, and could be a first step part of a broader package, already signalling the importance of cuts in CO_2 emissions to the HDV industry.

104. ***Economic***[67]***, and social*** impacts of this option are negligible.

105. Only negligible ***environmental*** impacts (related to other exhaust gases and particulate matters regulated under Euro VI) can be expected as fuel consumption would not be materially affected. Even assuming slightly lower fuel consumption (and CO_2 emissions), HDV manufacturers may optimize engines in such a way that lower fuel consumption and CO_2 emissions may not lead to significant overachievements to existing thresholds in air pollutants (as set under Euro VI), as there is no linear relationship between engine fuel consumption and air pollutant emissions.

106. Provided the necessary methodology is established beforehand, there have been no identified ***risks*** associated to the implementation of this option.

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66 Under the current EURO VI legislation for HDV all values for the engine are measured in g per kilowatt hour (g/kwh). Therefore also the measured fuel consumption is measured as g [fuel]/kwh or g [CO2]/kwh. The metrics and the reference is totally different from the perspective of a typical truck customer who is used to have a metrics for fuel consumption in litres per 100 kilometres (l/100km). This would not provide practical customer information. Also, the measurement under the current EUROVI legislation uses one more or less artificial cycle for all engines. Considering the different use of the engines in the different trucks (long haul, regional delivery, construction, coach, bus etc.) the actual measured fuel consumption is not representative for all the different duties of the trucks. This requires some adaptation through a proper methodology to be established.

67 Other than already mentioned administrative costs.

Option 1(ii) Determination of HDV whole vehicle fuel consumption and CO_2 emissions

107. Contrary to experience in the case of cars and vans, there is no agreed method of recording HDV CO_2 emissions: each country having considered an HDV rule thus needs to base itself either on dynamometer measures, simulation tools, real driving condition tests, manufacturers' declarations or default values. Given that real driving condition tests are not an option for all registered vehicles –this would be too cumbersome and costly- methods pursued so far are a combination of the other means.

108. While simulation appears the most promising avenue, there is currently no open public simulation tool able to reliably measure whole vehicle HDV CO_2 emissions. OEMs have a number of such tools, that are however calibrated and designed according to their specific needs, and provide non comparable results. The EU VECTO simulation tool under development aims at addressing this gap and providing a reliable measurement of HDV CO_2 emissions, that could be made available not only within the EU, but in other countries as well. This would open the possibility of international cooperation and even possibly facilitate regulatory convergence. In order to enhance consumer information and awareness the option considered may also entail a form of labelling.

109. ***Effectiveness.*** Effectiveness of this option in curbing HDV fuel consumption and CO_2 emissions is expected to be real even though limited: this action would establish a reliable track record of whole HDV emissions, independent from each manufacturer's measurement, providing reliability and transparency to the market as to real vehicle performances. This would be expected to increase awareness among fleet operators on the most cost effective vehicles to operate, and influence decision making in purchasing new HDVs. While a precise quantification of this action's effect over time (this would apply only to new vehicles and only progressively affect the whole HDV fleet) on HDV fuel consumption and emissions in the EU is not possible (there is no reliable methodology for such an assessment), its impact is however not expected to be considerable in curbing HDV CO_2 emissions in view of the Transport White Paper's objectives. Emissions may only be reduced by a maximum of a few percentage points.

110. ***Efficiency***. The costs involved would be: administrative costs incurred in preparing and adopting the legislation; VECTO development and operation (costs supported by the Commission); registration and reporting costs for national authorities, as well as monitoring cost of the Commission; and for HDV OEM manufacturers, preparing and submitting HDV technical data for the assessment and registration of HDV CO_2 performance. An indicative assessment was carried out (see annex 12), except for the last category (costs for the OEM manufacturers). This assessment suggests that administrative costs :
- for Member States' type approval authorities would be limited and possibly comprised between €130.000 and €650.000, under the assumption that OEMs would register vehicles by series with homogeneous characteristics (and not individually); part or the totality of these costs would be charged to OEMs by type approval authorities;
- for the Commission, costs are related to preparing the legislation, monitoring[68] developments, and the development and operation of the VECTO tool, and would possibly be comprised between around € 0.7 million annually.
A more complete assessment of costs –including for OEMs- will only be carried out at a later stage. Such an assessment would also need to take into consideration the cost of

[68] Monitoring costs could be shared with the European Environment Agency.

proofs and checks of the certification procedure to be carried out. Overall in view of its expected limited costs this option would meet the efficiency objective.

111. ***Predictability.*** While this option would be insufficient to provide strong guidance to stakeholders in decision making and investment decisions, it is a preliminary step to option 3. As such it would contribute establishing a predictable regulatory environment.

112. ***Economic and social impacts***. This option is not expected to trigger material ***economic*** impacts, beyond those already listed above. A more transparent HDV market would contribute to an improved level playing field among HDV manufacturers and transport operators. While this option would create a few jobs linked to the preparation / submission of data by manufacturers, and the implementation of the simulation tool and reporting on HDV emissions at national and European levels, no further material ***social*** impacts of this option have been identified.

113. Only negligible ***environmental***[69] impacts (related to other exhaust gases and PMs already regulated under Euro VI) can be expected. While the relationship between total non-CO2 pollutant emissions and energy consumption may not be linear since pollutant emissions per kwh may vary, it seems reasonable to assume that pollutant emissions will slightly decrease. Quantitative estimates cannot be provided at this stage.

114. ***Risks*** to this option are related to the setting up of the VECTO simulation tool. While the current development of this tool is progressing satisfactorily, success cannot yet be fully guaranteed. A failure to finalise the simulation tool would jeopardize the implementation of this option.

Stakeholders views on option 1

115. The establishment of the VECTO simulation tool to measure HDV CO_2 emissions is supported by ACEA, its members, and component manufacturers. ACEA established a technical working group that provided input in the development of the tool, e.g. on the definition of vehicle categories and driving cycles that need to be agreed to measure emissions. In the two stakeholder consultation meetings that took place in February and July 2012, stakeholders generally supported sub-option 1 (ii). One engine manufacturer was however also in favour of sub-option (i) on the measurement of engine-only emissions.

5.2. Option 2 assessment: Include Road Transport CO_2 emissions in the EU Emissions Trading Scheme

116. As indicated above (section 4.2), the assumption in the present Impact Assessment is that HDV transport would be integrated into the EU ETS with road transport as a whole. This would take place upstream, with fuel suppliers defined as participating entities within the ETS. Fuel suppliers' related costs –i.e. purchasing emission allowances on the ETS carbon market that are required to meet the ETS policy cap- would be contingent upon the level of the policy cap and the carbon price, and expected to be passed through to HDV operators (and in the same way, to light-duty vehicles' users) in the fuel price.

Effectiveness

69 CO2 emissions have been dealt with under the impact on "effectiveness", and are not considered in this section on "environmental" impacts that applies to exhaust gases and particulate matters, which are Regulated by the Euro V and, as of 2014, the Euro VI Regulations.

117. While an option based on mandatory limits aims to improve the technical CO_2 efficiency of new HDV vehicles, this measure takes a broader perspective. It also incentivises operational CO_2 improvements in the HDV sector, as well as potential shifts towards low carbon fuels and modes. This measure would therefore be consistent with potential energy system changes such as the move towards alternative fuels (whether it is electricity, gas, second generation biofuels or hydrogen), and could therefore support the Clean Power for Transport Initiative (as described under the baseline). The reason is that a switch to such fuels would require incentives for the use of these fuels consistent with their carbon content. It is to be noted that an electrification of road transport leads to the inclusion of electric vehicles in EU ETS by default.

118. As inclusion in the EU-ETS is a cross-sectoral measure, affecting the distribution of effort between sectors, as well as modal and fuel shift, a full assessment would need to consider this broader perspective. Given the long-term nature of these processes, and the link with other parameters such as fuel prices, overall climate ambition, technological developments and infrastructure requirements, long term scenarios would be required to analyse in detail the expected effects. These issues are beyond the scope of the present analysis.

119. The EU-ETS extension to road transport would be effective in reducing economy-wide CO2 emissions. As the regulator has control over the total number of allowances and as compliance is enforced through Monitoring, Reporting and Verification (MRV) and strict penalties, the effectiveness of meeting the cap on emissions for all sectors covered by the system over a prescribed period of time is largely guaranteed under a cap-and-trade scheme such as the EU ETS, taking into account flexibilities allowed under the system (e.g. banking). This reduction is highly certain and immune to rebound effects. Would a rebound effect occur within one sector, the sector in question would have to buy allowances on the market, thus contributing to reductions elsewhere.

120. The effectiveness of the ETS would be more limited in terms of incentivising the CO_2 efficiency of new HDV vehicles, as foreseen under option 3. The reason for this is two-fold:
- first as the system allows more flexibility as to in which sectors and by which means emission reductions are to be achieved, other and cheaper options may be available;
- secondly, a market based instrument such as the ETS is less well suited to address specific market barriers, such as those described in the problem definition : market barriers may prevent the price signal to have a material effect on technological or operational improvements.

121. Additional non-market instruments, from improving the quality and dissemination of data and knowledge, to standard setting, could therefore still be needed.

122. For the HDV sector, cost abatement curves for technical measures calculated with fuel savings alone (see Annex 10) and fuel savings topped up with a carbon price virtually coincide as long as carbon prices are low. Under such circumstances, including road transport in the ETS (indirectly via fuel suppliers) would provide a limited incentive to invest in technical measures to improve vehicle technologies and would most likely not trigger any sizeable reduced HDV fuel consumption in view of low fuel use price elasticities[70]. Such a development would prevent the HDV sector from fully contributing to

[70] See "Price sensitivity of European Road Freight Transport, towards a better understanding of existing results". Survey for Transport and Environment by CE Delft and Significance, June 2010, available on : http://www.transportenvironment.org/sites/te/files/media/2010_07_price_sensitivity_road_freight_significance_ce.

the Transport White Paper's objectives, although a shift to lower carbon fuels (such as gas) might still occur.

Efficiency

123. The *technical feasibility* of the inclusion of road transport in the EU ETS was already considered in the 2008 Impact Assessment accompanying the proposed revision of the ETS Directive 2003/87/EC, which concluded that this would potentially be technically feasible. In the case of upstream integration through participation of fuel suppliers, administrative burdens would probably be limited, as monitoring could be based on the already mandatory monitoring of fuel trades for energy taxation[71]. A full assessment of the modalities under which transport could be included in EU ETS is however beyond the scope of this impact assessment.

124. A market instrument will in principle incentivise all possible abatement options, including yet unknown technical measures, behavioural and operational changes. The wide range of abatement options considered across sectors covered by the ETS should lead to a more efficient outcome. The allocation within ETS sectors of emission abatement efforts along the most efficient cost structure, with costs minimised and investments realised in those sectors with the most favourable marginal abatement costs ensures a high level cost effectiveness and efficiency of this instrument.

125. Furthermore, a level playing field is established among participants to ETS: all emitters of CO_2 face the same market carbon price, irrespective of sector or fuel used. There would in this respect be no difference in the carbon price faced by (electric) freight rail, aviation and HDV road transport.

126. In so far as revenues from the ETS are used to support climate policy goals, within or outside the HDV sector, further abatement, or a lowering of abatement costs, are both possible. To give a single example, recent research using endogenous technology models has shown[72] that combining support for research and development with a market incentive will improve dynamic efficiency compared to the market incentive alone, by lowering the long term costs of abatement. In addition, previous impact assessments have shown positive macro-economic effects in terms of jobs and growth of revenue recycling, for instance by lowering labour costs.

127. The above does neither prejudge, nor prevent, a possible unilateral inclusion of a number of transport operators in the ETS pursuant to Article 24 of the ETS Directive (2003/87/EC) which is possible any time, e.g. the inclusion of some of the largest transport operators in Member States applying pursuant to Article 24 provisions.

Predictability

128. One the recognised advantages of a cap-and-trade scheme consists in ensuring some predictability as to the quantity of emissions that will be allowed overall. The (indirect) inclusion of HDV transport in the EU ETS would, for those liable, contribute to a high

pdf. The survey concludes that freight fuel consumption elasticity to fuel price increases is low, at only 0.3% (a fuel price increase of 1% triggers a fuel consumption reduction of only 0.3%).

71 It should be noted that it is very unlikely that the existing monitoring system for energy tax would match the requirements for ETS, therefore, a certain level of modification to existing rules on tax warehouses and to movement control would most probably be necessary.

72 See, for instance, Acemoglu et al. American Economic Review 2012, 102(1): 131–166 http://pubs.aeaweb.org/doi/pdfplus/10.1257/aer.102.1.131

degree of predictability on the quantitative effort that needs to be made in contributing to curbing EU CO_2 emissions. In this sense, predictability provided by this option is very high and the emissions reduction (or the "cap") set by legislation will be reached, with no chance of overshooting, for instance due to rebound effects. In addition, the definition of the cap on a long term basis and the carbon price creates the necessary transparency for market operators to make informed decisions. Nevertheless, fuel suppliers made accountable, and indirectly HDV operators, will be faced with uncertainties in the price inherent to markets that may make it more difficult for them to respond to potential price signals. In this sense this option includes a degree of uncertainty.

Economic, social, and environmental impacts

129. ***Economic impact***s of this option are to a large extent contingent upon the evolution of the carbon price. A full analysis of the economic impacts of ETS expansion to the transport sector is beyond the scope of this impact assessment. Depending on the modalities by which it is implemented, it would generate costs to sectors where the abatement potential is low, benefits to other economic actors within the carbon market –unless market barriers prevent such benefits to be grasped-, and a decline in fuel imports. Effects on modal shift and fuel switch are likely.

130. The manner in which the revenues of ETS are generated and used has a large influence on the economic impacts**.** Using the revenues to lower tax rates on labour could have large social benefits for employment. This has been most recently analysed in the accompanying *Member state results* (SWD(2012) 5 final) of the *Analysis of options to move beyond 20% greenhouse gas emission reductions and assessing the risk of carbon leakage* COM(2010)265 final.

131. Implementing this option would likely generate opportunity costs for HDV fleet operators, if market barriers to the uptake of less carbon intensive technologies within the sector are not removed.

132. Inclusion of the transport sector in the EU ETS will have an effect on carbon prices, though the size and direction of this effect depends on the modalities of its inclusion. Some researchers have argued that too stringent caps on transport would risk raising carbon prices by a large amount, due to low elasticities in the sector. Others dispute this conclusion[73] and argue carbon prices could even drop under certain circumstances.

133. Any future analysis of the ***distribution*** of economic effects due to the inclusion of transport in the ETS shall require assumptions about the generation and use of revenues from ETS. It is clear however, that those revenues could be used to reach distributional goals or mitigate some of the effects of ETS inclusion.

134. Given assumptions on the use of revenues, further analysis would at the very least need to take into account: a) effects linked to actual investments possibly taking place to improve performance (also see assessment of option 3 below); b) effects linked to the cross sectoral trade of emission allowances within the ETS; and c) effects linked to reduced fuel consumption, for the state, the transport sector, oil companies and balance of payments d) effects linked to modal shift.

[73] Flachsland et al. *Energy Policy* 39(4): 2100-2110: Climate policies for road transport revisited (ii): Closing the policy gap with cap-and-trade.

135. ***Overall potential social impacts*** of the inclusion of transport CO_2 emissions in the EU ETS are expected to be minimal. The ETS would replace the carbon taxation in the proposed Energy Taxation Directive (the revised draft directive would only apply to non-ETS sectors) which is included in the baseline. The effects on the price of transport, which generate the above social impacts, are therefore muted by the fact that a different source of carbon pricing would be removed. Some job creations would be related to the use of revenues, and others attached cross-sectoral reallocations of value with sectors from which ETS allowances would be purchased by fuel suppliers.

136. ***Environmental*** (other than CO_2 emissions) impacts, beyond the achievement of overall CO_2 objectives, would be related to the sectors where abatement takes place, modal shifts and fuel switches.

Risks to this option

137. Further analysis and research is needed to investigate the feasibility of this option, related risks, and modalities under which a scope expansion of the ETS to the whole road transport sector could be carried out.

Stakeholders views on option 2

138. In the 3 July 2012 stakeholder meeting, HDV industry and transport services stakeholders generally argued that it was important to widen the analysis and conduct further studies into the possible benefits of joining the ETS scheme. One NGO suggested rejecting this option, noting that a previous consultation that took place in a Member State reached such a conclusion.

5.3. Option 3 assessment: Introduce legislation setting mandatory HDV CO_2 emission ceilings

139. While the EU has only regulated HDV exhaust pollutant emissions so far, Japan (2007), the US (2011) and more recently Canada (2012) have introduced rules to curb HDV fuel consumption or CO_2 emissions in various ways. Setting such rules for HDVs may facilitate regulatory convergence over the long term.

Option 3(i): set performance ceilings on engine-only CO_2 emissions of new registered vehicles

140. This option should be seen as the continuation of option 1(i) which considers the certification and reporting of engine-only emissions that, as of 1.1.2014, will start being measured as foreseen in the Euro VI Regulation. Once a baseline is established with reference values over a significant period, limits on engine CO_2 emissions could be established with appropriate metrics (as a function of the engine power). This would require the adoption of a new Regulation through the ordinary legislative procedure. Altogether this process will require several years before standards can actually be established.

Effectiveness

141. The effectiveness of this option in curbing fuel consumption and CO_2 emissions is proportionate to the potential of economically achievable CO_2 emission cuts in HDV (mostly diesel) engines. The latter potential is related to this option's rather limited scope, since HDV CO_2 emissions are not only a function of engine, but also transmission, auxiliaries, rolling resistance, and aerodynamics. One risk associated with this option is

linked to its focus on conventional fuel engines only that may become increasingly irrelevant and limited in scope with the progressive penetration of hybrid technologies.

142. The CE Delft study on abatement cost curves estimated the potential for reduced engine emissions. This suggests that on average about a third of the technical savings feasible to reduce whole vehicle emissions would be achievable at the level of the engine (see table 1, Annex 8). These estimates may however not fully materialise:
- while the reported negative marginal cost estimates are averages on technology packages, some single independent components within these packages may have positive marginal abatement costs, which would imply that they would not be included, and hence that the level of economically sustainable increased engine performance and reduced CO_2 emissions would be lower than assumed;
- the combination of several technologies may not allow for a strict addition (through incremental multiplication of percentages gained) of individual abatement rates: interactions in a system such as a full vehicle or an engine may not allow for this.
OEMs further argued in bilateral contacts with the Commission that thermal efficiency limits (of a rate of some 52% thermal efficiency vs. some 43-45% currently) make every percentage point gained on engine efficiency extremely challenging.

143. Furthermore, the scope of engine CO_2 emission measurement under Euro VI is ring-fenced and appears narrower than the above estimate on engine-related abatements. For instance, while waste heat recovery on exhaust engine gases allowing for some of the estimated emission abatements is included in the above estimate, the measurement of CO_2 emissions foreseen under Euro VI would not cover those, and thus any limit on engine-only emissions would need to disregard waste heat recovery technical upgrades (which according to one OEM estimate allow for a reduction in fuel consumption and CO_2 emissions of some 3% on a Euro VI engine).

144. CO_2 emissions benefits of improved engine technologies for new vehicles could possibly comprised be between 10% and 12% of the whole vehicle emissions (table 1, annex 8), i.e. some 28% to 34% of the total savings that are achievable through HDV technical upgrades. Assuming regulatory objectives with such abatement rates set for the year 2030, this would allow for HDV CO_2 emission abatements of some 5% to 7% by 2030 (whole fleet efficiency improvements are always delayed versus new vehicles'). By 2030, this would represent EU-wide annual savings in HDV CO_2 tailpipe emissions - versus the baseline scenario - comprised between 16.3 and 19.6 Mt CO_2.

Efficiency

145. This option would be implemented through legislation. Beyond the preparatory work and administrative costs that this involves, it would not trigger any additional administrative costs (for the Commission and Member States) other than those already necessary for the implementation of option 1(i) on the certification and reporting of engine emissions. OEMs would recover extra costs in the price of HDVs sold and, assuming limits are set at breakeven level of marginal abatement cost curves, HDV operators would recover additional purchase prices with fuel savings made (see table 3 below). In proportion of its possible benefits it can thus be considered as efficient.

Predictability

146. Establishing engine-only limits for HDV CO_2 emissions would contribute to establishing a more predictable regulatory environment in the same way as the one that has been established for cars and vans, and provide some guidance to HDV engine manufacturers –

mainly the OEMs- in their decision making and investment, including for the purpose of their R&D programmes. In view of the Transport White Paper objectives this cannot be the unique policy response to the identified problem: other complementary actions would be needed to curb CO_2 emissions. In this respect, it will not alone provide the comprehensive degree of predictability that stakeholders, particularly OEMs, are expecting.

Economic impacts

147. Economic effects of this option mainly relate to (i) technical upgrade investments in more fuel and CO_2 efficient engines to comply with regulatory limits and the distribution of the eventual burden for these efforts; (ii) the fuel saving effects distribution among the various stakeholders, and their effects for the EU as a whole:
- i/. Technical upgrades of engines needed to comply with a regulation on engine-only CO_2 emissions would be contingent upon the regulatory limit level chosen. Assuming a regulatory limit set at breakeven level of technology upgrades, and further assuming that by 2030 all new registrations would comply with the regulatory limit, the annual additional cost of HDV upgrades would amount to around €6,300 for each vehicle (see table 1, Annex 8) and €5.1 b for the whole EU[74]**.** This cost would be passed on to HDV fleet operators in the vehicle price. One should take into consideration as noted above that by the time costs to achieve such engine improvements may most likely have fallen sharply;
- ii/. This should be compared with the benefits and possible distribution of economic impacts related to HDV fuel consumption savings. Even with conservative assumptions on fuel savings benefits -lower than the ones reported by TIAX and CE Delft- an engine-only CO_2 emissions rule would possibly result in fuel benefits for HDV fleet operators at least outweighing additional investment costs in upgraded HDVs, with Member States losing excise tax revenue (they would conversely benefit from VAT collected on higher value HDVs), and oil companies losing significant turnover and gross margins. The EU as a whole could see its oil imports reduced by some €5.8 to 6.9 b annually (indicative values, see table 2 in Annex 8).

Table 3 Summary of option, indicative distribution of annual economic impacts by 2030 vs. the baseline

Economic impact summary	in euro (billion2010€)	2030 annual cost (-) benefit (+)
Net impact of option for:		
HDV manufacturing industry: increased production value		+5,1
HDV fleet operators		
- increased vehicle purchase price	-5,1	
- fuel savings	+14,4 to +17,3	
Net impact HDV fleet operators		+9,3 to +12,2
Oil companies : reduced turnover		-6,7 to -8,1
Member States : reduced tax income		-7,6 to -9,2

Source: European Commission

148. Annex 9 further assesses competitiveness aspects of the setting of possible regulatory limits on HDV emissions. The EU HDV industry would be expected to benefit as a whole from improved fuel and CO_2 efficiency of its production and remain competitive vis-à-vis other regions of the world that are also expected to progressively require increased HDV fuel performance and reduced CO_2 emissions.

[74] In 2010 euros. assuming an annual HDV fleet renewal of around 0.8 million by 2030 as assumed in the Primes-Tremove baseline. This estimate assumes no effect of engine upgrade requirements on HDV demand (additional vehicle costs being more than recovered through fuel savings).

149. Overall, the HDV manufacturing industry (mainly OEMs that produce the engines, and component manufacturers) would gain additional production value, and fleet operators would significantly reduce their operating costs: both would benefit from the introduction of emission limits on HDV engines. The EU as a whole would benefit from reduced fuel consumption. Under the assumption of a competitive environment reduced HDV fleet operators' operating costs would be passed on downstream to their clients in their prices and onwards to the whole economy, making it more competitive as a whole.

Social impacts

150. Assuming a competitive environment –and thereby a pass-through of economic benefits to their clients- HDV fleet operators would not directly see any employment impacts (unless second round effects trigger higher transport volumes; such possible effects have not been assessed, see methodology in annex 13).

151. With reduced fuel imports and added value in the HDV industry which has a positive trade balance, the social impacts of a regulatory requirement would normally be expected to be positive. Employment losses would be expected in the oil refinery and distribution industry, with conversely job creation in the HDV industry, mainly within OEMs and possibly some component manufacturers. The balance between positive and negative employment effects can be approximated in view of the respective labour intensity of oil companies and automotive manufacturers. Given the high labour intensity in the automotive industry compared to the oil industry (achieving a turnover of €1 billion requires on average 3,600 employees in the HDV industry and 380 employees in the oil companies), oil companies would be expected[75] to lose a small amount of jobs (potentially 1,500 to 2,000) compared with the potential amount of job creation in the automotive industry (potentially some 18,000 job creations). These indicative values suggest an overall favourable employment impact of the option. While the oil refinery and distribution industry is fairly evenly distributed among Member States[76], close to consumption markets, this is not the case for HDV manufacturing, with 5 countries (Germany, the Netherlands, France, Sweden and Spain)[77] accounting for 75% of the EU production: this implies an uneven geographical distribution of employment benefits.

Environmental impacts

152. Favourable environmental impacts (related to other exhaust gases and particulate matters already regulated the Euro VI) are not to be excluded, if significantly lower engine fuel consumption allows for reduced pollutant emissions. This can however not be taken for granted, since HDV manufacturers may optimise engines in such way that significant overachievements to existing thresholds in air pollutants (as set under Euro VI, with pollutant limits expressed as a ratio per kWh) would not necessarily derive from reduced engine fuel consumption and CO_2 emissions. Hence, while the environmental impact of this option can only be positive due to lower engine fuel consumption, it may not be sizeable: there is no linear relationship between fuel consumption and air pollutant emissions. Quantitative estimates of environmental benefits of this option cannot be provided at this stage.

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75 Assuming constant labour productivity

76 With some exceptions however: Belgium and the Netherlands have higher than average share and are net exporters; conversely some very small countries do not have any oil refinery and are net importers of oil refined products, see Annex 6, table 11.

77 See Annex 6, table 1.

Risks

153. Risks to this option are minimal, its main pre-requisite is the prior implementation of option 1(i). One important risk however that is associated with this option is that its emphasis on conventional fuel engines may become partly irrelevant with the evolution of technology, notably hybridisation that it will not capture.

Stakeholder views

154. In the stakeholder consultation on 22 February 2012, one engine manufacturer supported this option. In the stakeholder consultation meeting of 3 July 2012, two participants provided comments. ACEA considered that engine only limits would not provide consistent incentives and may not be the most cost effective option. Transport & Environment, while concurring with ACEA, nevertheless suggested to pursue mandatory recording and reporting of engine CO_2 emissions in parallel with that of full vehicle emissions.

Option 3(ii): set performance ceilings on whole HDV CO_2 emissions of new registered vehicles

155. This option considers the setting of emission limits for new EU registered HDVs in the same way as followed for cars and vans to act upstream on vehicle performance and the renewal of the fleet with more energy efficient vehicles. Vehicle manufacturers would be made accountable for compliance with the regulated limits on new vehicles' emissions. This option requires the preliminary completion of the VECTO emissions simulation tool and prior implementation of a reporting regulation (see section 5.1 on option 1.ii). As long as a precise record of these emissions is not available, setting limits for new registered vehicles cannot take place in a reliable way. This implies that this option is a medium- to long-term one.

Effectiveness

156. Curbing vehicle emissions cannot take place overnight: rolling-out technical upgrades is a process that needs to be managed over time, taking into consideration the rhythm of fleet renewal: the lifetime of HDVs is on average around 11 years, with important variations among vehicle categories (buses and coaches appear to have a longer lifetime than trucks). Assuming for instance (see below) CO_2 emission limits set for 2030, their fully-fledged roll-out for the whole EU HDV fleet would not materialise before 2040. Estimates on progress that can be achieved are an approximation of information available ex-ante, that may turn out to be under- or over-optimistic. The same applies to costing estimates of such technical upgrades. Benchmarks need to be established with a long term view and regular updates and corrections to integrate latest developments.

157. The absence of a clear baseline on HDV emissions –as long as they are not recorded in a reliable way- further implies caution as to estimates on the potential for fuel savings and CO_2 emission abatement. The TIAX study, which reviewed the findings of AEA-Ricardo (see section 2.4), estimated the potential for abatements on a generation of Euro VI 2014 vehicles with technologies widely available over the period 2015-2020 that could be rolled out to the EU HDV fleet by 2030. Both the abatement potential and the costing estimates only give a photograph at the time of the study (December 2011) and will have to be reviewed.

158. Notwithstanding these limitations, available estimates (from AEA-Ricardo and TIAX on emissions abatement potential and related costs, and CE Delft cost curves) provide an

indication on the direction and magnitude of the medium- and long-term potential for HDV CO_2 emission reductions. These are used on an indicative basis in the present Impact Assessment, taking note of some reservations expressed by a few OEMs, and without at this stage deciding on any limit values. They would be reviewed in due course in case this option is implemented.

159. Reported marginal abatement rates of breakeven levels for technical upgrades that could improve suggest two main categories of vehicles: (i) those for which hybridisation is already expected to be a beneficial upgrade, i.e. vehicles with a frequent "stop and start" drive cycle –municipal utility vehicles, urban delivery, construction, and buses- that could achieve on average a 43% cut in their fuel consumption and emission levels (with technologies expected to be available over the 2015-2020 period); and others – service, regional delivery, long haul, and coaches- for which hybridisation is not yet beneficial, which lowers the potential for emission abatements, on average 31% : costs may however go down with mass production and technical improvements, which would significantly influence estimates made by CE Delft on breakeven levels (see cost curves study) and possibly allow for some of these vehicle categories to breakeven for hybrid. Even for the latter category there appears to be a considerable potential. Setting limits would imply a close assessment of the potential improvement that can reasonably be expected for each category, with important variations across vehicle categories. As noted for option 5.i, overestimates of the emissions abatement potential may take place.

160. Notwithstanding upside and downside risks on estimates – which may to some extent neutralise each other - the AEA-Ricardo, TIAX and CE Delft analysis provide a useful indicative assessment of the abatement potential, that will be re-assessed in due course.

161. Using this weighed potential of some 35% (see table 3 in Annex 8) of emission abatement as an indicative 2030 reference target (for a regulation applying to 2014 Euro VI reference HDVs) would imply that new HDV emissions could be reduced in 2030 by some additional 20% vs. the baseline scenario that assumes a +/- 1% annual improvement in fuel efficiency of new registered HDVs over the period 2015-2030. Setting such limits would normally take place with intermediate steps and several reviews to adjust market uptake objectives with actual ones and technical and economic possibilities.

162. Assuming on an indicative basis-regulatory requirements setting such limits for 2030 –i.e. a reduction of 35% of CO_2 emissions vs. 2015 levels - are introduced no later than in 2020, and a progressive adjustment of new vehicle registrations with this objective, this fuel efficiency and CO_2 emissions reduction objective would translate into fleet efficiency improvements of a lower level by 2030 (possibly around 12.4% below the baseline scenario estimates for 2030[78]) with subsequent HDV fleet emission savings of 36.7 $MTCO_2$. The full impact would further materialise beyond 2030 with the rolling out of the emissions limit for the whole EU HDV fleet (the full effect on fleet emissions would materialise only by 2040). As moving targets would most likely be introduced, beyond 2030 further CO_2 emission reductions would be achieved with more ambitious reduction levels.

163. The current impact assessment does not assess potential "rebound" or "second round" effects (see methodology in annex 13): if fuel consumption can be effectively curtailed by

[78] This estimated -12.4% reduction of HDV fleet emissions by 2030 is lower in % terms than the TIAX and AEA-Ricardo reports' estimated ones (respectively -28% and -25%), the main reason being that TIAX used a different baseline with the b-a-u scenario of the AEA-Ricardo Lot1 report that foresees increasing HDV emissions over the period 2015-2020.

double digit percentage values as expected with this option, operational costs of HDV transport may decrease – subject to the evolution of fuel prices – and demand could increase for this mode of transport in spite of other transport modes – particularly rail – being less carbon intensive. Some of the CO_2 emission benefits of this option would thereby be lost due to higher HDV transport activity. This risk should not be underestimated: such rebound effects would have to be monitored closely and addressed. At this stage, as the extent to which such rebound effects may occur is also very much contingent upon the evolution of the market price of fuel (expected to increase), no other operational conclusion on this issue can be reached than the need for close monitoring.

Efficiency

164. Industrial costs and benefits are assessed below under the section on economic impacts. Given that this option already assumes the implementation of a certification and of a reporting regulation on HDV CO_2 emissions (see above indicative assessment of administrative costs under option 1.ii), the only additional administrative costs involved are (i) administrative costs related the adoption of the new regulation itself, (ii) administrative costs on the side of national authorities and vehicle manufacturers related to compliance with this regulation and its implementation and monitoring, and (iii) monitoring costs. Assuming OEMs which produce the engine-chassis-cabin of vehicles would be accountable for CO_2 emissions, their limited number (eight) would facilitate implementation. In view of the likely benefits of curbing CO_2 emissions (as reported in table 4), and provided economic benefits at least outweigh costs (which would be guaranteed by recourse to regulatory objectives based on marginal emission abatement costs' breakeven levels) it can be concluded that this option complies with the efficiency objective.

Contribution to the predictability objective

165. Setting medium- and long-term CO_2 emission objectives for new registered vehicles would enable HDV manufacturers - in particular OEMs that at least produce the cabin, chassis and motor, - to plan ahead the development of their new models in liaison with component manufacturers that provide a number of technical upgrades. This process is already taking place with cars and vans with favourable results, allowing car manufacturers to plan investments and upgrades required for their new models. This will also facilitate renewal choices of HDV fleet operators, mainly transporters, and give them an indication of fuel savings that may be achievable with upcoming models. It can thus be expected that this option will contribute to improve predictability on the regulatory environment and thereby facilitate investment and decision making for the main stakeholders.

Economic impacts

166. As in the previous option on engine-only limits, the main economic impacts of this option relate to: (i) technical upgrade investments in more fuel and CO_2 efficient vehicles to comply with regulatory limits and the distribution of the eventual burden for these efforts, as well as the chain of consequences that this may imply in particular for the HDV industry and also HDV fleet operators; and (ii) the fuel saving effects distribution among the various stakeholders, and their effects for the EU as a whole.

167. Investments in necessary technical upgrades can be approximated on the basis of marginal abatement curves produced by CE Delft and breakeven levels. The first low cost upgrades are expected to take place in any event under the baseline scenario. They would under a regulation setting limits be topped up by additional upgrades to reach the regulated level by

2030. On an annual basis, the cost of fleet renewal (new HDVs registered) would accordingly be increased by some €11,300 per vehicle, i.e. €9.2b with the baseline Primes-Tremove estimate of annual vehicle registrations in 2030 (see table 4 in annex 8)

168. This cost would represent a corresponding annual turnover increase (€ 9.2b) for the HDV automotive industry, with the related added value shared among OEMs, body/trailer builders and component manufacturers. It represents a sizeable commercial opportunity for the industry.

169. Against this investment needed to upgrade HDV performance, the cost of which would be passed on to HDV fleet operators, the latter would be expected to make significant savings in fuel consumption more than compensating for the increased HDV price: having determined the regulatory limit with the breakeven point of marginal abatement costs would ensure that savings will be more important than costs. Annual savings for the HDV fleet would amount to some 12.4% of fuel consumption by 2030.

Table 4: Summary indicative[79] distribution of annual economic impacts by 2030 vs. the baseline

Economic impact summary in euro (billion2010€)	2030 annual cost estimate
Net impact of option for:	
HDV manufacturing industry: increased production value	9,2
HDV fleet operators	
- increased vehicle purchase price	-9,2
- fuel savings	32,4
Net impact HDV fleet operators	23,2
Oil companies : reduced turnover	-15,2
Member States : reduced tax income	-17,2

Source: European Commission

170. The analysis of distribution effects shows, as in previous options, that HDV fleet operators would be the first beneficiaries of improved vehicle performance with fuel savings of about €32 billion annually by 2030 vs. the baseline assumed level. Under the assumption of a competitive environment, this benefit is expected to be passed on downstream to their clients, and would benefit the whole EU economy, making it more competitive by reducing the cost of transport. Moreover, reduced fuel consumption would trigger a favourable balance-of-payments benefit through a reduction in oil imports of some €13billion by 2030 (annex 8, table 5). As a consequence Member States would lose fuel excises revenue and oil companies fuel sales and related margins.

171. Overall, the indicative distribution of potential effects of this option among the main EU stakeholders is the following (table 4 above), compared with the baseline scenario. Introducing CO_2 emission limits set at marginal breakeven abatement cost levels would hence be beneficial for the EU economy, reduce its energy dependency, and create new growth opportunities for the HDV industry. While HDV fleet operators are expected to be the primary beneficiaries of this policy measure, its benefits would under the assumption of a competitive economic environment be passed on to end-users of transport and eventually consumers through reduced transport prices.

[79] The Reference scenario 2010, developed with the PRIMES-TREMOVE model, has been finalized in the beginning of 2012 and has been calibrated on available statistics for the year 2005. Therefore, results for HDVs registrations for 2010 in PRIMES-TREMOVE represent projections rather than historical data and are different from recent Eurostat 2010 HDV registration data. The 2030 projections on HDV registrations should be regarded as an indication on the nature, potential magnitude and direction of the main impacts, bound by the uncertainties associated with the projections. As mentioned in annex 13, "second round" effects have not been assessed either, that could trigger increased transport activity as a result of lower costs vs. the baseline assumptions.

172. ***Competitiveness***. As already mentioned in the case of option 3.i, Annex 10 further assesses competitiveness aspects of the setting of possible regulatory limits on HDV emissions. The EU HDV industry is highly competitive, has a positive trade surplus and specialisation index in HDV production and trade. It would further be expected to benefit as a whole – both OEMs and component manufacturers- of improved fuel and CO_2 performance of its production –by adding value to its products- and improve its competitiveness vis-à-vis other regions of the world that also already require (Japan, US, Canada, China) or are expected to require increased HDV fuel performance and reduced CO_2 emissions.

173. It can be concluded that the economic impacts of this option are favourable for the EU, prone to support innovation improving HDV performance, employment, competitiveness and growth, and to reduce energy dependency.

Social impacts

174. One of the important potential economic effects of this option (see table 4) is a shift of added value:
- from the oil refinery and distribution sector that would lose some significant amounts of fuel demand and hence need to curb its production;
- to HDV manufacturing that would have to increase the value of its production by incorporating on new vehicles technical upgrades needed to reduce fuel consumption and CO_2 emissions in line with the regulatory limits objectives.

175. This implies potential employment losses in the first one, and job creations in the second. The net balance has to be examined in light of both sectors' respective labour intensity: generating €1 b turnover requires on average 380 employees in the oil industry, vs. 3 600 in the automotive industry, i.e. a labour intensity 9.5 fold more important in the automotive sector[80]. As estimated in table 4, the potential turnover impact of this option (vs. baseline scenario) may in 2030 amount to:
- € 9.2b additional turnover for the automotive industry;
- reduced turnover of some € 15.2b in the oil industry (indicative values).
Given the above compared labour intensities, this shift could potentially translate into 5.800 job losses in the oil industry –under constant labour productivity assumptions-, compared with job creations of some 33.000 in the automotive industry[81] (indicative values). This assessment does not include potential job creations through spill-over effects in component and auxiliary manufacturers' companies, which would be sizeable as well.

176. The conclusion of such estimates, while not a forecast, confirms a very favourable impact of this option on employment. The expected geographical distribution of such employment benefits is :
- on one side expected to be rather evenly distributed among Member States as regards job losses in the oil industry, except for a few countries such as the Netherlands that have an over-representation of refinery production, or conversely very small countries without refineries;
- this is unlikely to be the case for jobs gained in HDV manufacturing, with five countries[82] accounting for about 75% of the total EU production (see annex 6, table 1), which suggests an uneven distribution of job benefits.

[80] See annex 6, table 9.
[81] Assuming similar and constant labour productivity, as in the previous section.
[82] Germany, the Netherlands, France, Sweden and Spain.

177. As regards HDV operators of freight and passenger services, assuming a continued competitive environment –and thereby a pass-through of this option's economic benefits to their clients- there would not be direct employment impacts of the present option (unless second round effects trigger higher transport volumes which have not been assessed). Finally the economy would benefit of a more competitive transport industry, with employment benefits spread over the whole economy.

178. This indicative assessment is consistent with the recent findings of a recent *literature review on employment impacts of GHG reduction policies for transport* that confirms positive effects in terms of jobs creation[83].

Environmental impacts

179. Under the Euro VI Regulation HDV non-CO2 pollutant emissions are regulated on the basis of permitted mass of pollutant emissions per KWh. In view of this, CO_2 reducing measures which reduce total power use of the HDV would lead to a corresponding reduction in aggregate pollutant emissions. Generally, cost effective measures that will be deployed reduce energy use since they reduce energy losses for example through improved aerodynamics or reduced friction. While the relationship between total non-pollutant emissions and energy consumption may not be linear since pollutant emissions per KWh may vary, it nevertheless seems reasonable to assume that pollutant emissions will decrease with fuel consumption savings made as a result of application of these measures. Quantitative estimates cannot be provided at this stage.

Risks

180. Risks to this option mainly relate to (i) a satisfactory completion of the simulation tool development to measure HDV CO_2 emissions; and (ii) to a subsequent satisfactory implementation of option 1.ii. As long as these preliminary steps have not been fulfilled a regulation setting limits based on a reliable record of emissions cannot be introduced. Finally, while the risk of rebound effects of fuel consumption has not been assessed quantitatively, it should not be underestimated and would have to be both monitored and to the extent needed addressed in due course.

Stakeholders views on option 3.ii

181. HDV industry and transport operators, as well as some logistics companies were generally reluctant as regards the introduction of new binding emission limits, and instead favoured industry initiatives to improve the energy efficiency of HDV vehicles and the footprint of operating HDV fleets. One Member State supported this view, others considered that the introduction of emission limits would need to be envisaged. OEM and transport operators' representatives considered that end-users, i.e. transport operators, should reap clear economic benefits of such mandatory limits in case they are introduced. Some stakeholders suggested not to exclude alternative fuels from the solution eventually pursued, which would imply taking into consideration well-to-wheel emissions.

[83] CE Delft report , July 2012 by S.de Bryun, L. Brinke, B.Kampman, M. Koopmann, Commissioned by the European Climate Foundation.

6. COMPARING THE OPTIONS

6.1. Comparing the options in terms of effectiveness in reducing fuel consumption and CO2 emissions

182. Improving transparency and knowledge of HDV emissions on whole vehicle emissions (option 1.ii) may contribute to curbing emissions by raising awareness, and facilitating benchmarking of vehicles and fleet performance.

183. Based on the above assessments, the option expected to trigger the highest HDV fuel savings and CO_2 emission reduction is the setting of CO_2 limits for whole vehicles (3.ii), followed by the option setting limits for engine-only CO_2 emissions (3.i). These options would contribute to an accelerated uptake of technological improvements within the sector. The inclusion of transport in EU-ETS (option 2) would be the most effective in delivering overall GHG objectives, as the goals set by the cap would be met without any risk of rebound effect. Options 2 and 3 are furthermore not mutually exclusive.

6.2. Comparing the options in terms of efficiency

184. The setting of CO_2 emission limits for engine-only CO_2 emissions (option 3.i seen in conjunction with option 1.i), may have slightly lower costs compared to the setting of whole-vehicle emission limits (option 3.ii seen in conjunction with option 1.ii which has higher administrative costs), due to costs associated with the development and operation of the VECTO simulation tool on HDV emissions necessary under options 1.ii and 3.ii. Setting emissions limits for the whole vehicle will however most effectively address the uptake of abatement technology and overall achieve cost efficient emission reductions. If the inclusion of road transport in the ETS is implemented by targeting fuel suppliers, the administrative burden for this option will be limited, as the existing infrastructure for fuel taxation could be used. ETS extension would aim for maximum cost-effectiveness across all sectors covered, but would be less appropriate to exploit the negative cost abatement potential that is untapped because of market barriers. Finally option 1, even as an intermediate step, would involve limited costs, while contributing to curbing emissions, and thus comply with efficiency requirements.

6.3. Summary of intervention logic: policy mix.

185. The various options presented complement each other and potentially constitute a consistent package addressing the main drivers of HDV CO_2 emission increases, and addressing problems that have been identified. Options can be implemented simultaneously and/or independently, except option 3 that requires prior implementation of option 1.

186. Drivers of emission increases would be addressed by various means:
- the ***carbon content of fuels*** : the inclusion of road transport in the ETS (option 2) and the introduction of emission limits (option 3) would further incentivise low carbon fuels;
- ***performance of new vehicles*** is expected to be fostered by increased knowledge and transparency under option 1 and boosted by mandatory limits on vehicles' emissions under option 3;
- ***good practices in HDV fleet operation*** will benefit from option 1 that would increase awareness on fuel consumption and CO_2 emissions and facilitate energy savings in HDV fleet operation.

Table 5 Policy mix: how do options address emission drivers and identified barriers

	Option 1: Improve knowledge, comparability and accountability for HDV emissions	**Option 2: Include road transport emissions in EU ETS**	**Option 3: Set mandatory CO_2 emission limits for new registered vehicles**
Main addressees of actions	HDV manufacturers	Primarily fuel suppliers, indirectly fleet operators	HDV manufacturers
Drivers of emissions directly addressed			
c./carbon content of fuels	Increase awareness on emission performance of low carbon fuels	ETS inclusion due to foster use of low carbon fuels in road transport	Foster sale of vehicles with engines using low carbon fuels (including hybrids) and use of the low carbon fuels
d./ performance of new vehicles	Improve transparency +comparability among new vehicles and thereby foster fuel and CO2 performance based competition		Emissions ceilings becoming industry performance targets fostering uptake of low carbon technologies
e./ modus operandi of HDV fleet	Increase awareness of fleet operators on fuel consumption and CO2 emissions	Pass-through carbon pricing in fuel price and thereby reduce fuel consumption (see assessment section 5.2)	
Market barriers			
- knowledge gap has a market barrier effect	- revised legislation to register emissions, -new legislation to report emissions		Further increase awareness by introducing mandatory emission limits
- rigidities in uptake of cost effective technological change leading to energy savings			Emissions ceilings becoming industry performance targets that prevail on resistances to uptake of low carbon technologies
Timeline	Short-term	Medium- to long-term	Medium- to long-term
Inter-dependence between options	Stand-alone	Stand-alone	Prior completion of option 1 required

187. Market barriers would also be addressed by complementary actions:
- the ***knowledge gap*** would be addressed by option 1 which is meant to focus on this issue;
- *rigidities in the uptake of carbon saving cost effective innovation* would be phased out if emission ceilings are introduced (option 3) and become industry targets internalised by vehicle manufacturers.

188. As regards the **timeline**, option 1 is a short-term (completing simulation tool VECTO) and medium-term one (amending exiting type-approval legislation, enacting new one). Including road transport within the ETS (option 2) or introducing mandatory emission limits (option 3) have a medium- to long-term horizon notably, in the case option 3, as it is contingent upon prior implementation of option 1.

6.4. Contribution of the options to the objectives

189. The ETS option (option 2), even though addressing fuel suppliers, provides clarity on overall emission reduction objectives: by construction, the ETS sets a cap that if needed

will be complied with by trading carbon with other enterprises/sectors. The two ***options*** suggesting limits on engine-only (3.i) and whole vehicle emissions (3.ii), like the cars and vans regulations, provide certainty as to the future standards and vehicle upgrades that will be required. Compliance costs (abatement costs of each technology), as shown in the AEA-Ricardo and TIAX studies, are broadly known in these two options, even though as in the case of cars and vans may turn out *ex-post* to have been over-estimated *ex-ante*. Option 1 on the adoption of regulatory requirements establishing more knowledge and transparency on the level of emissions would contribute to more market clarity.

Table 6: Comparison of Options in view of 3 main pursued objectives

Options / Objectives	Baseline	Option 1: Improve knowledge, comparability and accountability for HDV CO_2 emissions	Option 2: Include road transport CO_2 emissions in EU ETS	Option 3: Set mandatory CO_2 emission limits for new registered vehicles
Effectiveness in reducing fuel consumption and CO_2 emissions	**- (low)**	**+** **Modest reduction of HDV emissions**	**+ likely (low) for HDV, though potentially high (+++) for the rest of the economy in sectors with lower marginal abatement costs**	**(i) engine-only emissions ceiling: ++ (medium)** **(ii) whole-vehicle emissions ceiling +++ (high)**
Efficiency	**=**	**+** **Modest costs**	**+** **Could use existing fuel taxation infrastructure,**	**(i) motor-only emissions ceiling: +++** **(ii) complete vehicle emissions ceiling ++**
Predictability of regulatory environment	**Currently no clear perspective.**	**+ some partial degree of improvement calling for further clarifications**	**++ on emission levels (fixed by cap)** **- on costs due to uncertainty of carbon price evolution**	**(i) motor-only emissions ceiling: +** **(ii) complete vehicle emissions ceiling : ++**

6.5. Impacts for SMEs, including micro-enterprises

190. ***Impacts for SMEs in the manufacturing industry***. The design and production of complete trucks, tractors, or motor-chassis-cabins is a highly concentrated industry dominated by OEMs. However, SMEs play an important role within the industry of component manufacturers and also that of trailers manufacturers and body builders. Option 1 would not be expected to have sizeable impacts for SMEs of the manufacturing industry. Neither would option 2 on ETS inclusion that would apply to operations of HDVs with effects on manufacturing, given that emission abatements would be externalised to ETS participants in other sectors. Option 3 on the setting of limits would be expected to trigger a higher

value for the EU HDV manufacturing industry as a whole that would benefit both OEMs and SMEs producing components, trailers or HDV bodies.

191. ***Impacts for transport operators, most of which are micro-enterprises.*** As shown in Annex 6, table 10, haulage companies with more than 50 trucks represent less than 3% of the total EU truck fleet, while companies with less than 10 trucks represent around 84% of the fleet: freight remains to a large extent an activity of very small firms. Turnover data (Annex 6, table 6) suggest that firms are even smaller for passenger transport, with an average turnover per enterprise of only € 0.3 million, versus € 0.5 million for freight enterprises. Option 1 on increased transparency will facilitate the choice of energy efficient HDVs for transport SMEs and thereby contribute lowering their operating costs. Option 2 on ETS inclusion of the transport sector would use existing fuel taxation infrastructure. It could raise operating costs if SMEs are not able to overcome market barriers to the uptake of abatement measures. If these can be overcome, SMEs could profit from ETS inclusion, depending on the way the scope expansion is designed. If used for this purpose, the use of revenues from ETS could further help SMEs. Option 3 on setting HDV CO_2 emission limits will affect SMEs in the same way as all transport operators (see section 5.3) with additional costs to purchase increasingly efficient HDVs, benefits due to fuel savings, and an overall net benefit provided regulated emission ceilings are set close to the breakeven level of marginal abatement cost curves.

192. ***Overall, micro-enterprises*** would not be directly subject to options 1 and 3 that are addressed to HDV manufacturers, nor directly to option 2 which is addressed to fuel suppliers. Option 2 would only potentially marginally affect the fuel purchase price that they have to pay. They could potentially benefit from more transparency in the market (option 1), and more efficient vehicles as a result of option 3. There does hence not appear to be a real case, should a number of these options be implemented, for sheltering micro-enterprises from EU actions and legislation in this respect.

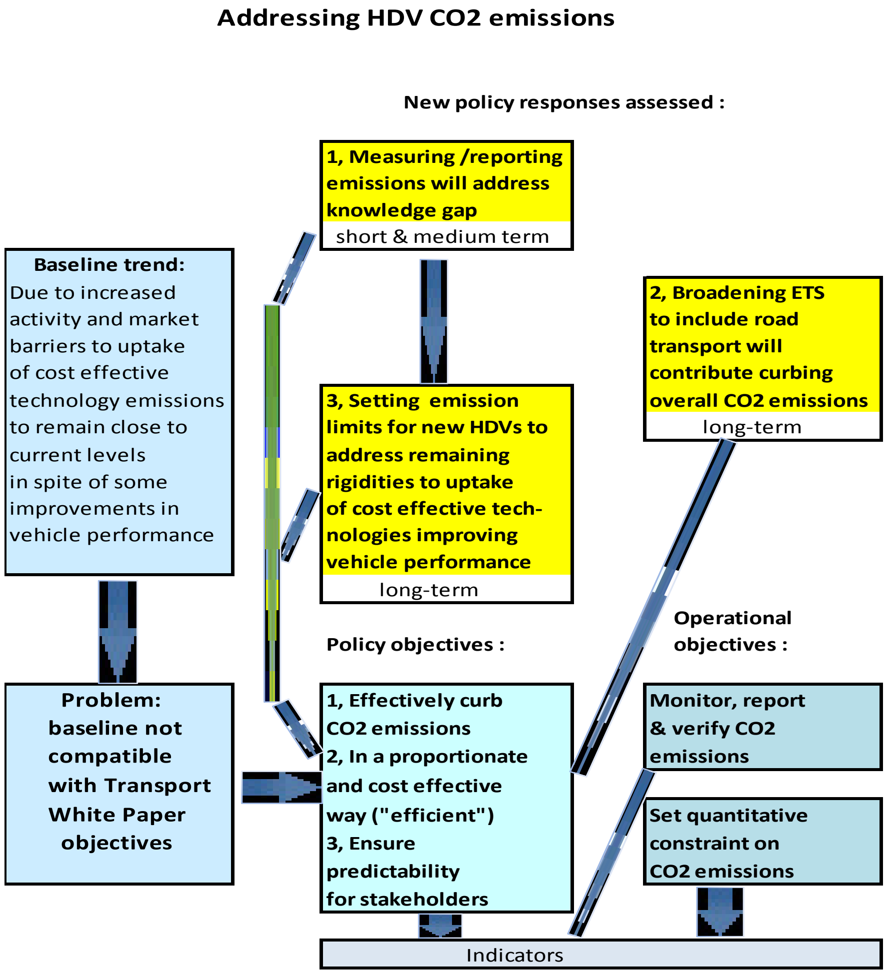
6.6. Comparing the options in terms of coherence with EU objectives

193. Beyond the specific objectives considered in this Impact Assessment, the broader EU objectives (see section 3.4) to which it relates are mainly:
- sustainable growth;
- the decarbonisation of the EU economy, with the overall policy objective of GHG emissions reduced by some 80-95%% in 2050 vs. 1990;
- sector specific objectives as defined in the Transport White Paper, with the objective of reducing CO_2 emissions in the transport sector by some 60% in 2050 vs. 1990 levels.

194. Option 1 on improving knowledge and transparency of HDV CO_2 emissions and Option 3 on the introduction of mandatory CO_2 emission limits for new vehicles contribute to lowering the transport sector's CO_2 emissions and hence overall EU CO_2 emissions. Option 2 on the inclusion of road transport CO_2 emissions in the EU ETS would reduce overall CO_2 emissions with a high degree of certainty. It would be consistent with potential energy system changes such as the move towards electrification of road transport, and the use of gas and biomass in all energy related sectors. A level playing field would be established for the participants to ETS, irrespective of sector or fuel used. Revenues from the ETS could be recycled into various goals. On its own, however, ETS extension would not tackle market barriers to the uptake of more energy efficient technologies, which leave economic benefits unrealised. Because of this, and at current market prices, it would not materially

lower emissions in the HDV sector, and guarantee this sector's contribution to the objectives of the Transport White Paper.

195. Option 3.ii on the setting of limits for whole-vehicle emissions, would, by overcoming market barriers to the adoption of negative cost-technologies, significantly reduce the transport services' operating costs and would make them more competitive and contribute to a more competitive EU economy as a whole. It would also be effective in reducing energy consumption and emissions and thus contribute to a more sustainable EU economy, with reduced EU oil imports and energy dependency. As is shown is section 5.3, by shifting value and jobs from the oil industry to the HDV manufacturing industry, it would contribute to industrial growth, competitiveness, and employment. This option is however sensitive to rebound effects, making the overall reduction less certain. Targets which require the uptake of abatement measures with positive marginal costs might be more difficult to enforce, unless incentives are given to lower these marginal costs. Being a medium and long term option with preliminary requirements, i.e. the completion of the HDV emissions simulation tool under development and the implementation of option 1.ii, it would thus support the medium and long-term growth agenda beyond 2020, looking towards the 2030 horizon. This legislative action would furthermore overall support innovation and job creation in the HDV manufacturing industry.



6.7. Concluding remarks

196. This Impact Assessment underpins a Commission strategy for reducing HDV fuel consumption and CO_2 emissions in the EU. Any subsequent legislative proposal will be subject to a more specific Impact Assessment.

197. Options 1(i) on the recording of engine-only emissions and subsequently 3(i) on setting limits on engine-only emissions would only have been considered further if the VECTO simulation tool's feasibility were not confirmed. In April 2013 the Joint Research Centre issued a report on the "proof of concept" of the VECTO simulation tool confirming that it can provide accurate and reliable estimates of HDV fuel consumption and CO_2 emissions and that a future certification scheme of CO_2 emissions could be based on such a simulation tool. In view of this latest positive development options 1(i) and 3(i) will hence not need to be considered further.

198. The current market is characterised by a lack of knowledge and comparability of actual HDV CO_2 emissions. The successful deployment of the VECTO tool and the implementation of option 1(ii) on the certification and reporting these emissions are expected to remedy this situation.

199. These are necessary priority short and medium-term steps before more ambitious actions can be envisaged in the medium and longer term:
- either to curb HDV CO_2 emissions – option 3(ii) on the setting of emission limits;
- and/or to consider including HDV transport with road transport as a whole into the ETS as foreseen under option 2. As regards the latter option, more research is needed on the modalities of addressing road transport emissions as a whole, and examining whether they could and should be addressed upstream by making fuel suppliers accountable on behalf of road transport in the ETS.

Subject to their eventual design both options may not be mutually exclusive and require further in depth analysis in the framework of future Impact Assessments.

7. MONITORING AND EVALUATION

Monitoring

200. ***Effectiveness objective***: with regard to the effectiveness objective, monitoring is closely linked to a successful deployment of the VECTO simulation tool. The foreseen short and medium-term follow-up developments are: the completion of the HDV CO_2 emissions simulation tool, which requires a close monitoring of its performance and reliability throughout its development process; a possible adaptation of the type approval legislation; and a new regulation proposal to record information on HDV CO_2 emissions (option 3.ii). Once an HDV emission simulation tool is in operation together with registration and recording legislation, this will provide the data required to monitor the effectiveness of the present strategy. The main quantitative ***indicators*** in this respect will be (i) new vehicle fuel consumption and (ii) CO_2 emissions for each HDV category.

201. ***Efficiency/cost proportionality objective***: upon the introduction of certification and reporting legislation, detailed enquiries shall assess implementation costs: quantitative indicators will consist in administrative costs that lie with the European Commission, national authorities, and the HDV manufacturing industry.

202. ***Predictability objective***: will be monitored through close inter-actions with stakeholders and enquiries on their degree of awareness of EU policy in this field.

203. Commission Services will further continue to closely monitor market and technological developments in this field.

Evaluation

204. Evaluation of this strategy and its various options will only come at a later stage, upon its implementation.

Annexes

ANNEX 1: RESULTS OF THE PUBLIC CONSULTATION

REDUCING CO_2 EMISSIONS FROM ROAD VEHICLES

RESULTS OF THE PUBLIC CONSULTATION

SEPTEMBER 2011–DECEMBER 2011

In line with the Commission's commitment to transparent and interactive policymaking 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 or the Commission services.

EVALUATION OF THE ONLINE STAKEHOLDER CONSULTATION ON REDUCING CO_2 EMISSIONS FROM ROAD VEHICLES

1. SUMMARY HIGHLIGHTS

This document provides an evaluation of the responses from individuals and stakeholders to a public consultation (conducted through an online questionnaire) on reducing CO_2 emissions from road vehicles. In total, 3 233 responses were submitted via the online questionnaire. The online consultation was only available in the English, German and French languages, and the majority of responses came from stakeholders/individuals from the United Kingdom, Germany and France. Responses were also submitted from organized stakeholders (137 out of 3233), with very active participation from companies/professional associations followed by NGOs.

While there was some differing views between respondents on the appropriate methods, policies and initiatives for reducing road vehicle emissions, there was an overwhelming consensus that the reduction of CO_2 emissions from road vehicles is a key aspect in the EU effort to reduce greenhouse gas (GHG) emissions and slow down the effects of climate change. Some respondents acknowledged the progress to date in this particular policy area, however, the main theme identified in the majority of responses was a desire for Europe to continue focussing on and improving its efforts to reduce CO_2 emissions from road vehicles. A large number of respondents, primarily individuals, felt that binding legislation with ambitious targets was essential if overall road vehicle emissions are to continue to be reduced. On the other hand, some representatives of vehicle manufacturers raised concerns over setting new long-term targets and called for the focus on implementation of the existing legislative framework, highlighting that the targets in place are already challenging.

A range of initiatives and policy areas were highlighted as being important in the on-going effort to reduce CO_2 emissions from road vehicles. These included measures to affect consumer purchasing decisions, the need to provide further education for the public, the development of public transport, a modal shift to less energy and resource intensive modes of transport, the need to further incentivise the development of and research into alternative fuels and fiscal measures to incentivise the use and development of cleaner vehicles.

Some of the main obstacles to reducing CO_2 emissions from road vehicles identified by respondents are a lack of ambition in terms of targets, resistance from manufacturers, an over reliance on personal vehicles and a lack of promotion and incentives to encourage the development and purchase of more efficient vehicles. The majority of comments focussed on light duty vehicles, although comments were also submitted in respect of heavy duty vehicles.

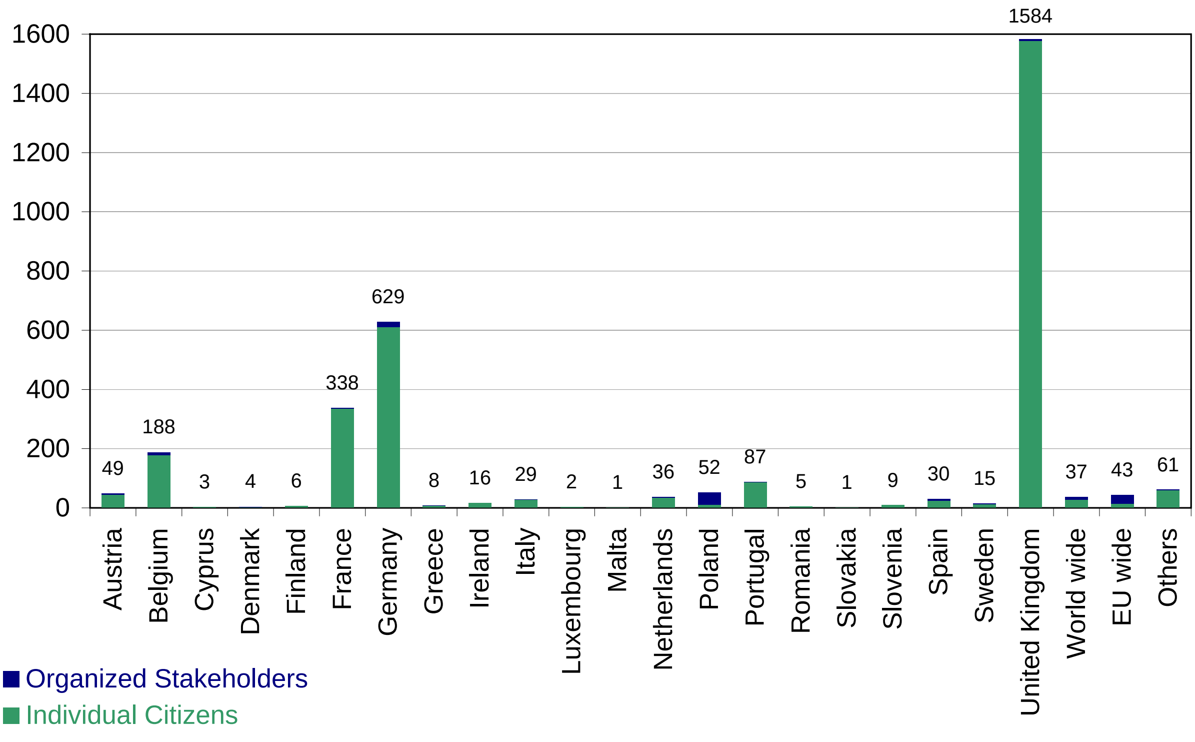
2. INTRODUCTION

The Climate Action Directorate-General of the European Commission launched this public consultation on road vehicle CO_2 emissions as part of its preparation for a revision of Regulation (EC) No 443/2009, Regulation (EC) No 510/2011 and the development of a HDV strategy. The consultation was open from 16 September 2011 to 09 December 2011. It was conducted online through an interactive questionnaire which was posted on the website of DG Climate Action http://ec.europa.eu/clima/consultations/0012/index_en.htm together with additional documents as required in the stakeholder consultation guidelines (protection of personal information note and specific privacy statement).

3. BASIC QUANTITATIVE DESCRIPTION (EVALUATION OF PART A)

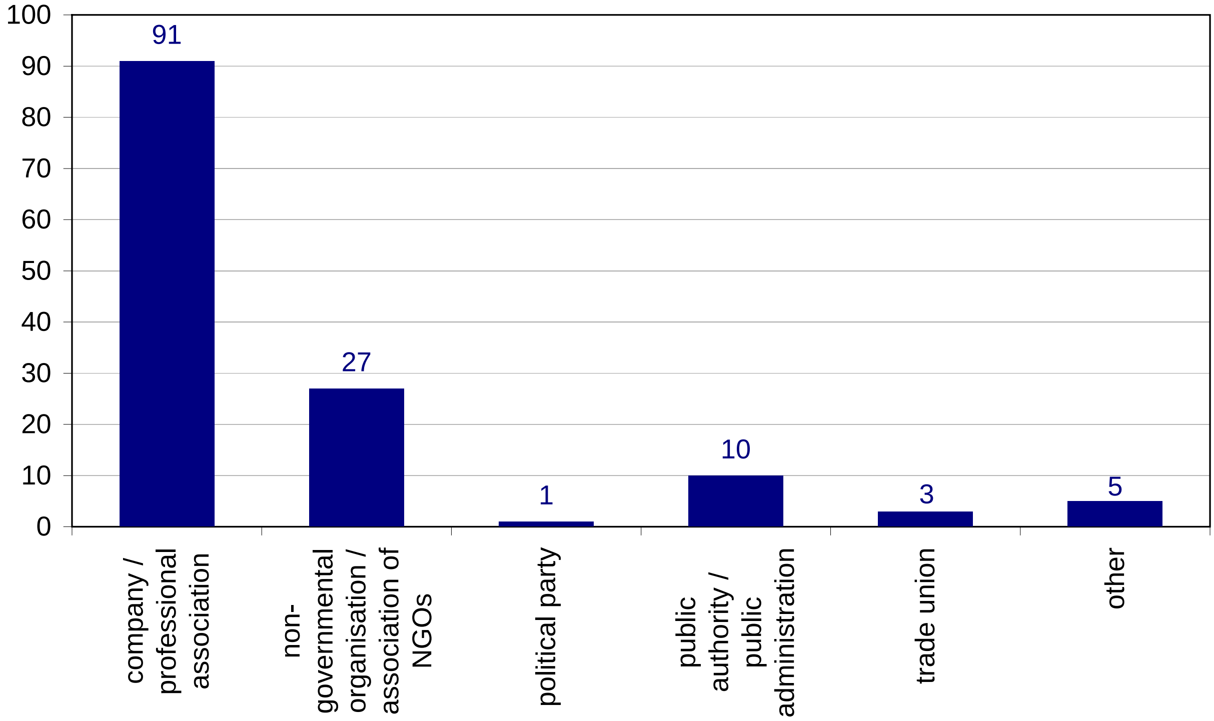
In total, 3233 responses have been submitted via the online questionnaire and evaluated. The vast majority of these responses were from individual citizens (3096) with a relatively small proportion from organized stakeholders (137). The fact that the questionnaire was only available in English, German and French has probably influenced the results, as evident from Figure 1. None of the stakeholders or citizens who responded to the consultation indicated to being from Bulgaria, the Czech Republic, Estonia, Hungary, Latvia or Lithuania and thus these countries are not shown in Figure 1. Although an overwhelming majority of responses were submitted by individual citizens, Poland was the only Member States where organised stakeholders submitted more than half of responses.

Figure 1: Received responses by country of origin indicated in the questionnaire



In total 137 organised stakeholders answered the questionnaire. Most of these contributions were received from companies or professional associations, followed by NGOs and associations of NGOs (ses Figure 2).

Figure 2: Received responses from stakeholders by affiliation



A further 6 responses were received by email due to technical difficulties with responding to the online IPM questionnaire. Answers and attachments in these emails were in various formats. These responses were not evaluated as part of the quantitative evaluation shown in this document, but their content was taken into the respective qualitative evaluation sections. If relevant, position papers from registered stakeholders (regardless of the method of submission) who agreed to the publication of their responses are published on the website[84].

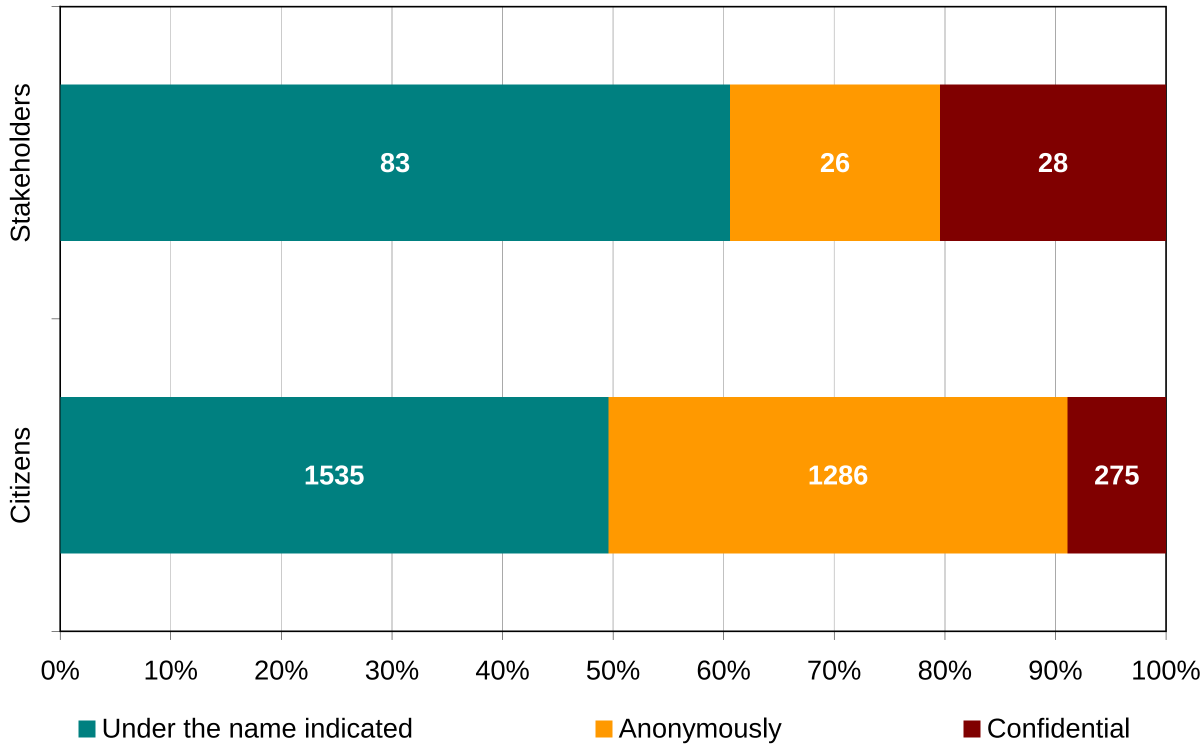
Respondents had to make a choice about the confidentiality of their responses by selecting one of the following 3 options:

- under the name indicated - I consent to publication of all information in my contribution and declare that none of it is under copyright restrictions that prevent publication.
- anonymously - I consent to publication of all information in my contribution and declare that none of it is under copyright restrictions that prevent publication.
- not at all – keep it confidential - my contribution will not be published, but it will be used internally within the Commission.

The breakdown of the choices made by respondents in respect of confidentiality is shown in figure 3.

[84] http://ec.europa.eu/clima/consultations/0012/index_en.htm

Figure 3: Confidentiality of received responses



4. EU POLICY ON ROAD-VEHICLE GREENHOUSE EMISSIONS (EVALUATION OF PART B)

*Analysis of responses to **Questions B.1-B.5***

B.1 Setting greenhouse emission standards for road vehicles is an important aspect of EU action to reduce such emissions.

B.2 These standards should be in line with the greenhouse targets in the EU's roadmap to a low carbon economy and Transport White Paper.

B.3 Road vehicle greenhouse gas emissions standards should be set based on the average greenhouse gas emissions of new vehicles entering the vehicle fleet.

B.4 Standards for road vehicles should apply equally to different technologies used for powering road vehicles.

B.5 EU regulation of road-vehicle emissions stimulates innovation in the automotive sector and helps keep Europe's automotive industry competitive.

In general, the responses to section B of the consultation questionnaire were quite similar amongst stakeholders and individuals. For most questions, there was stronger support amongst individuals towards entirely agreeing with the policy statements, while with stakeholders there was more of a split between those who entirely agreed and those who partly agreed with the policy statements set out in section B.

Of individuals, 95% agreed that it was important to set greenhouse gas (GHG) emission standards as part of overall EU action to reduce such emissions while 55% of stakeholders entirely agreed and 31% partly agreed. A majority of respondents (89% of individuals entirely/partly and 77% of stakeholders entirely/partly) agreed that these standards should be in line with the GHG targets set out in the EU's roadmap to a low carbon economy and Transport White Paper. The choice of the appropriate measurement approach for setting GHG emission standards provoked a broader range of responses. While 64% and 59% of individuals and stakeholders respectively were in favour (entirely/partly agreed) of using the (current) fleet average approach, 33% of all respondents were either neutral or disagreed to some extent with setting targets based on the average GHG emissions of new vehicles entering the entire fleet.

Stakeholders (72% entirely/partly agreed) and individuals (69% entirely/partly agreed) were mainly supportive of applying standards equally to different technologies used for powering road vehicles, while 72% of stakeholders and 83% of individuals agreed or partly agreed that EU regulation of road-vehicle emissions stimulates innovation in the automotive sector and helps keep Europe's automotive industry competitive. The number of stakeholders who disagreed or partly disagreed that standards should be applied equally to different technologies or that EU regulation had had a positive impact in terms of innovation and competitiveness (12% and 13% respectively) was proportionately higher than that of individuals.

These results are shown graphically in figures 4 and 5.

Figure 4: Answers from all citizens to questions in Part B

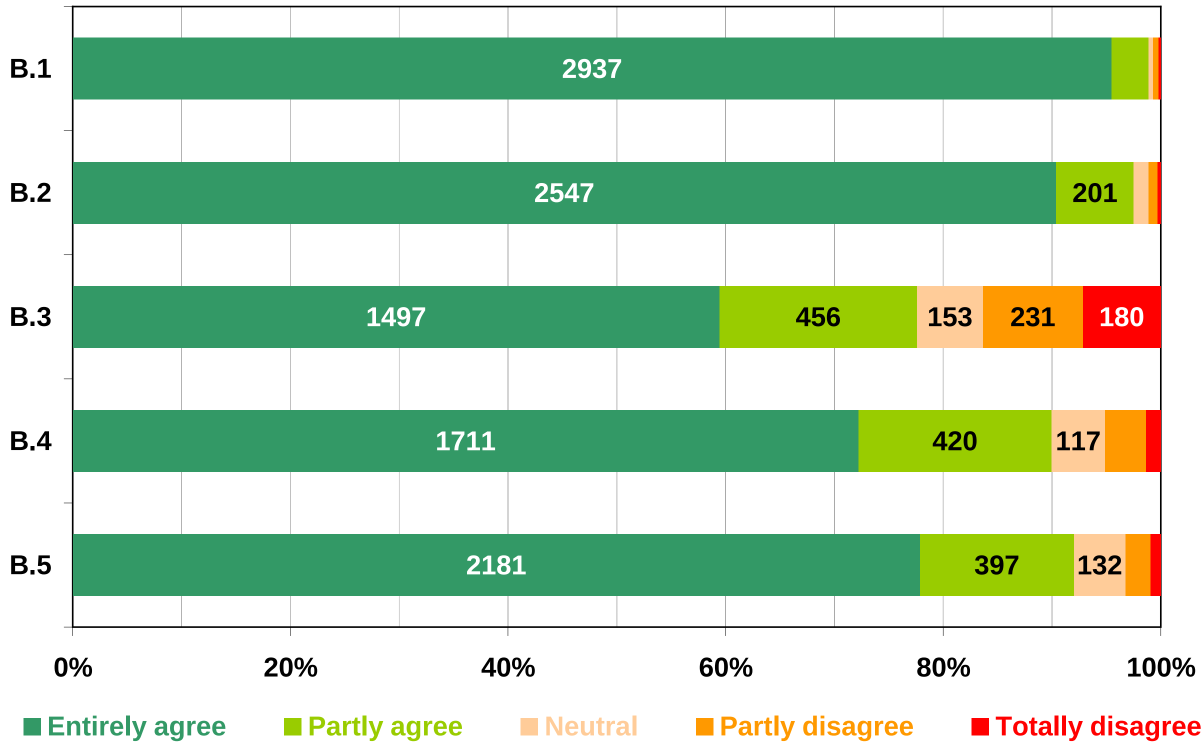
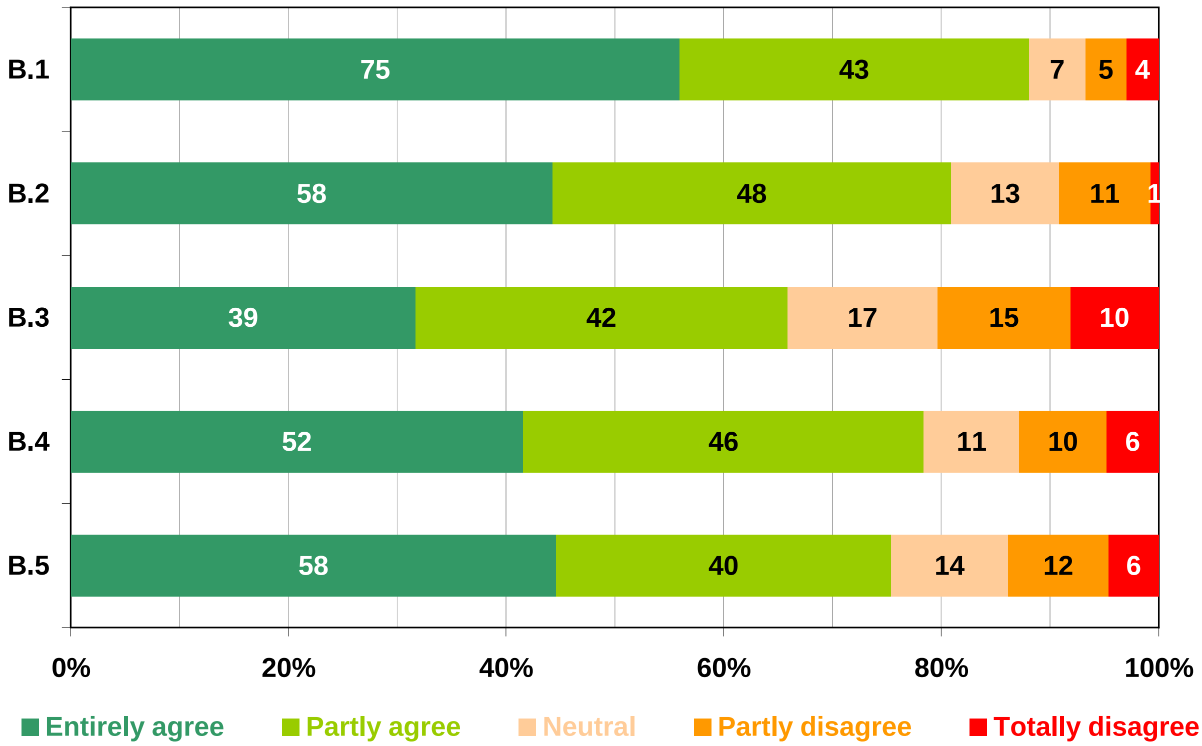


Figure 5: Answers from organized stakeholders to questions in Part B



5. HEAVY-DUTY VEHICLES (EVALUATION OF PART D)

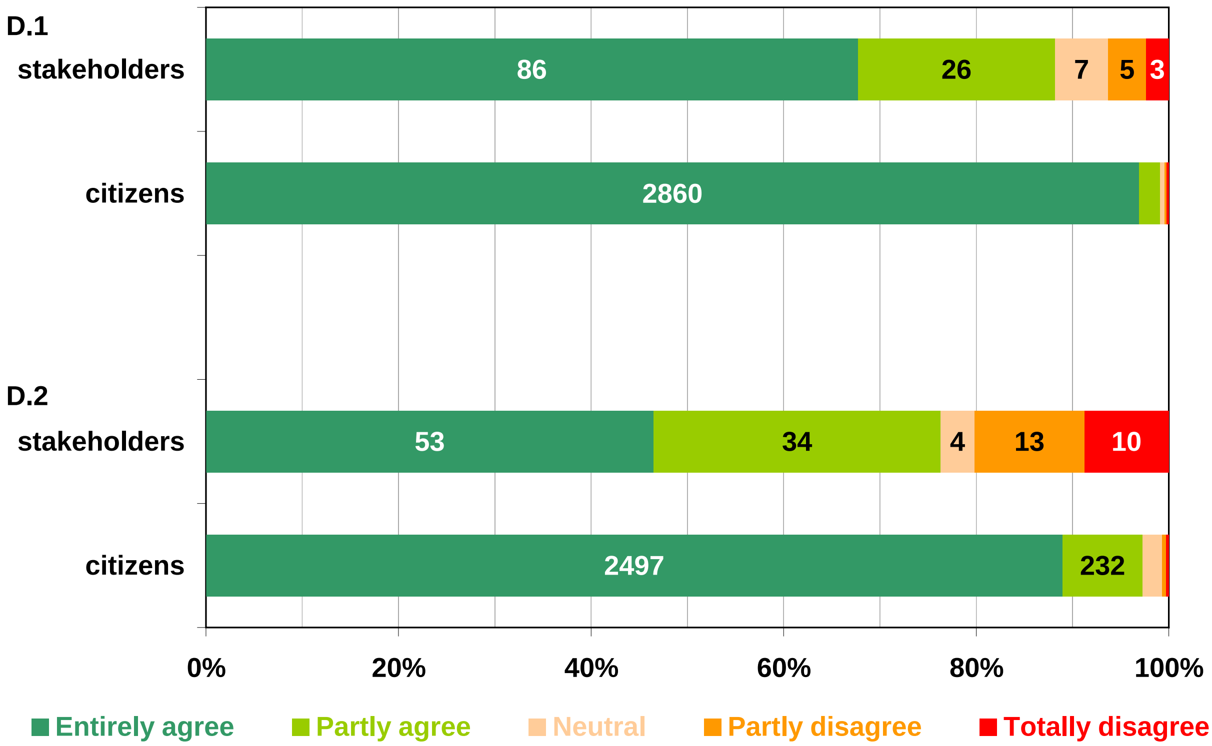
Analysis of responses to ***Questions D.1 & D.2***

D.1 The EU should have a strategy for reducing HDV greenhouse gas emissions.

D.2 Additional regulation (as opposed to non-regulatory measures) is needed for this purpose.

In relation to heavy duty vehicles, over 92% of individuals entirely agreed that the EU should have a strategy for reducing GHG emissions, with 88% of individuals also (entirely or partly) agreeing that additional regulation was the best approach for such a strategy. The support from stakeholders for a strategy on reducing heavy duty vehicle GHG emissions was proportionally less than that from individuals although it was still strong, with 82% either entirely or partly agreeing that an EU strategy was necessary and 64% agreeing that regulation was needed as the main approach of such a strategy. 11% of stakeholders had either neutral views or disagreed that an EU strategy was required and furthermore, 20% of stakeholders had either neutral views (3%) or disagreed entirely or partly (17%) that regulation was needed for the purpose of a HDV strategy.

Figure 6: Answers to questions D.1 & D.2 in Part D

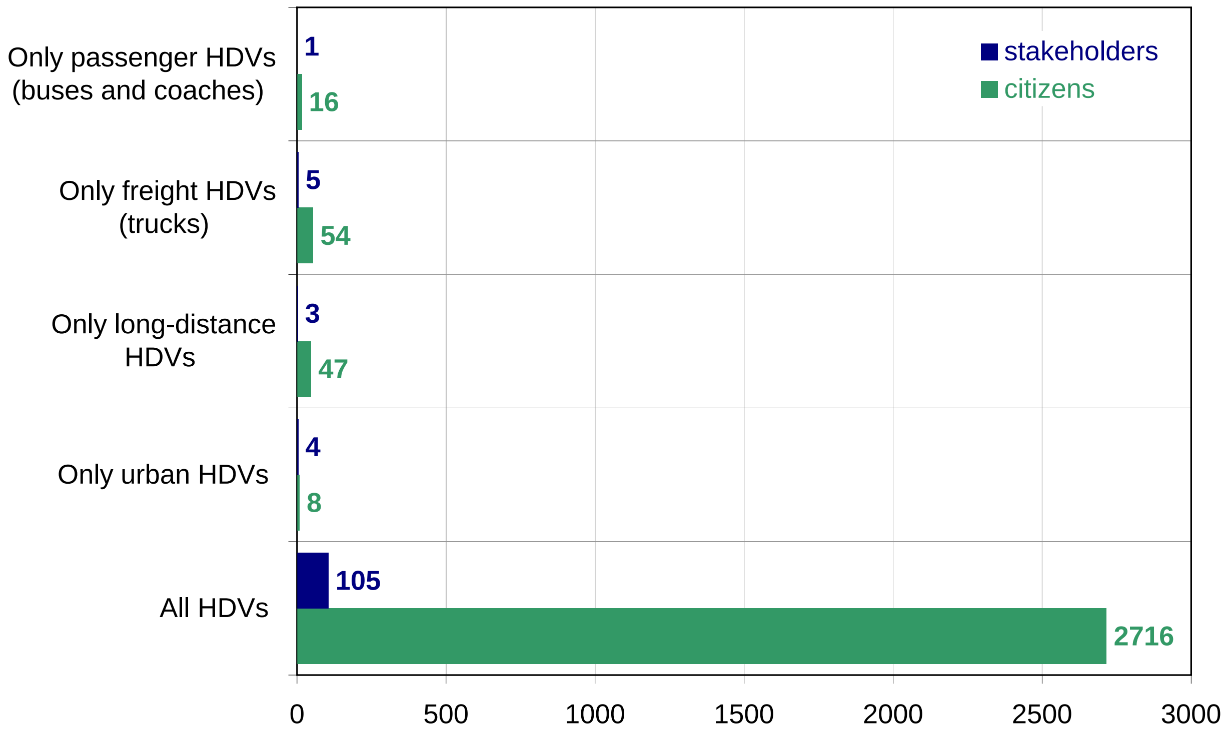


Analysis of responses to ***Question D.3***

D.3 If the Commission proposes a HDV greenhouse gas strategy, which types of HDVs should it cover (as far as is feasible)? (single choice)

With regard to the types of HDVs which should be covered by an EU HDV GHG strategy (if proposed), the vast majority of stakeholders (77%) and individuals (88%) felt that such a strategy should cover all HDVs. Only 9% of stakeholders and 4% of individuals felt that an EU HDV strategy should narrowly and specifically focus on certain types of HDVs.

Figure 7: Answers to question D.3 in Part D



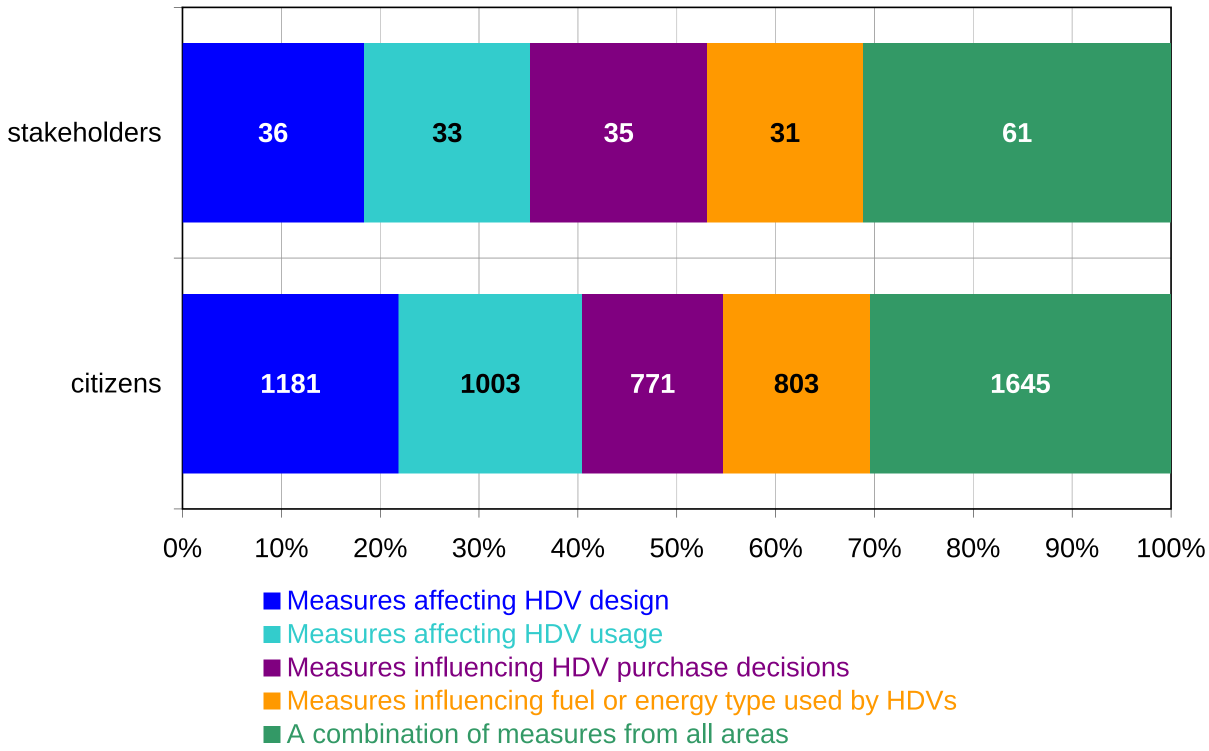
Analysis of responses to ***Question D.4***

D.4 And what sort of measures should be considered for inclusion? (max 3 choices)

In terms of the measures which should be considered for inclusion in any EU HDV GHG strategy, respondents were permitted to select up to three of the five options presented. The percentages given in the following analysis represent the proportion of individuals and stakeholders who selected each option.

The overall range of opinions was similar across stakeholders and individuals. A combination of measures from all areas was the most popular choice for stakeholders (45%) and individuals (53%). 38% of individuals and 26% of stakeholders also selected measures affecting HDV design as being important, while 24% of stakeholders and 32% of individuals felt that measures affecting HDV usage should be included in any strategy. Measures influencing decisions in relation to the purchase of HDVs (26% stakeholders, 25% individuals) and the type of fuel or energy used by HDVs (23% stakeholders, 26% individuals) were also selected as being an important part of any HDV GHG emissions reduction strategy.

Figure 8: Answers to question D.4 in Part D



7. FUTURE DEVELOPMENTS – BEYOND 2020 (EVALUATION OF PART E)

*Analysis of responses to **Questions E.1 and E.3***

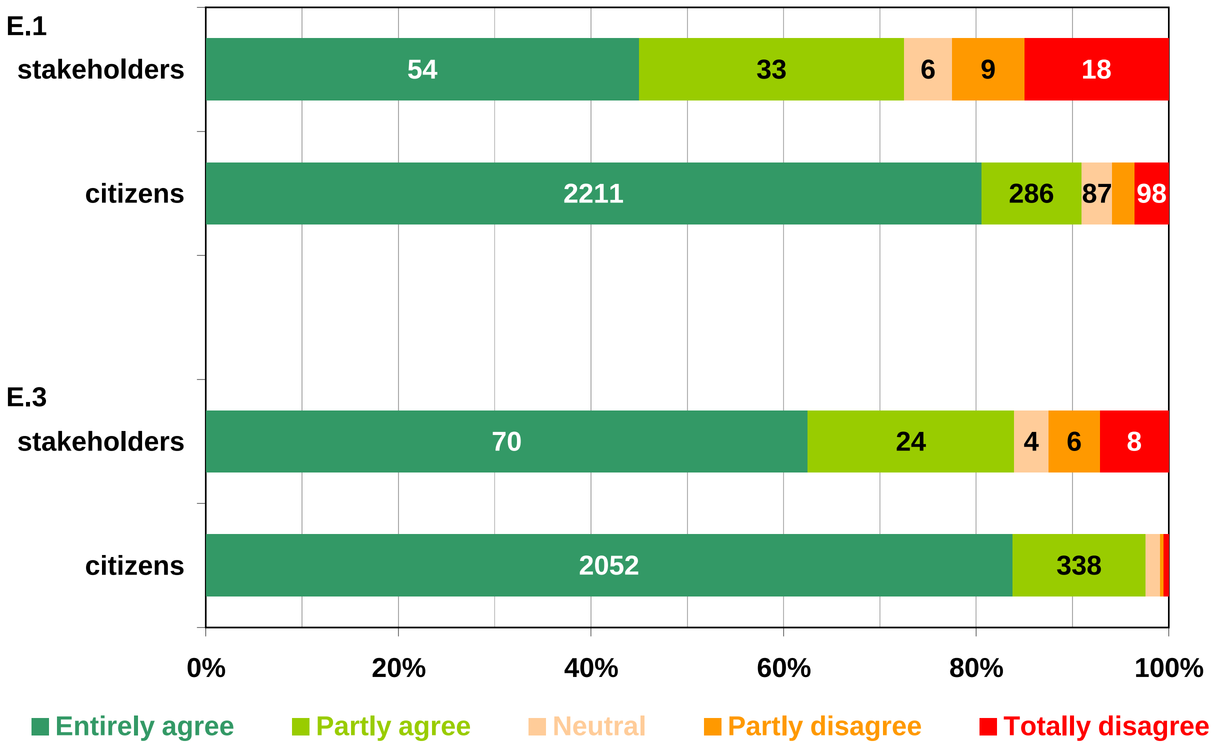
E.1 Road-vehicle emissions may be reduced by changes in other policies, such as taxation. Should targets for road vehicles continue to be set, regardless?

E.3 Should the approach to regulating road-vehicle emissions consider emissions from the whole energy lifecycle?

With regard to developments beyond 2020, there was a slight variation in the views expressed overall between stakeholders and individuals. A majority of individuals (81% entirely/partly agreed) and stakeholders (64% entirely/partly agreed) felt that targets for road vehicles should be set, regardless of the potential impact of other measures on road-vehicle emissions. Quite a significant number of stakeholders (20%) partly or totally disagreed that targets should continue to be set for road vehicles while less than 5% of individuals made similar responses.

There was general support for a life cycle energy approach to regulating road-vehicle emissions from individuals, with 66% entirely agreeing that this approach should be taken and 11% partly agreeing. Proportionally a smaller number of stakeholders were in favour of such an approach (69% entirely/partly in favour), with 13% either being neutral on the issue or disagreeing that a life-cycle energy approach should be adopted.

Figure 9: Answers to questions E.1 & E.3 in Part E



Summary of responses to ***Question E.2***

E.2 In your opinion, which are the policies in which changes might affect the setting of greenhouse gas targets for road vehicles?

Respondents to this question highlighted a range of general policy areas in which changes might affect the setting of GHG targets for road vehicles. A common theme in a large number of responses (over 300 individual responses and over 30 responses from organisations) was a belief that taxation or fiscal policies could have a significant effect on the setting and achievement of targets. Many organisations listed taxation as a key policy area without providing further detail while some individuals highlighted specific tax policies including general taxes on fuel/cars/maufacturers, tax reductions/exemptions for company cars, lower taxes for low emitting vehicles, taxation on alternative fuels and carbon taxes. A large number of respondents (over 200 individuals) argued that policies promoting the use of alternative transport for freight, such as rail and river, and for people, such as walking, cycling, electric and hybrid vehicles, would have a significant effect on the setting of GHG targets. Furthermore over 100 respondents (inc. 5 from stakeholders) felt that policies promoting, developing and improving public transport would be important. In addition over 60 respondents argued that congestion policies, including environmental zoning and road charging, would reduce overall road usage and influence the setting of GHG targets. Further policy areas aimed at reducing road usage and long distance travel, such as general foreign & trade policies and the promotion of local production and consumption (over 75 individuals) were highlighted as being influential on the setting and achievement of targets. Improved industrial and employment policies and practices were also considered to be potential mechanisms through which road usage could be reduced.

A large number of respondents (over 120, including Transport & Logistiek Vlaanderen (Road Haulage Association) and European Road Haulers Association (UETR)) identified policies concerning the design, manufacturing and sale of vehicles as being areas in which further changes and improvements could impact on the setting of GHG targets. Policies in respect of research, development and promotion of alternative fuels (over 90 respondents) and energy/renewable energy (over 70 individuals) were also highlighted by respondents as important. A number of individual respondents (over 40) and organisations (including International Council on Clean Transportation, European Tyre & Rubber Manufacturers Association (ETRMA), Fédération nationale des transports routiers (FNTR), Federeation Internationale de l'Automobile (FIA)) felt that policies concerned with improving public education/awareness of emissions/green technology and behavioural campaigns could have an impact on the setting of GHG targets. A large number of respondents also felt that R&D and innovation (over 75, including 18 organisations) and investment in infrastructure and improved urban planning (over 60) could affect the setting of GHG targets.

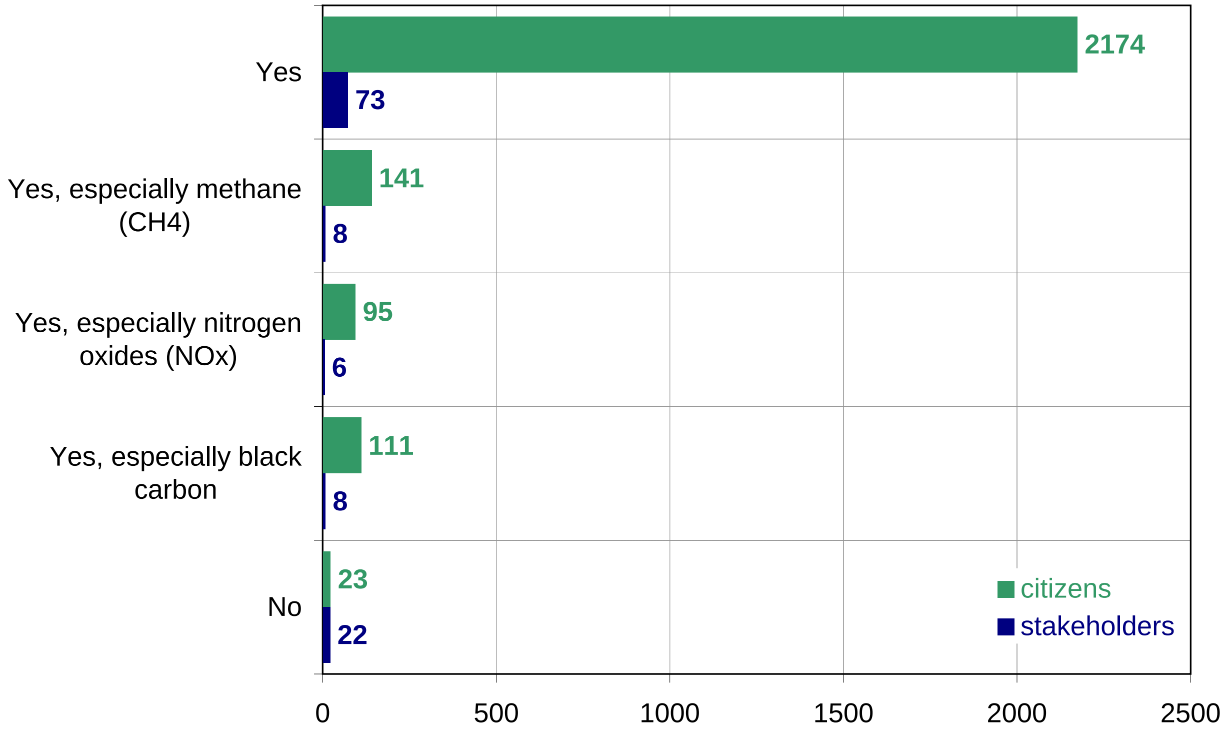
Organisations such as Transport for London, Jumbocruiser Limited, International Association of Public Transport (UITP) and Verband Deutscher Verkehrsunternehmen (VDV) highlighted emission policies such as the EURO classes legislation as an area which could affect the setting of targets while a significant number of individuals (over 90) provided general comments on the actual setting of emission limits and targets. Respondents also highlighted other general policy areas as being significant. These included general transport policy (150+), environment policy (70+), climate change policy (20+), air quality policy (8+), agricultural policy (10+), economic policy (75+), social policy (30+) and health policy (10+).

Analysis of responses to ***Question E.4***

E.4 Should other road-vehicle greenhouse emissions also be measured, alongside carbon dioxide (CO2)?

Individuals tended to be more demanding with regard to the issue of other road-vehicle greenhouse emissions being measured alongside $CO_{2.}$ 70% of individuals agreed that other greenhouse emissions should be measured with 5%, 3% and 4% specifically agreeing that methane, nitrogen oxides and black carbon respectively should be measured. Less than 1% of individuals felt that other greenhouse emissions should not be measured. 53% of stakeholders agreed that other greenhouse emissions should be measured with 6%, 4% and 6% specifically agreeing that methane, nitrogen oxides and black carbon respectively should be measured. 16% of stakeholders specified that other road-vehicle greenhouse emissions should not be measured.

Figure 10: Answers to question E.4 in Part E



Analysis of responses to ***Questions E.5 & E.6***

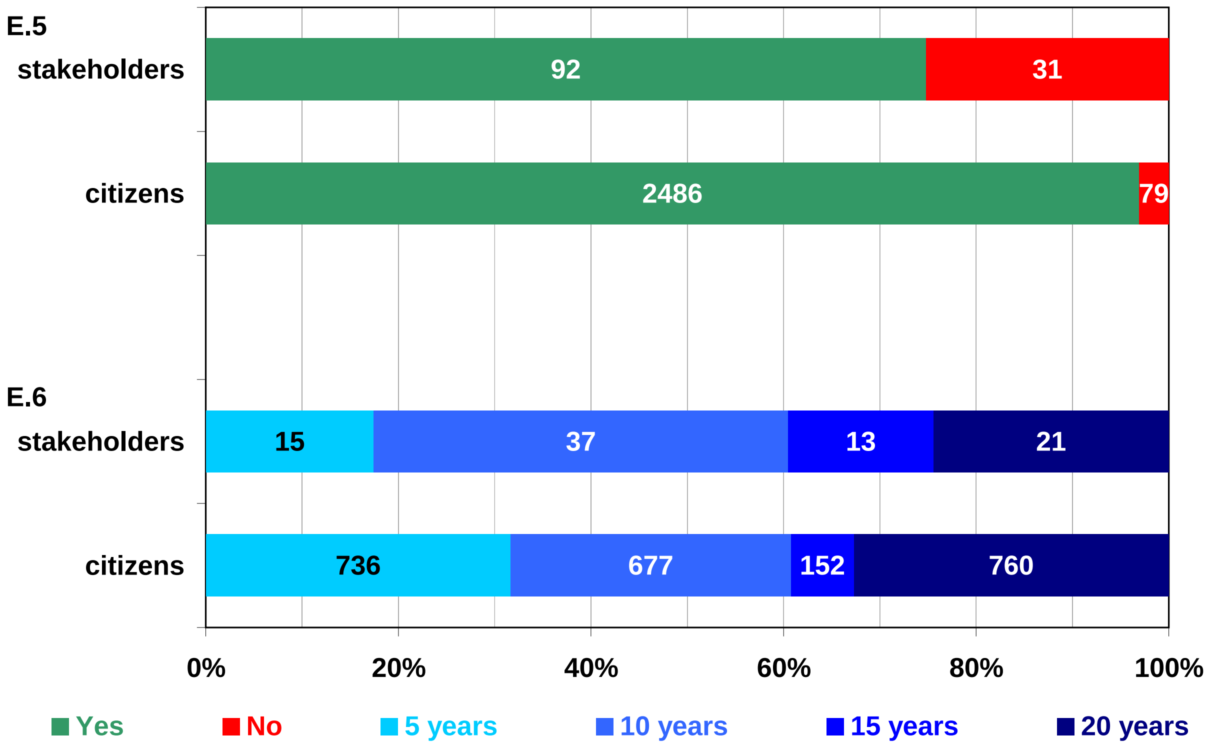
E.5 Should longer-term indicative targets (for after 2020) be set?

E.6 Please specify for what time period (following adoption of the related legislation)?

While the majority of both stakeholders (67%) and individuals (80%) agreed that longer term indicative targets should be set for after 2020, there was more opposition to this amongst stakeholders with 23% disagreeing with the setting of longer term indicative targets as opposed to only 3% of individuals disagreeing with the setting of longer term targets. 17% of individuals and 10% of stakeholders provided no opinion on question E5.

Responses in relation to the time frame for such legislation were quite mixed amongst both stakeholders and individuals. A quarter of all individuals chose not to answer question E6 or expressed no opinion, but of those that did 32% felt that the time frame for targets (following adoption of the related legislation) should be within 5 years, 29% specified 10 years, 15% specified 15 years and 33% specified that 20 year targets should be set. With regard to the stakeholder responses, 63% provided an answer to E6. Of these respondents, 17% felt that the time frame for targets (following adoption of the related legislation) should be within 5 years, 43% specified 10 years, 15% specified 15 years and 24% specified that 20 year targets should be set.

Figure 11: Answers to questions E.5 & E.6 in Part E

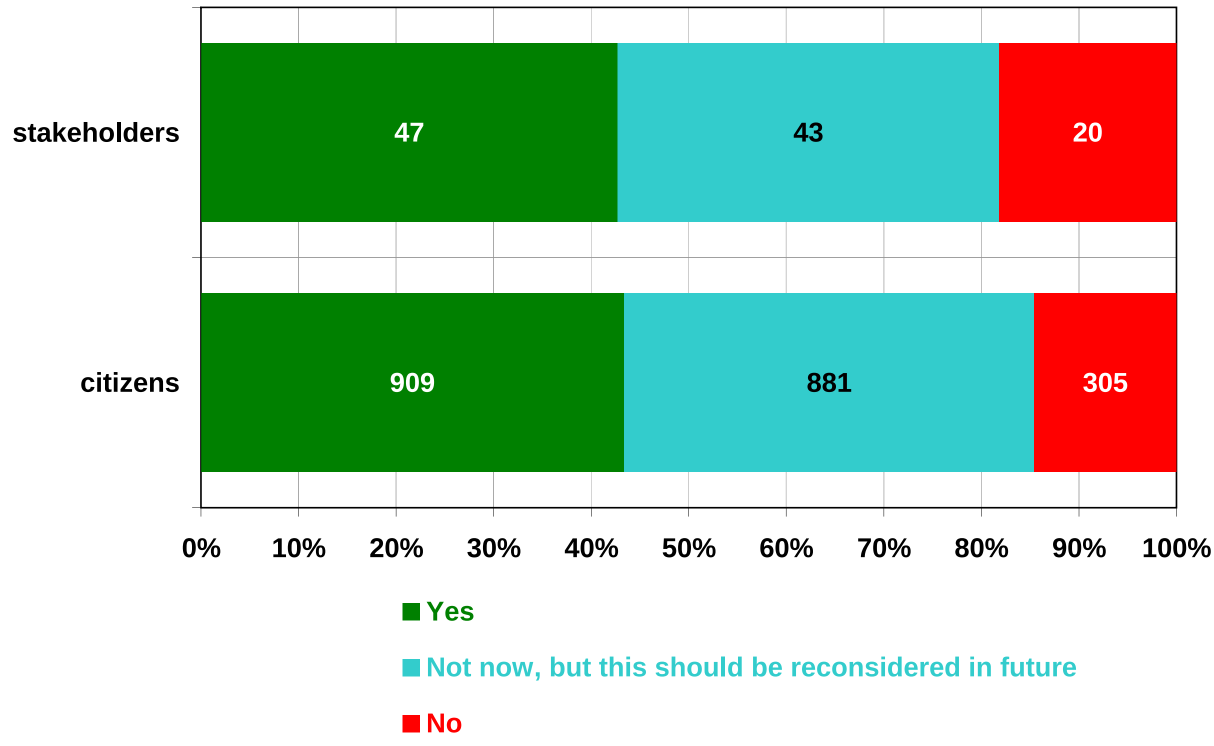


*Summary of responses to **Question E.7** (only answered if respondents answered No to Question E5)*

E.7 Please specify why long term indicative targets for after 2020 should no be set

The respondents who did not agree that long term indicative targets (for after 2020) should be set mostly argued that it was more appropriate to focus on implementing action in the short term to reduce CO_2 and achieve the targets already set for 2020. Around 10 organisations (including representatives of the car industry) and 20 individuals questioned the practicality of setting indicative targets for beyond 2020 without having knowledge of the developments in technology which may or may not materialise between now and then. In addition, 10 respondents claimed that short term targets are more achievable than unrealistic long term targets. The International Road Transport Union further stated that, in the absence of new procedures for the declaration of fuel consumption and CO_2 generation of complete transport units being designed, voluntary targets set by the transport industry should be encouraged. Other comments raised by a small number of respondents (<3) included the setting of conditioned fleet targets, the limited positive impact of legislation on small business, the restriction of private vehicle use and the inconvenience for hauliers of too many policy changes.

Figure 12: Answers to questions E.8 in Part E



Analysis of responses to ***Question E.8***

E.8 The current legislation contains vehicle-based targets until 2020. For post-2020, should we consider alternatives to vehicle-based greenhouse gas regulation?

In relation to question E.8 and the possible consideration of alternatives to vehicle-based targets post 2020, responses were generally quite similar amongst stakeholders and individuals. 34% of stakeholders and 29% of individuals agreed that alternatives to vehicle based regulation post 2020 should be considered. 31% of stakeholders and 28% of individuals felt that alternatives to vehicle based regulation should not be considered now but be reconsidered in the future, while 15% of stakeholders and 10% of individuals felt that alternatives to vehicle based regulation should not be considered. A significant number of stakeholders(20%) and individuals(32%) had no opinion or chose not to answer the question.

Summary of responses to ***Question E.9***

E.9 Please specify which alternatives

The respondents who provided comments on alternatives to vehicle based greenhouse gas regulation (post 2020) highlighted a number of other policy areas and initiatives in which further measures could be implemented to reduce the emission of greenhouse gases. A common theme in a number of responses from individuals (around 65) was a desire for the promotion and development of improved rail and river networks for the transportation of both people and goods. These individuals argued that a reduction of road usage is key to reducing pollution and a proportion of these respondents also recommended that more widespread, targeted congestion measures and road-charging policies should be implemented in towns and cities. In tandem with these comments, a significant number of other respondents (around 40) highlighted the importance of developing, promoting and incentivising the use of public transport, walking and cycling as viable, affordable and safe alternatives to the use of private vehicles. Further promotion and development of electically powered vehicles was supported by organisations including Shecco and Going Electric as well as individuals, as was the research, development and promotion of alternative fuels and more sustainable/renewable energy sources (individuals). The promotion of local production and consumption was also considered to be economically and enviromentally advantageous by individuals.

A large number of respondents (greater than 60) argued that a holistic approach was required with regard to the regulation of all industries/sources of pollution in society, with particular reference being made by some to the airline and energy production industries. A number of transport and motoring organisations, including Transfrigoroute International and IRU, highlighted the importance of implementing a wide range of initiatives in the field of transport, energy and fiscal policy as well as industry led initiatives to reduce fuel consumption. Taxation policy was also viewed as a key tool by individual respondents (around 40), who argued that further initiatives, ranging from the introduction of a carbon tax to having higher taxes on companies/consumers producing/purchasing high emitting vehicles and vice versa, could have a significant effect on the manufacturing, promotion and sale of goods (in particular vehicles) with a subsequent effect on the environment. Some respondents (around 30) also pointed out the fact that well-to-wheel emissions should be part of all future targets (City of Stockholm), while other respondents (around 15) supported the introduction of a personal carbon allowance (or cap and trade) scheme.

Both individual (around 15) and organisational (including ETRMA) respondents supported the undertaking of further research and stakeholder engagement on possible alternative policy options and the development of new technology for reducing pollution. A number of individuals (around 15) supported measures to regulate and improve the design and production of vehicles, with particular focus on the energy costs and emissions from vehicle production, the weight of vehicles and the type and recyclability of materials used in vehicle production.

8. Additional comments (Evaluation of part F)

The comments provided as additional input covered a wide range of issues concerning heavy-duty vehicles.

While most individual respondents' comments focussed on cars and, to a lesser extent, vans' emissions, some also (around 230) made comments on HDV emissions and ways to curb them (primarily in the additional comments section but also in other parts of the questionnaire). Among those a significant majority (65%) insisted on the need for a policy supporting a freight transport modal shift to less energy and lower GHG emission intensive modes such as trains and waterways. A number (69) of these individual respondents also considered that, in order to curb emissions, the transport and logistics chain should be reorganised with a more extensive recourse to local rather than remote suppliers of goods.

Among other comments made by individuals, a number of options were supported: the need to regulate heavy duty vehicles' emissions (10), with two respondents even suggesting that a 2025 emissions target should be set for HDVs in the same way as for cars and vans; charging external societal costs of road freight transport(1); taxes on road freight(15), higher taxes on fuel(4), avoiding lower pricing of fuel in favour of duty-vehicles(1); carbon foot-printing of merchandises (4); the use of bio-fuels by HDVs(7), with one respondent suggesting a ban from town centres of HDVs powered by fossil fuels; the use of hydrogen and electricity by buses(1); the need to improve HDV performance through further R&D (6); providing incentives for influencing purchasing decisions, i.e. encouraging business to invest in more efficient vehicles (5); having more stringent checks, controls and speed limits for HDVs(5); and restricting the size of HDVs (4).

Various organisations (43) also provided comments on HDVS within the questionnaire and in written submissions: NGOs, enterprises, public authorities, and professional associations or federations. A large number of organisations (13, including Transport for London and Fenebus) were in favour of policies which encouraged an active modal shift in favour of less energy and emission intensive transport modes such as rail or waterways for freight, as well as the promotion of public transport for passengers. Furthermore some organisations (8, including Fenebus, Jumbocruiser and Federal Association of German Bus and Coach Operators (BDO)) specifically highlighted the promotion of buses and coaches as a means to reducing overall transport emissions and felt that the benefits of imposing fiscal and legislative measures on buses were questionable. Other organisations (2, including Argyll and Bute Council) felt that the promotion of local suppliers, and thus shorter delivery journeys, would have a positive effect. A significant number of organisations (13), including NGOs (World Wildlife Fund (WWF)) and professional associations (Transfrigoroute International) felt that a comprehensive strategy to reduce emissions was required. A number of organisations (8, including the Swedish Transport Agency and Administration, Greenpeace, WWF) argued that specific legislation and targets were essential in respect of HDVs, with some suggesting milestone targets, while a number of other respondents (9, including Le Poste, IRU) felt that market forces would be more effective than regulation in reducing fuel consumption and CO_2 emissions.

The positive impact of further support for R&D into improving the efficiency of HDVs was highlighted by a number of organisations (11, including Bundesverband Güterkraftverkehr Logistik und Entsorgung (BGL), ETRMA, UITP) while others highlighted the need to pursue measures which affect purchasing decisions and incentivise the move to more efficient vehicles (11, including Jumbocruiser, Le Poste, Transport for London). Support was also expressed for the increased use of bio-fuels and non-fossil fuels by a range of organisations (10, including UETR). A number of organisations (9), in particular professional associations and public authorities (Swedish Transport Agency and Administration, IRU, Transport for London) commented on the need for a measurement methodology/tool for measuring HDV CO_2 emissions. Furthermore, other organisations (10, including IRU) commented on the appropriate measurement metrics with regard to assessing HDVs, for example, CO_2 per ton-km or per passenger/km, m3-km of goods. A small number of organisations commented on the Energy Taxation Directive (3, including VDV, European Express Association) and the need to focus on measures which reduce fuel consumption (5, including BGL and BDO). While the Community of European Railway and Infrastructure Companies (CER) and the European Express Association was in favour of charging for the external costs of transport (all types), European Association for Forwarding, Transport, Logistics and Custom Services (CLECAT) emphasised the importance of recognising that transport companies already incur costs which are internalised through excise, taxes or charges.

Other comments made by a small number of organisations included the taxation of freight transport, increasing fuel taxes, the recyclability of HDVs, the need to focus on the classes which emit the most, the need to focus specifically on measures which reduce fuel consumption, labelling, the importance of regulating engine-only emissions, allowing longer vehicles for transporting freight and banning the use of HDVs altogether.

RECEIVED WRITTEN CONTRIBUTIONS

Please visit our website to see the specific concise contributions and position papers received. Only contributions from organized stakeholders who provided their registration number in the Transparency Register and at the same time indicated that their contribution should be treated as "under the name indicated" are published on our website. All contributions have not been edited and are shown as submitted. They do not represent the opinions and views of the European Commission and are the sole responsibility of those submitting these responses.

http://ec.europa.eu/clima/consultations/0012/index_en.htm

ANNEX 2 : STAKEHOLDER MEETINGS

STAKEHOLDER MEETINGS, COMMISSION SUMMARY

I. 22 February stakeholder meeting

Chairman: Philip Owen, DG Climate Action

List of participants attached

1. Reducing Heavy-Duty Vehicle (HDV) CO_2 emissions, ways and scope

Introduction

An EU strategy for reducing LDV CO_2 emissions was adopted in 2007 and legislation has been enacted setting limits on car and van CO_2 emissions. In contrast HDV emissions have so far not been regulated and therefore the Commission announced in 2010 that it would prepare an HDV emissions strategy. A public internet consultation was held in autumn 2011 and responses largely support such a strategy. In September 2011 the Commission started work on the Impact Assessment which will assess options for the strategy, expected to be adopted in 2013. The aim of this meeting was to discuss the potential for curbing CO_2 emissions and policy options. A second meeting would take place later before the summer, to discuss possible approaches for the EU strategy.

Presentation of analysis on potential for reduced HDV emissions

The contractor[85] presented the main findings from a recent report on *European Union Greenhouse Gas Reduction Potential for Heavy Duty Vehicles*. The study found that across the eight HDV segments examined, potential CO_2 savings from all technologies available during the years 2015-2020 range from 30 to 52% for new vehicles. Applying these fuel-saving technologies to all new vehicles as of 2020 had the potential to reduce fleet-wide HDV greenhouse gas emissions to 28 % below projected business-as-usual levels in 2030, in spite of significant expected HDV fleet growth. This is broadly consistent with findings from a previous Commission study on HDV emissions in the EU[86].

Summary of discussion

Stakeholders generally welcomed the consultation. A number asked for clarifications regarding underlying assumptions of the study.

Original Equipment Manufacturers (OEMs) expressed doubts with regard to the magnitude of achievable HDV fuel consumption and CO_2 emission reductions. In contrast it was stated by an NGO that experience shows ex-ante estimated costs are always higher than the outcome for environmental measures. OEMs noted that one of the effects of environmental legislation to reduce pollutant emissions (Euro IV, V and VI standards) had been some loss in fuel efficiency

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[85] TIAX consulting, author of the report of December 2011on European Union Greenhouse Gas Reduction Potential for Heavy Duty Vehicles.
http://ec.europa.eu/clima/policies/transport/vehicles/heavy/docs/icct_ghg_reduction%20_potential_en.pdf

[86] AEA – Ricardo report, February 2011: Reducing and Testing of Greenhouse Gas Emissions from Heavy-Duty Vehicles: Lot1: Strategy
http://ec.europa.eu/clima/policies/transport/vehicles/docs/ec_hdv_ghg_strategy_en.pdf

and increased CO_2 emissions. Some technologies would be more promising for specific vehicle segments than others, and there were in particular uncertainties as regards the possible costs and rate of uptake of hybridisation.

There was consensus that improved aerodynamics could play a role. A number of figures were quoted all pointing to small changes enabling significant benefits at low costs.

Several participants considered that increasing weights and dimensions of HDVs could achieve additional savings. This was contested by others who argued that longer and heavier vehicles would not be a solution in view notably of rebound effects of increasing load and dimensions.

Participants from the transport and logistics sector reported that a number of schemes were already in place in their sector to reduce freight fuel consumption and CO_2 emissions. New initiatives were being launched to measure transport's carbon footprint: a collective approach was preferable in this respect, and many improvements in fleet operations were taking place without legislation. Driver training was considered important, but needed to be followed by actions managing driver performance and actual fuel consumption. It was suggested that it was more important to focus on the results than the training. Public transport operators insisted on the importance of modal shift to public transport as a means of reducing emissions, and the need for improved operating conditions, notably an increased operational speed of buses in cities.

The metric for a future measurement methodology and efficiency registration was considered sensitive by a number of participants and should not merely be based on fuel and CO_2 emissions per km.

One NGO participant considered that there was a clear market failure in view of the lack of recent new HDV performance improvements and the very short payback periods considered by operators.

2. Discussion of policy options to curb emissions

Participants were invited to indicate which options the Commission should consider and privilege among a number of listed possible policy options.

A methodology and tool to measure emissions in a standard way, thereby ensuring transparency and comparability, was considered by most stakeholders as a priority. Testing procedures are key to ensuring this is relevant to real world operations. One manufacturer suggested that engine rather than full vehicle emissions should be targeted.

According to numerous participants the strategy should be comprehensive and aim at reinforcing European HDV manufacturers perceived leadership, encouraging continuous improvement in HDV performance. Manufacturers and operators generally expressed preferences for a non-regulatory approach. Transport and logistics operators' representatives generally favoured industry initiatives, several noting the advantages of collective approaches. According to a number of participants incentives would be welcome to support industry initiatives, the use of biofuels, and investments in refuelling infrastructure for alternative less GHG intensive fuels. Subsidies to support R&D were also needed to prepare future more efficient vehicles. Participants also stated that due consideration should be taken of the fact that transport is very much an SME activity.

It was suggested that economic factors such as fuel price escalators, fuel price cost pass through clauses and the possibility for third party logistics providers to profit on sub-contractors' fuel costs all reduced incentives to reduce CO_2 emissions. There was evidence that the level of fuel use is linked to the type of contract in force. An OEM noted that uncertain fuel prices hamper investments in technology.

There was a widespread view that vehicle emissions certification could be beneficial and improve transparency once an emissions measurement tool is in place. Labelling was favoured by a number of participants but needed cautious consideration in view of the variety of vehicles, technologies and operating conditions.

A strategy should encompass already existing actions such as the existing type approval legislation. A number of participants considered that EU legislation on weights and dimensions, currently under review, should be made more flexible, allowing for larger trucks, and/or more aerodynamic ones.

The possible inclusion of HDV emissions in the European Trading System was briefly discussed. It was pointed out that it would be ineffective since in view of the relative costs the transport sector would rather purchase allowances than invest in CO_2 emission abatement.

NGOs noted that voluntary processes and regulatory approaches were not necessarily contradictory as this has been the approach followed so far in Japan and the US. A step-wise comprehensive approach to curb HDV CO_2 emissions would be required.

Some Member States participants considered that a strategy should take into consideration specific national situations and be technology neutral (Finish Transport Safety Agency). A comprehensive long-term strategy would be needed (Swedish Transport Administration), including possibly a regulatory approach over the long term. The UK (Office of Low Vehicle Emissions) favoured an integrated approach based notably on support to industry initiatives and the uptake of more efficient vehicles rather than recourse to regulatory measures.

Commission closing remarks

The Commission chairman confirmed that a holistic approach would be required. Some avenues already appeared more promising than others. Commission services remained available for further bilateral contacts with stakeholders. Before the completion of the Impact Assessment foreseen by the end of 2012 another stakeholder meeting will be organised in June or July.

List of participants

Organisation	
AB Volvo	
Association des Industries de Marque	AIM
Association for Emissions Control by Catalyst	AECC
Austrian Ministry of Transport and Noise	
Belgian Shippers' Council	OTM
Belgium Ministry of the Environment	
Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (DE)	
Bundesverband Güterkraftverkehr Logistik und Entsorgung	BGL
Community of European Railways	CER
Cummins Ltd	
DAF Trucks N.V.	
Daimler AG	
Danish Transport Authority	
DHL	
Environmental Ministry Belgium	

Europe (Natural & Bio Gas Vehicle Association Europe)	NGVA
European Aluminium Association	
European Association of Automobile Suppliers	CLEPA
European Automobile Manufacturers' Association	ACEA
European Biodiesel Board	EBB
European Brands Association	AIM
European Express Association	EEA
European Road Haulers Association	UETR
EVO – The Dutch Shippers' Council	
EvoBus GmbH / Daimler Buses	
Fédération Nationale des Transports Routiers	
Fédération Nationale des Transports Routiers (F)	FNTR
Finnish Transport Safety Agency	
FLUXYS SA/NV	
Freight Transport Association	FTA
Greater Than	
Heineken	
International Association of Public Transport	UITP
International Council on Clean Transportation	ICCT
International Road Transport Union	IRU
KTI Institute for Transport Sciences (Budapest)	
La Poste (F)	
Liaison Committee of the Body and Trailer Building Industry	CLCCR
Low Carbon Vehicle Partnership (UK)	
MAN SE	
MAN Truck & Bus AG	
Meta-Ricerche Cornetti Diol. (It)	
Ministère de l'Écologie, du Développement durable, des Transports et du Logement	MEDDTL
Ministry of Infrastructure and the Environment (NL) Climate, Air Quality and Noise Department-Environmental Protection Office	
Natural & bio Gas Vehicle Association	NGVA Europe
Nordic Logistics Association	
Permanent Representation of the Netherlands to the EU	
Permanent Representation of the Republic of Poland to the EU	
Polish Automotive Industry Association	
Procter & Gamble	
Ricardo UK Ltd	
Scania	
Society of Motor Manufacturers and Traders	SMMT
Spanish Federation of Transport by Bus	Fenebus
Spanish Urban Collective Surface Transport Association	
Swedish Transport Administration	
Tesco	
The European Tyre and Rubber Manufacturers' Association	ETRMA
TNO	
Transfrigoroute International	

Transport & Environment	
Transport & Environment	
Transport and Logistics Netherlands	
Transport en Logistiek Nederland	
TU Delft – Delft University of Technology	
United Parcel Service	UPS
Verband der Automobilindustrie	VDA
Vlaamse overheid, Departement Leefmilieu, Natuur en Energie	
Volvo Buses	
Wirtschaftskammer Österreich	

II. 3 July 2012 Stakeholder meeting

Chairman: Philip Owen, DG Climate Action

List of participants in Annex

1. Introduction

The chairman introduced the meeting and welcomed the participants. The Commission is currently considering and developing options with regard to an EU HDV strategy and will prepare and finalise an Impact Assessment (IA) by the end of 2012 with a view to having a Communication on an HDV CO2 emissions strategy adopted in summer 2013. No further stakeholder meetings are planned prior to the adoption of a strategy, although the Commission is happy to meet with stakeholders individually during early autumn 2012.

2. Results of the Public Consultation on Reducing CO_2 Emissions from Road Vehicles (Ian Hodgson, DG Climate Action)

The Commission gave a short presentation on the results and comments, relevant to HDVs, provided in respect of a public consultation on reducing CO2 emissions from road vehicles. There was significant overall support for a HDV emissions strategy and a consensus that any Commission proposal should cover all types of HDVs. In general, individuals expressed stronger support than organisations for setting long term targets and adopting a regulatory approach while organisations' support for such actions tended to be more nuanced. Individuals expressed strong support for a modal shift in transport, while a broad range of comments in respect of HDVs was received from organisations. A summary of the responses is available on the DG Climate Action website at: http://ec.europa.eu/clima/consultations/0012/summary_en.pdf

3. Development of a simulation tool to measure HDV emissions. State of play & discussion (Peter Brunner, DG Climate Action)

The Commission provided an overview with regard to the development of the HDV CO2 emissions simulation tool. Detail on the methodology was presented including a description of the input parameters for the tool. The tool will be further developed under a new contract. It should be completed by mid-2014. The aim is to develop a tool which is sophisticated and accurate while also being user friendly. The Commission thanked JRC, ACEA and OEMs for providing assistance and expertise in the development process.

Participants highlighted other fuel consumption measurement industry initiatives and foot-printing schemes which are currently in place or being developed such as the Green Freight Initiative. Some participants requested clarity on the timeline in view of the adoption of a HDV strategy foreseen in 2013. The Commission stated that it should be possible to confirm the tool's feasibility in early 2013, well in advance of any proposed strategy. Controlling environmental conditions during testing, identifying accountability for meeting standards and the relationship with CEN standards were raised as issues by other participants. The Commission confirmed that the simulation tool aims to facilitate technology uptake and incentivise the promotion of greater fuel efficiency. Other issues raised included the metrics being used and whether the tool was designed to simulate lifecycle (Well-To-Wheel) or tailpipe (Tank-To-Wheel) emissions. It was confirmed that it is intended to simulate tailpipe emissions.

4. Presentation and discussion of the first results of an on-going study on cost curves on HDV CO_2 emissions abatement costs (Arno Schroten, CE Delft)

The contractor87 presented some detail and examples of the marginal abatement cost curves in respect of packages of technical measures which it has developed for the Commission. Curves were derived for 8 vehicle categories, with average curves also being derived for trucks and buses. Tailpipe emissions are considered and biofuels were not taken into account. The project considered the AEA Ricardo88 and TIAX89 studies which covered abatement technologies for HDVs. The input values were eventually based on the TIAX study. Sensitivity analyses were carried out using the CE Delft model and adjusting different variables. The main conclusion of the project was that there is significant CO2 abatement potential with zero or negative costs for operators of trucks and buses and from society as a whole.

Several participants sought further clarity with respect to the break-even abatement potential tables. The contractor reiterated that the analysis presented provided an indication of costs and potential savings which could be achieved over the lifetime of the vehicles. The Commission indicated that internal analysis concluded that the effect of adding a carbon price to the oil price had a minimal impact on the cost curves. A number of participants suggested that biofuels (in particular bio-methane) should have been considered in the study. The contractor confirmed that biofuels were not considered mainly because they currently do not greatly reduce emissions and their costs would be at the high end of the scale. The contractor also indicated that a study assessing market barriers to implementing reduction measures is currently being performed. Costs for measures referred to in the study were based on mass deployment of these technologies and so the actual cost may still be greater at the moment.

The exclusion of vehicles powered by natural gas in the study was considered disappointing by a number of participants. The ACEA representative highlighted reservations with regard to the original TIAX study, which was based on the US market and adapted to the EU market. The Commission confirmed that further analysis and studies would be carried out before any decision to legislate is taken. T&E supported the cost curves study's findings and emphasised that the industry was capable of achieving large reductions in emissions at costs beneath current estimates. This was considered premature by another stakeholder.

The cost curves report and calculator will be placed on the DG CLIMA website by the end of July.

[87] CE Delft, author of the report on Establishing marginal abatement cost curves for Heavy Duty Vehicles for packages of technical measures
[88] http://ec.europa.eu/clima/policies/transport/vehicles/docs/ec_hdv_ghg_strategy_en.pdf
[89] http://ec.europa.eu/clima/policies/transport/vehicles/heavy/docs/icct_ghg_reduction%20_potential_en.pdf

5. Main Policy options: Commission preliminary assessment and discussion (Christophe Pavret De La Rochefordiere, DG Climate Action)

A preliminary assessment of the main EU strategy policy options was provided.

Baseline Scenario

The baseline scenario differs slightly from that in the 2011 Transport White Paper (TWP) and incorporates policies which are already proposed by the Commission but not yet formally adopted by the co-legislators. The scenario assumes some decoupling with GDP and 1% per year improved fuel efficiency of vehicles. The outcome is that the rate of HDV emissions increase slows down beyond 2020, stabilising and returning to 2005 emission levels by 2050. This option was not considered compatible with the Commission CO2 policy objectives as announced in the Transport White Paper.

ACEA suggested that this may under-estimate possible annual improvements in fuel efficiency, indicating that a 20% improvement versus 2005 levels was possible by 2020. The Commission highlighted that the decoupling assumption was based on increasing energy prices and the impact of existing policies to shift more traffic to rail and waterways. Some stakeholders stated that restrictions caused by HDV size and weight legislation were counter-productive. Following a query on differentiating between decoupling of freight and passenger transport from GDP, the Commission confirmed it was expected that freight transport would grow slightly more than passenger transport.

Implement Transport White Paper (TWP) actions (DG MOVE)

The Commission gave indications on the timing of a number of initiatives foreseen in the 2011 TWP for which impact assessments are on-going. A Clean Power for Transport Initiative proposal will be finalised in the 4th quarter of 2012 as will a proposal on the review of the weights and dimensions legislation. The announced "e-freight" initiative proposal will be finalised in the 1st quarter of 2013. A review of the cabotage legislation proposal should be finalised in the 2nd quarter of 2013. The review of the road user charging directive will also be completed in the 2nd quarter of 2013. Finally, work on the "zero emissions urban logistics" initiative is on-going and it is planned to bring a proposal forward in the 2nd quarter of 2013. DG MOVE was working closely with DG CLIMA on all of these areas.

It was asked whether DG MOVE's initiative on CO2 foot-printing was linked to DG CLIMA's calculation project on HDV emissions. The Commission confirmed that the DG MOVE project was linked to action 29 from the TWP and would rather support private sector schemes. It was also considered unlikely that carbon pricing would be included in the revised road charging legislation given the Commission proposal in the draft revised Energy Taxation Directive to already include a carbon price in fuel prices.

Improve Knowledge and Transparency of HDV CO_2 emissions

This option is linked to the simulation tool being completed. It foresees a subsequent introduction of registration and reporting legislation and the possible development of a certification or labelling scheme. Legislation would be required to introduce recording of emissions and some data would have to be available before a labelling scheme could be introduced. Reporting would apply to new vehicles. This option would not be expected to contribute sufficiently to the level of emission reductions required and committed to under the TWP and the 2050 Roadmap.

Some participants argued that increased transparency would increase competition and drive the industry towards further emission reductions and possibly be sufficient to achieve objectives. Others felt that increased transparency should only be part of the overall package of measures considered. ACEA stated that market forces can be a significant factor in reducing emissions but recognised that they would not be sufficient to achieve the overall reduction objectives being considered. A more comprehensive strategy was required. The UK FTA highlighted the 2.6% reduction in carbon emissions recorded by its members in the second annual report of its scheme.

The Commission emphasised that option 3 was not about foot-printing but would complement such schemes in place or envisaged. It was considered appropriate for the Commission to discuss the methodological aspects further with Green Freight Europe representatives. A query concerning possible scrappage schemes was raised, and the Commission confirmed that the Impact Assessment will not cover such schemes. As regards availability of CO2 information upon completion of the simulation tool, the Commission confirmed its intention in principle to make the information publicly available in a transparent way.

Include HDVs in Emissions Trading Scheme (ETS)

This option involves including HDV CO_2 emissions in the existing EU ETS. The most likely outcome would be that HDV operators would purchase allowances for their emissions rather than invest in upgraded vehicles and it could therefore have limited effectiveness in curbing HDV CO_2 emissions. An alternative solution may be to integrate HDV CO_2 emissions in the ETS at the level of fuel distribution companies but this could also have a limited effect in reducing their emissions. In conclusion this option may face limitations in terms of achieving overall transport emission objectives. The purchasing of allowances would mean that more emissions reductions in other sectors would be achieved. Furthermore, the purchasing of allowances from other sectors would be accompanied by overall cost savings due to the increased flexibility.

T&E agreed that this option would not deliver CO2 savings in transport or have any benefits for the ETS. Other participants argued that it was important to widen the analysis and conduct further studies into the possible benefits of joining the ETS scheme.

Limits on HDV CO_2 emission

The final option presented by the Commission was the setting of either engine-only CO2 limits or whole vehicle limits. Setting engine-only limits would be quite straightforward and practical since Euro VI legislation already covers measurement of engine CO2 emissions. The Commission was still assessing the legal aspects of this option. This option would have limitations in terms of lowering emissions. ACEA highlighted developments in the U.S where there are engine regulations and a simulation approach for the rest of the vehicle, but they did not consider this to be the most cost effective and consistent approach. T&E considered that the engine only approach was inferior to the whole vehicle analysis.

The second option in terms of CO2 emission limits (whole vehicle) would be a medium to long term option requiring the simulation tool to be finished, a registration and reporting system to be in place and an appropriate dataset available from which to arrive at appropriate limits. Further cost curve studies and cost benefit analyses would be needed before finalising a proposal to legislate for whole vehicle limits. Initial indications are that this option could be effective in contributing to meeting transport CO2 reduction targets. The IA will provide indicative estimates of the likely costs and benefits for different sectors of introducing such legislation.

One participant emphasised the importance of providing incentives for hauliers to implement improved management and driving practices. The issues of WTW emissions and accountability for achieving limits within the multi-stage manufacturing process of vehicles were again highlighted. T&E considered the setting of limits to potentially be beneficial but emphasised that it is also important to concentrate on making progress in the short term. The Netherlands representative supported the setting of limits as market forces would not be sufficient to reach the level of reductions required. Participants emphasised that OEMs and transport operators would have to be confident about gaining an adequate return for investment in new technologies. The Commission recognised the issue of designating accountability for meeting limits as one which would have to be given further consideration and a solution arrived at before any legislation could be drafted.

6. Commission concluding remarks

The chairman provided a short summary of some of the key issues which had been raised. It was noted that stakeholders wanted the simulation tool development to be coordinated with private foot-printing schemes already in place. The request for considering biofuels and gas powered vehicles was noted. With regard to the main options presented, it was noted that stakeholders asked for a coordinated approach on the various policies monitored and implemented by DG MOVE and DG CLIMA. Transparency was considered important. Stakeholders requested that the Commission ensures that the cost-benefit outcome of options eventually pursued should be favourable for the transport industry and technologically neutral. Participants were also keen for the Commission strategy to be consistent with voluntary private carbon emissions mitigation and foot-printing schemes already launched in a number of Member States. Finally, the Commission confirmed that the Impact Assessment will be finalised by the end of the year with a view to having a strategy Communication adopted in summer 2013.

Annex - List of Participant organisations

Organisation	
AEA consulting	
Association des Industries de Marque, AIM Delegation (Procter & Gamble / Unilever)	AIM
Association for Emissions Control by Catalyst	AECC
Association of European Vehicle Logistics	ECG
Association of French Road Haulage	
BAE Systems	
Belgian federal administration of environment	
Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (Germany)	
CE Delft	
Comité de Liaison de la Construction de Remorques	CLCCR
Climate, Energy and Building Affairs Energy Agency	
Continental Automotive GmbH	
Continental Reifen Deutschland GmbH	
Cummins Ltd	
DAIMLER	
Dr. Koch Consulting e.K. On behalf of Continental	
European Biodiesel Board	EBB
European Aluminium Association	
European Association for Electric Vehicles	AVERE
European Association for Forwarding, Transport, Logistic and Customer Services	CLECAT
European Association of Automobile Suppliers (CLEPA(DELPHI/DENSO/ZF/BOSCH)	CLEPA
European Automobile Manufacturers' Association	ACEA
European Renewable Ethanol	ePURE
European Shippers Council	
European Small Business Alliance	
EvoBus GmbH/Daimler Buses	
Flemish Government - Environment, Nature and Energy Department	

Freight Transport Association	FTA
General Directorate of Traffic, Ministry of Interior, Government of Spain	
Goodyear Innovation Center	
Greater Than AB	
Green Freight Europe	
HARTENERGY	
International Council for Clean Transportation	ICCT
International Association of Public Transport	UITP
International Road Transport Union	IRU
IVECO	
MAN SE	
Michelin	
Ministerio de Industria, Energía y Turismo (Spain)	
Ministry of Environment of the Republic of Lithuania	
Ministry of Environment, Climate Change Section, Belgium	
Ministry of Infrastructure and the Environment, Netherlands	
National Union of Road Hauliers from Romania	UNTRR
Natural & bio Gas Association	NGVA Europe
Nordic Logistic Association	NLA
Permanent Representation of Lithuania to the European Union	
Polish Automotive Industry Association	PZPM
Robert Bosch GmSH	
Royal Federation of Belgian transport and logistics service providers	FEBETRA
Scania	
Spanish Confederation of Freight	CETM
Spanish Federation of Transport by Bus	Fenebus
Swedish Transport Agency	
Transport & Environment	T&E
Transport en Logistiek Nederland	
United Parcel Service	UPS
Verband der Automobilindustrie	VDA
Voith Turbo GmbH & Co. KG	
Volvo Group	
Volvo Trucks	

ANNEX 3 : TRANSPORT WHITE PAPER ACTIONS

The following actions, foreseen in the Transport White Paper, are expected to contribute – directly or indirectly- curbing HDV CO_2 emissions.

(i) Review cabotage legislation

The Transport White Paper also identifies the "elimination of the remaining restrictions on cabotage" (Regulation 1072/2009/EC) as a means of making road transport more efficient and more competitive, including by increasing loading factors of vehicles.

(ii) Review road user charging

An on-going *review of road user charging legislation* aims to promote a more systematic use of distance related road charging reflecting infrastructure and external costs based on the polluter-pays and user-pays principles

(iii) Review the weights and dimensions legislation, notably with the aim of reducing fuel consumption and CO2 emissions

The type approval legislation[90] on weights and dimensions recently introduced an allowance (50 cm) for aerodynamic devices fixed at the rear of new trucks/trailers. In line with this, the Commission has proposed[91] a revision of Directive 96/53/EC on weights and dimensions of vehicles in international traffic that goes further by proposing a new set of allowances that should support solutions to improve the aerodynamics of HDV.

(iv) E-freight

The aim of the initiative is to create the appropriate framework to streamline the electronic flow of information associated with the physical flow of goods, in support of planning, execution, monitoring and reporting on multimodal freight transport, to ensure liability for intermodal transport and to promote safe, secure and clean freight transport.

(v) Transport carbon footprint: method and schemes

A *carbon foot-printing initiative* is under preparation to support improved transparency and end-user information on the CO_2 impact of freight and passenger transport;

(vi) Adopt and implement a strategy for near-"zero-emission urban logistics" in 2030

The Transport White Paper also announced a *strategy for near "zero-emission urban logistics"* providing guidelines to better monitor and manage urban freight flows. In December 2013 the Commission put forward specific recommendations for coordinated action between all levels of government and between the public and the private sector in

90 Regulation EC 661/2009 and Directive 2007/46/EC
91 COM(2013) 195 final

urban logistics area, urban access regulation area, deployment of intelligent transport system (ITS) solutions and urban road safety area.

(vii) "Clean Power for Transport" - an alternative fuel strategy – and the revised TEN-T guidelines

THE RECENT "CLEAN POWER FOR TRANSPORT" INITIATIVE (ALSO FORESEEN IN THE TRANSPORT WHITE PAPER) AND THE REVISED TEN-T GUIDELINES, SUPPORTED BY THE CONNECTING EUROPE FACILITY, FURTHER SUPPORT THE DEVELOPMENT OF ALTERNATIVE FUEL INFRASTRUCTURE AND INCREASED USE OF NATURAL GAS FOR HDV[92,93,94].

[92] Commission Communication COM(2013)17 "Clean power for transport: a European alternative fuels strategy", and proposed Directive COM(2013)18 on the deployment of alternative fuels infrastructure. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2013:0018:FIN:EN:PDF

[93] Regulation (EU) No 1315/2013 of the European Parliament and of the Council of 11 December 2013 on Union guidelines for the development of the trans-European transport network and repealing Decision No 661/2010/EU

[94] Regulation (EU) No 1316/2013 of the European Parliament and of the Council of 11 December 2013 establishing the Connecting Europe Facility, amending Regulation (EU) No 913/2010 and repealing Regulations (EC) No 680/2007 and (EC) No 67/2010

ANNEX 4 : MODELLING FRAMEWORK

MODELLING FRAMEWORK - MAIN RESULTS AS REGARDS HDV EMISSIONS

1. TRANSPORT BUSINESS AS USUAL DEVELOPMENTS UP TO 2050

1.1. Modelling Framework

European Commission services have carried out an analysis of possible future developments in a scenario at unchanged policies, the so-called "Reference scenario 2010". The "Reference scenario 2010" was used in the impact assessment accompanying *A Roadmap for moving to a competitive low carbon economy in 2050*[95], the impact assessment accompanying the *White Paper - Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system*[96] and the impact assessment accompanying the *Energy Roadmap 2050*[97]. The Reference scenario is a projection of developments in the absence of new policies beyond those adopted by March 2010. In order to take into account the most recent developments (higher energy prices) and the latest policies on energy taxation and infrastructure adopted by November 2011, an additional scenario (also named Scenario 0 here) was modelled to serve as a business as usual scenario for the present impact assessment.

This "business as usual" scenario (Scenario 0) is a projection, not a forecast, of developments in absence of new policies beyond those adopted by November 2011. It therefore reflects both achievements and limitations of the policies already in place. This projection provides a benchmark for evaluating new policy measures against developments under current trends and policies.

Scenario 0 builds on a modelling framework including PRIMES energy model and its transport model (PRIMES-TREMOVE)[98], PROMETHEUS and GEM-E3 models. Scenario 0 has been finalised at the beginning of 2012. The starting point for developing Scenario 0 is the "Reference scenario". This "Reference scenario" has been extensively described in:

- The impact assessment accompanying *A Roadmap for moving to a competitive low carbon economy in 2050*, which also provides in its Annexes additional information on PRIMES modelling undertaken in the decarbonisation framework.

- The impact assessment accompanying the *White Paper - Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system*, Appendix 3 (pages 130-152). The list of policy measures included in the "Reference scenario" is provided in Appendix 4: *Inventory of policy measures relevant for the transport sector included in the 2050 Reference scenario* (pages 153-155).

95 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=SEC:2011:0288:FIN:EN:PDF
96 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=SEC:2011:0358:FIN:EN:PDF
97 http://ec.europa.eu/energy/energy2020/roadmap/doc/sec_2011_1565_part1.pdf
98 http://www.e3mlab.ntua.gr/e3mlab/PRIMES%20Manual/The_PRIMES_MODEL_2010.pdf

➢ The impact assessment accompanying the *Energy Roadmap 2050*, Part A of Annex 1, which describes assumptions, results and sensitivities in much details with respect to the *Reference scenario* (pages 49-97)[99].

It is thus deemed not necessary to reproduce all information contained in the above listed references, but rather to discuss the common and different assumptions included in Scenario 0 relative to the "Reference scenario" and to provide the most relevant information with respect to the subject of this Impact Assessment.

Due to the detailed structure of the data by transport mode in the PRIMES-TREMOVE model and the lack of statistics, detailed data are not available for periods before 2005 and thus not shown in this section, even if data on aggregated level are shown prior to 1990 elsewhere.

1.2. Key assumptions of Scenario 0

The **population** projections draw on the EUROPOP2008 convergence scenario (EUROpean POPulation Projections, base year 2008) from Eurostat, which is also the basis for the 2009 Ageing Report (European Economy, April 2009)[100]. The key drivers for demographic change are: higher life expectancy, low fertility and inward migration.

Table 1. Main baseline scenario indicators 2005-2050

Baseline scenario indicators	2005	2010	2015	2020	2030	2050
EU GDP in 000 M€05	11732	11732	13522	15021	17842	23925
Oil price boe in USD 2010	60	85	81	89	107	128
Fleet buses and coaches (thousand vehicles)	790	763	829	896	946	1021
Fleet trucks (thousand vehicles)	8007	7822	8859	9201	9884	11132
Buses and coaches activity in Gpkm	526	543	572	595	623	666
Trucks activity in Gtkm	1740	1853	2068	2181	2322	2628
Buses and coaches final energy demand in ktoe	5082	5274	5479	5497	5130	4473
Trucks final energy demand in ktoe	91012	96872	106550	109561	105821	107530
Buses and coaches tank-to-wheel emissions ktCO2	15353	15439	15650	15101	13720	13720
Trucks tank-to-wheel emissions ktCO2	275438	284011	304650	301598	283162	285653
HDVs tank-to-wheel emissoins ktCO2	290792	299451	320300	316699	296882	299374

Source: European Commission

Baseline scenario indicators % annual change 2010-2050	'10-'20	'20-'30	'30-'40	'40-'50
GDP	2,2	1,7	1,5	1,5
International oil price	0,4	1,8	0,9	0,9
Fleet buses and coaches (passenger transport)	1,6	0,5	0,5	0,3
Fleet trucks (freight)	1,6	*0,7*	*0,6*	*0,5*
New registrations buses and coaches	1,4	0,9	0,2	0,3
New registrations trucks	2,7	*1,6*	*0,0*	*0,8*
Buses and coaches activity in Gpkm	0,9	0,5	0,4	0,2
Trucks activity in Gtkm	1,6	0,6	0,7	0,5
Buses and coaches final energy demand in ktoe	0,4	-0,7	-0,5	-0,9
Trucks final energy demand in ktoe	1,2	-0,3	0,1	0,0
Buses and coaches tank-to-wheel emissions ktCO2	-0,2	-1,0	-0,6	-1,0
Trucks tank-to-wheel emissions ktCO2	0,6	-0,6	0,1	0,0

Source: European Commission

[99] Short-term projections for oil, gas and coal prices were slightly revised according to the latest developments in the Reference scenario as 2010 compared to the version used in A Roadmap for moving to a competitive low carbon economy in 2050.

[100] European Commission, DG Economic and Financial Affairs: 2009 Ageing Report: Economic and budgetary projections for the EU-27 Member States (2008-2060). EUROPEAN ECONOMY 2|2009, http://ec.europa.eu/economy_finance/publications/publication14992_en.pdf . The "baseline" scenario of this report has been established by the DG Economic and Financial Affairs, the Economic Policy Committee, with the support of Member States experts, and has been endorsed by the ECOFIN Council.

The **macro-economic** projections reflect the recent economic downturn followed by sustained economic growth. The baseline scenario assumes that the recent economic crisis has long lasting effects, leading to a permanent loss in GDP. The recovery from the crisis is not expected to be so vigorous that the GDP losses during the crisis are fully compensated. In this scenario, growth prospects for 2011 and 2012 are subdued. However, economic recovery enables higher productivity gains, leading to somewhat faster growth from 2013 to 2015. After 2015, GDP growth rates mirror those of the 2009 Ageing Report. Hence the pattern of our baseline scenario is consistent with the intermediate scenario 2 "sluggish recovery" presented in the Europe 2020 strategy[101]. The medium and long term growth projections follow the "baseline" scenario of the 2009 Ageing Report (European Economy, April 2009)[100], which derives GDP growth per country on the basis of variables such as population, participation rates in the labour market and labour productivity.

The population and macroeconomic assumptions used in Scenario 0 are common with those of the "Reference scenario 2010".

Table 2: Growth rates for key baseline assumptions

Annual growth rates [%]	2010 > 2020	2020 > 2030	2030 > 2040	2040 > 2050
Population	+0.29	+0.12	+0.00	-0.09
Number of households	+0.65	+0.40	+0.31	+0.23
GDP	+2.21	+1.74	+1.50	+1.45
Household income	+1.91	+1.43	+1.58	+1.55

The **energy import prices** projections in Scenario 0 are based on a relatively high oil price environment and are similar to reference projections from other sources[102,103]. The baseline price assumptions for the EU27 are the result of world energy modelling (using the PROMETHEUS stochastic world energy model[104]) that derives price trajectories for oil, gas and coal under a conventional wisdom view of the development of the world energy system. This stochastic model is particularly well suited given the great uncertainty regarding future world economic developments and the extent of recoverable resources of fossil fuels. The price development to 2050 is expected to take place in a context of economic recovery and resuming GDP growth without decisive climate action in any world region. Prices were

[101] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:2020:FIN:EN:PDF

[102] The US Energy Information Administration and the International Energy Agency.

[103] Projections for oil, gas and coal prices are similar to those used in the "Reference scenario" in the Energy Roadmap 2050.

[104] http://www.e3mlab.ntua.gr/e3mlab/PROMETHEUS%20Manual/prometheus_documentation.pdf

derived with world energy modelling that shows largely parallel developments of oil and gas prices whereas coal prices remain at much lower levels[105].

Table 3: Energy import prices

€'10 per boe (*)	2010	2020	2030	2040	2050
Oil	85.2	89.0	106.6	116.9	127.6
Gas (NCV)	53.8	62.5	77.1	87.4	99.0
Coal	22.8	28.9	32.8	32.8	33.7

(*) boe = barrel oil equivalent

Similarly to the "Reference scenario 2010", the **price of the CO_2 emissions allowances** in the EU Emissions Trading Scheme reaches 15 €'10/tCO_2 by 2020 and is further projected to reach and stay around 50 €'10/tCO_2 in period 2040-2050 in Scenario 0.

The following policy assumptions are included in Scenario 0 in addition to the "Reference scenario":

Area	**Measure**	**How it is reflected in the model**
Pricing and taxation		
Taxation	Energy taxation Directive (revision 2011)	Changes to minimum tax rates to reflect the switch from volume-based to energy content-based taxation and the inclusion of a CO_2 tax component. Where Member States tax above the minimum level, the current rates are assumed to be kept unchanged. For motor fuels, the relationships between minimum rates are assumed to be mirrored at national level even if the existing rates are higher than the minimum rates. Tax rates are kept constant in real terms.
Internalisation of local externalities	Eurovignette Directive (Directive 2011/76/EU)	Reflected through the introduction of infrastructure charges in Poland (starting with 2011) and the announced introduction of distance based infrastructure charges in Denmark and Belgium (from 2014).
Infrastructure	TEN-T guidelines (revision 2011) and Connecting Europe Facility.	Reflected through the increase in the capacity and performance of the network resulting from the elimination of bottlenecks and addition of missing links, and increase in the train length (to 1.5 km) and maximum axle load (to 22.5 tonnes), reflected through decreases in operation costs and time costs and higher load factors

105 In PRIMES and PRIMES-TREMOVE models all monetary values are expressed in constant terms (without inflation). The economic modelling is based on Euro (€), for which the exchange rate is assumed to depreciate from the currently high levels of around 1.4 $/€, there will be a somewhat faster increase in energy prices in euros than in dollar.

		for freight.
Internal market	Recast of the first railway package (EC proposal 2010)	Reflected through a reduction of average operating costs for railway undertakings.
Other assumptions		
Energy import prices		Short-term increase to reflect the evolution of prices up to 2010 as in the Energy Roadmap 2050.
Technology assumptions	Higher penetration of Electric Vehicles reflecting developments in 2009-2010 national support measures and the intensification of previous action programmes and incentives, such as funding research and technology demonstration (RTD) projects to promote alternative fuels.	Slightly higher penetration of Electric Vehicles. Assumed specific battery costs per unit kWh in the long run: 390-420 €/kWh for plug-in hybrids and 315-370 €/kWh for electric vehicles, depending on range and size, and other assumptions on critical technological components[106].

1.3. Scenario 0 results

Total **transport activity** is projected to grow in the next 40 years. Even though some decreases were observed recently as a consequence of the recent economic and financial crisis, the recovery foreseen is reflected by transport activity returning to its long-term trends. Road transport is expected to maintain its dominant role in both passenger and freight transport within the EU. Passenger transport by rail is projected to grow faster than passenger transport by road, while the growth rates in road and rail freight transport are expected to be in the long run more similar. Air transport and fast passenger trains are foreseen to grow significantly (and roughly at the same rate) and thus increase their shares in transport demand.

Table 4: Transport activity annual growth rates in the baseline scenario

	2010 > 2020	2020 > 2030	2030 > 2040	2040 > 2050
Activity changes measured in Gvkm				
Road transport	1.35	0.68	0.60	0.38
Public road transport	0.87	0.44	0.41	0.24
Busses	1.76	1.18	0.43	0.22
Coaches	0.47	0.07	0.39	0.26
2Wheelers	1.39	1.02	0.60	0.41
Private cars (M1)	1.33	0.69	0.55	0.36
Small cars	1.22	1.10	0.67	0.40
Medium cars	1.93	0.27	0.27	0.22
Big cars	-2.02	1.76	1.80	0.95
Passenger LDV (N1)	1.58	0.78	0.62	0.38
Road Freight Transport	1.46	0.65	0.82	0.52
Trucks (HDV)	1.66	0.53	0.80	0.50
HDV 3.5 - 7.5 tons	1.52	-0.08	1.03	0.43

106 International Energy Agency (2009), Transport, Energy and CO2: Moving Towards Sustainability.

HDV 7.5 - 16 tons	2.10	0.67	0.63	0.52
HDV 16 - 32 tons	1.57	0.79	0.88	0.49
HDV >32 tons	1.56	0.55	0.62	0.54
Freight LDV (N1)	0.69	1.16	0.99	0.65
Activity changes measured in Gpkm for passenger and Gtkm for freight				
Passenger trains	1.87	1.95	1.05	0.72
Freight trains	2.34	1.35	0.78	0.58
Aviation	3.79	2.55	1.50	1.28
Passenger inland navigation	0.96	0.86	0.47	0.31
Freight inland navigation	1.45	1.43	0.56	0.27

As shown in **Table 4** modal shift in the area a passenger transport is taking place due to an increase of the relative share of aviation. Conversely, the situation in the area of freight is expected to be more stable (however Primes-Tremove did not model air freight), with a modest shift of the relative share of HDV transport to train, and HDV freight retaining the bulk of its overall market share.

Table 5: Distribution per mode, baseline scenario (in percentage shares)

	2010	2020	2030	2040	2050
Passenger transport %	100	100	100	100	100
Road	83	81	78	77	76
Rail	8	8	9	9	9
Aviation	9	11	13	14	15
Inland navigation	1	1	1	1	1

	2010	2020	2030	2040	2050
Freight transport activity %	100	100	100	100	100
Trucks (HDVs)	70	70	68	68	68
Freight Light Duty Vehicles	2	2	2	2	2
Rail	17	18	19	19	19
Inland waterway navigation	11	10	11	11	11

Figure 1: Transport activity of heavy duty vehicles

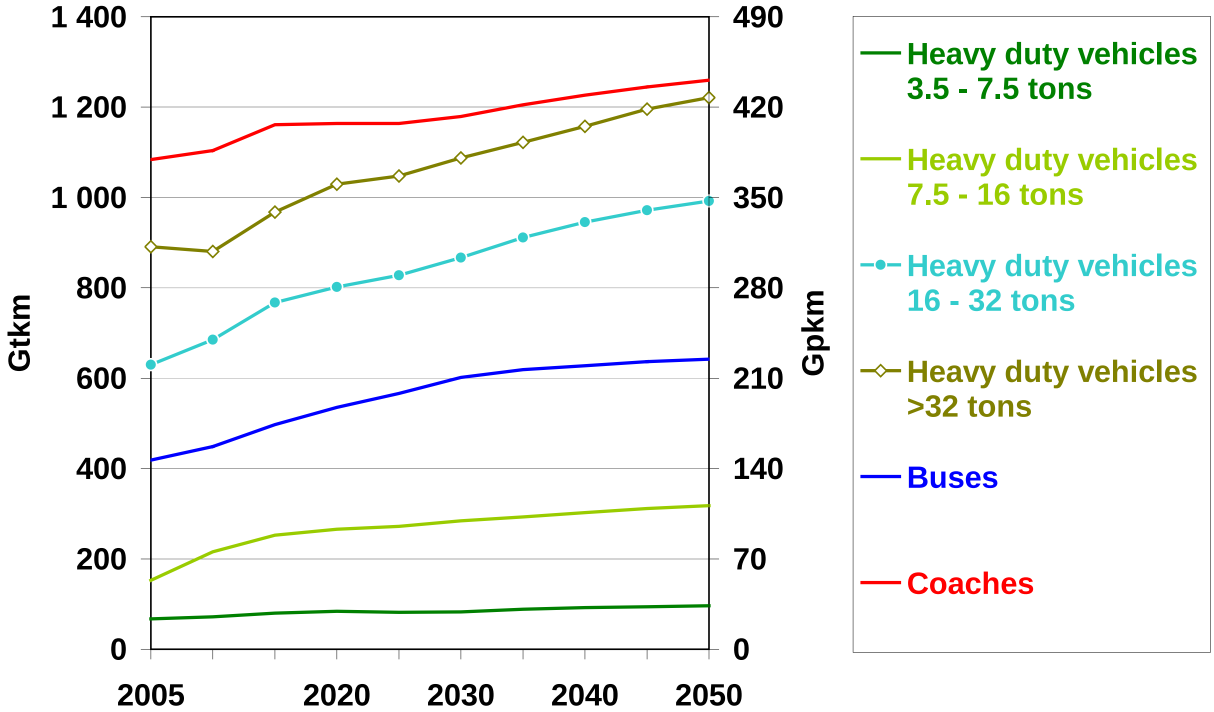
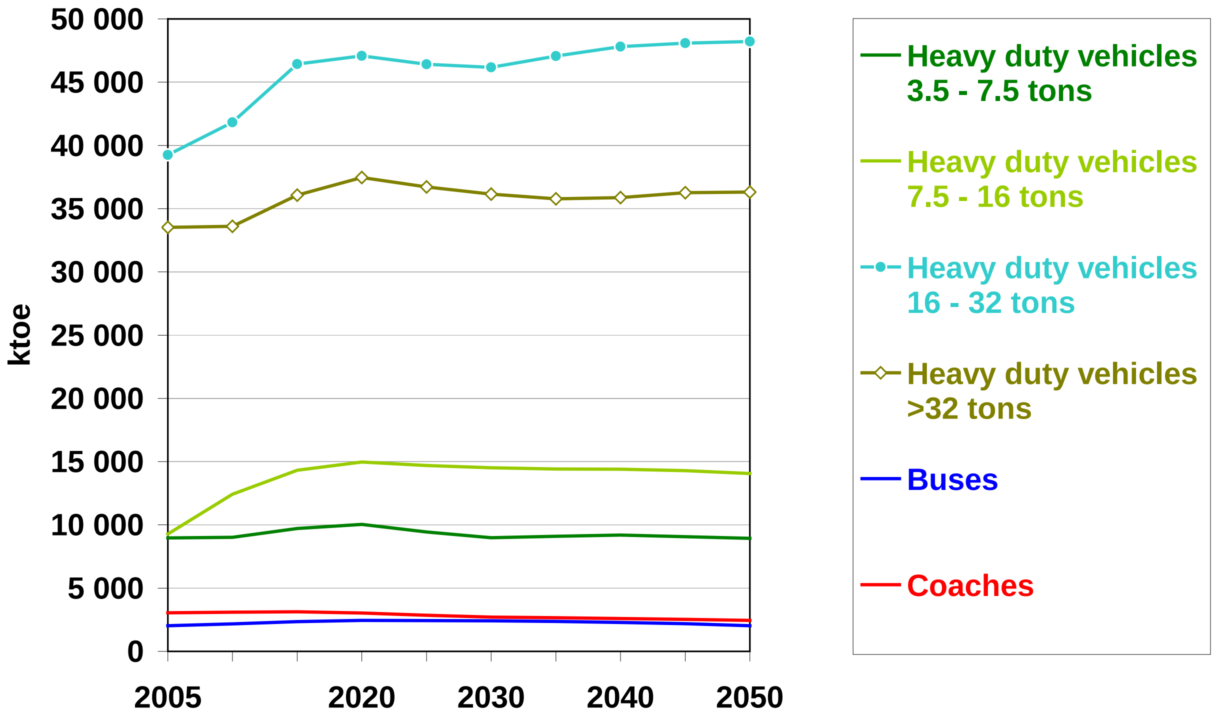


Figure 2: Energy use of heavy duty vehicles



NB: Ktoe = Kilotonnes oil equivalent

Figure 3: Energy use of heavy duty vehicles by fuel

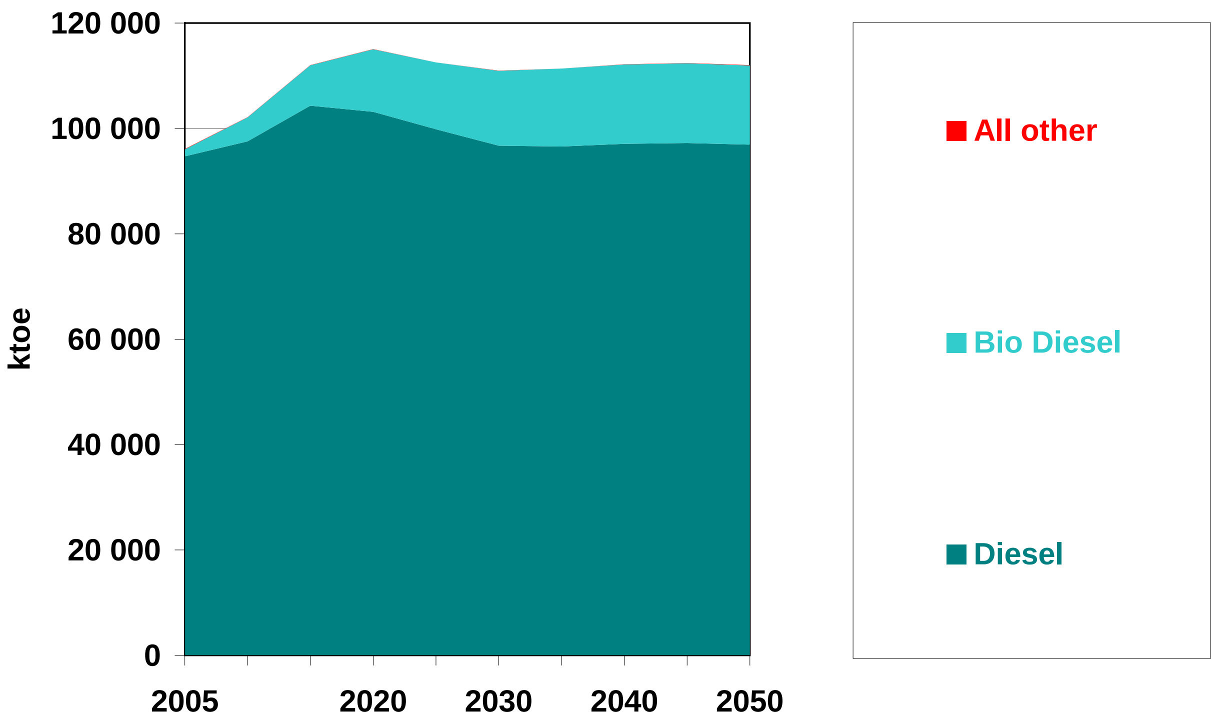


Figure 4: TTW CO_2 emissions of heavy duty vehicles **TTW = tank-to-wheel**

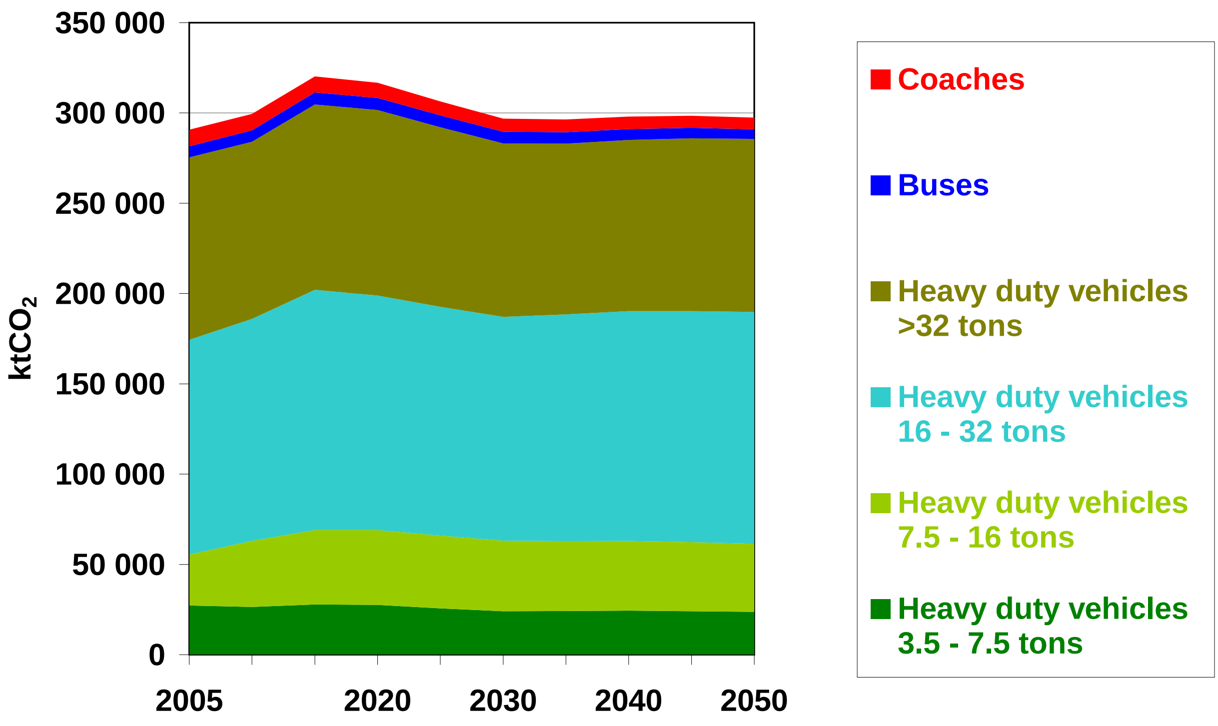
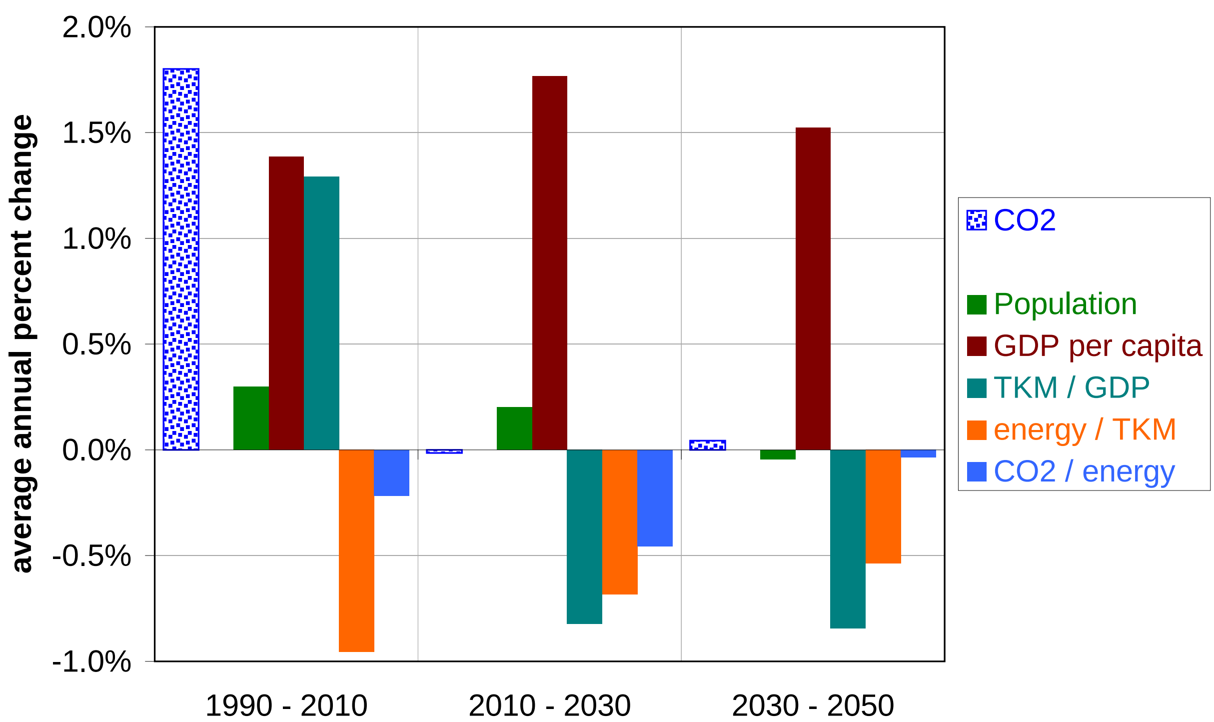


Figure 5: Decomposition of TTW CO_2 emissions of heavy duty vehicles



As can be seen from Figure 3, the **energy use** of heavy-duty vehicles is projected to increase and after 2025 stabilise at around 112 Mtoe, despite increased activity. This is due to improvements in the efficiency of new heavy duty vehicles as well, to a lesser extent, as a consequence of implementing the proposal for the revision of the Energy Taxation Directive.

Evolution of **CO_2 emissions** (**Figure** 4) is showing slightly less growth then energy use due to anticipated small increase in the use of biofuels. Compared to 2005, CO_2 emissions from heavy duty vehicles in the baseline scenario are expected to peak around 2015-2020 (10% above 2005 levels). In periods 2030-2050 they are expected to be stabilised at approximately 2% above 2005 levels. While detailed official historical statistics of CO_2 emissions from heavy duty vehicles within road transport sector are not available, estimates suggest that between 1990 and 2010 the CO_2 emissions of heavy duty vehicles increased by around 36%. With that in mind, one can roughly estimate CO_2 emissions changes with respect to 1990: in both, 2030 and 2050, at around the 2010 level.

A **decomposition** of heavy duty vehicles CO_2 emissions into the product of population, GDP per capita, tonne-km per GDP, energy per tonne-km (approximation for the energy efficiency) and carbon intensity of fuels is shown in Figure 5. While in last 20 years (period 1990-2010) the improvements in energy efficiency and fuel carbon intensity were not able to offset the activity increases, the expected change in the economies transport intensity (tkm/GDP) results in profound effect on CO_2 emissions. As a consequence of increasing fuel prices as well as recent financial and economic crisis, we can see some significant improvements for all efficiency related indicators affecting CO_2 emissions from heavy duty vehicles in the period 2010-2030. The rate improvements for fuel carbon intensity in period 2030-2050 slow down significantly.

2. SCENARIO 1 - SENSITIVITY OF THE BASELINE: EFFICIENCY IMPROVEMENTS

Scenario 1 assumes efficiency improvements in the next 40 years for heavy duty vehicles considerably lower than in the baseline scenario (scenario 0). This allows to quantify how much further efficiency improvements bring in terms of energy and CO_2 savings. In the **Table 5** the exact rates of improvements in Scenario 0 and Scenario 1 are compared.

Table 6: Improvements in average efficiency of new registrations
(diesel conventional engine)

% p.a.	Scenario 0				Scenario 1			
	10 > 20	20 > 30	30 > 40	40 > 50	10 > 20	20 > 30	30 > 40	40 > 50
Buses	-1.09	-1.13	-0.56	-1.11	-0.64	-0.37	-0.14	-0.39
Coaches	-1.31	-1.21	-0.52	-0.99	-0.89	-0.48	-0.13	-0.34
HDV 3.5 – 7.5t	-0.39	-1.00	-0.42	-0.38	-0.08	-0.33	-0.15	-0.23
HDV 7.5 – 16t	-0.21	-1.11	-0.34	-0.35	0.11	-0.45	-0.12	-0.21
HDV 16 – 32t	-0.36	-1.24	-0.26	-0.33	0.01	-0.49	-0.07	-0.20

HDV above 32t	-0.30	-1.30	-0.37	-0.34	0.04	-0.54	-0.15	-0.23

In general the impact of this lower vehicle fuel and CO_2 efficiency on total HDV freight transport activity is small – slight reductions up to 3% in 2050. The increases in CO_2 emissions in Scenario 1 are the same as the increases in energy use, however due to no changes at all in the structure of fuel use (near 100% of diesel use).

Table 6: Key differences for trucks in Scenario 1 compared to Scenario 0

trucks	2020	2030	2040	2050
vehicle-km	-0.4%	-1.6%	-2.9%	-3.0%
tonne-km	-0.9%	-1.5%	-2.2%	-2.5%
energy	+1.8%	+6.4%	+9.7%	+11.6%
TTW CO_2	+1.8%	+6.4%	+9.7%	+11.6%

For buses and coaches the trend is also affected by lower efficiency in passenger cars and some small shift of passengers from cars to public transport on road. However the differences in activity are very small in Scenario 1 when compared to Scenario 0 (see 7).

Table 7: Key differences for buses and coaches in Scenario 1 compared to Scenario 0

buses & coaches	2020	2030	2040	2050
vehicle-km	+0.2%	-0.0%	-0.1%	+0.4%
passenger-km	+0.2%	+0.0%	+0.0%	+0.5%
energy	+1.9%	+8.4%	+14.1%	+19.8%
TTW CO_2	+1.9%	+8.3%	+14.0%	+19.4%

There is no significant direct impact on air pollutants. If fuel consumption decreases, truck manufacturers may optimize the engines in such way that significant overachievements to existing in air pollutants limits (Euro6/VI) should not be expected.

Overall if efficiency improvements in future are not as high as claimed by industrial actors in the HDV field (around 1% p.a.), but roughly more than halved, additional CO_2 emissions in 2020 amount around 6 Mt CO_2. These additional CO_2 emissions increase to 19 Mt CO_2 in 2030 and 35 Mt CO_2 in 2050. The cumulative additional emissions in the period 2030-2040 can be estimated (based on the modelling results) at around 272 Mt CO_2, which is roughly equivalent to annual CO_2 emission of trucks in 2035 (283 Mt CO_2). Total cumulative additional CO_2 emissions in period 2020-2050 are at 715 Mt CO_2, which is roughly equivalent to the average annual emissions of total road transport in the baseline scenario in this period.

3. SENSITIVITY ANALYSIS

A number of other sensitivity analysis tests were carried on the baseline scenario by running alternative PRIMES-TREMOVE scenarios. In particular:

- i./ in case the revised Energy Taxation Directive proposed by the Commission in 2011 - which foresees a rebalancing of diesel fuel and gasoline prices and pricing CO2 within the gasoline and diesel fuel price (the proposed revised ETS assumed a CO2 /Ton price of EUR 20) is not adopted - an alternative run of the baseline scenario suggests that HDV tailpipe emissions would increase only slightly more, i.e. 2.6% in 2030 and 2.4% in 2050 above the baseline;

- ii./ conversely, assuming significantly higher oil prices with an oil price reaching USD 167.3 boe in 2050 vs. USD 128 boe in the current baseline (in 2010 prices), i.e. some 30% above baseline assumptions, HDV 2050 tailpipe emissions would decrease by 5% vs. the baseline, i.e. an increase moderated to some 31% above their 1990 level.

ANNEX 5: HDV FLEET SEGMENTATION

MAIN CHARACTERISTICS OF THE HEAVY-DUTY VEHICLES' FLEET

HDVs are defined as freight vehicles of more than 3.5 tonnes (trucks)[107] or passenger transport vehicles (buses, coaches)[108] of more than 8 seats. The EU HDV market has been highly vulnerable to recent economic cycles and crises: as in the case of a number of investment goods markets, sector cyclical adjustments tend to be much sharper and radical – both ways- than overall GDP growth cycles. Truck registrations fell sharply in 2009 (-44%), recovered in 2010 and 2011 but fell again in 2012 (- 9%) against the background of a worsening economic environment, with altogether around half a million (499,895) vehicle registrations[109]. As a result 2012 truck registrations remained significantly below 2008 levels. The market of buses and coaches appears less cyclical, with about 32,000 registration in 2012, up 1.2% against 2011. In view of the much smaller numbers of buses and coaches passenger transport emissions represent a minor share of total HDV CO_2 emissions.

Table 1: Main HDV categories (trucks)

Category	Main vehicle mission	Registrations last decade (%)
3.5-7.5 tons: Service and delivery	Distribution of goods mainly in cities	18.7%
above 7.5 tons:		
Urban delivery and collection	Distribution in cities or suburban sites from a central store to selling points	6,7%
Municipal utility	Refuse collection trucks, road sweepers.	6,8%
Regional delivery and collection	Distribution of consumer goods from a central warehouse to local stores	20,4%
Long haul	Delivery to national and international sites of 1 day or more trips	32,5%
Construction	On- and off-road construction site vehicles	14,9%

Source: AEA, based on ACEA input

Primary fleet data are not available, with estimates relying on a number of assumptions: the AEA-Ricardo report[110] estimated the EU truck fleet around 6.5 million vehicles in 2008. The HDV fleet is heterogeneous with dissimilar vehicles that have different uses and drive cycles. AEA, based on data and definitions provided by the professional automotive industry association, ACEA[111], segmented the HDV market along six categories of trucks (table 1) and

[107] According to international classifications, N2 and N3 vehicles used for the carriage of goods and having a maximum mass between 3.5 tonnes and 12 tonnes (N2) or exceeding 12 tonnes (N3).

[108] According to international classifications, M2 and M3 vehicles used for the carriage of passengers and comprising more than eight seats in addition to the driver's seat and having a maximum mass not exceeding 5 tonnes (M2) or exceeding 5 tonnes (M3).

[109] Source: ACEA

[110] Aleady quoted report available under : :http://ec.europa.eu/clima/policies/transport/vehicles/docs/ec_hdv_ghg_strategy_en.pdf

[111] Association des Constructeurs Automobiles Européens.

two of passenger vehicles[112]. Most fleet operators are SMEs and even micro-enterprises, with 81% of the truck fleet owned by enterprises having less than 10 trucks (see Table10 in Annex 5). The average lifetime of trucks appears to be shorter (around 11 years) than that of buses and coaches (some 15 years)[113].

Among passenger HDVs, the two main categories are buses and coaches with :
- buses representing 76% of registrations[114], that can be split into: city buses representing 45% of registrations; and inter-city buses representing 31% of registrations;
- and coaches representing 24% of registrations (also AEA estimates based on ACEA input).

The heterogeneity of the fleet is even higher than it would appear based on these eight categories, as each category can be further segmented according to the size and weight of vehicles, the number of axles etc. Furthermore, contrary to cars and vans that have long series of production, HVDs are to a large extent customised to end-users' needs, implying only rather short series of production of homogeneous vehicles. Other factors also play a role such as shape and aerodynamic performance, real drive cycle, effective average load, etc. This altogether makes the assessment of fuel consumption and vehicle's CO_2 emissions more challenging than in the case of small road vehicles such as cars.

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112 For more details, see AEA-Ricardo report "*Reduction and Testing of GHG Emissions from Heavy-Duty Vehicles-Lot 1: Strategy*", pp57-72, available under: http://ec.europa.eu/clima/policies/transport/vehicles/docs/ec_hdv_ghg_strategy_en.pdf

113 Source: AEA-Ricardo report, p 175.

114 Period 2007-2009, same AEA source as above.

ANNEX 6 : STATISTICAL DATA

Table 1: Heavy Duty Vehicle Production in the EU by Country in 2010

	Trucks	Coaches & buses	Total
Austria	18814	0	18814
Belgium	24340	430	24770
Czech Republic	1411	2711	4122
France	39120	3436	42556
Germany	134129	6936	141065
Hungary	2760	130	2890
Italy	28770	1130	29900
Netherlands	44764	1317	46081
Poland	2015	4487	6502
Portugal	4320	70	4390
Spain	36891	254	37145
Sweden	30000	10000	40000
United Kingdom	10116	1508	11624
Total EU	**377450**	**32409**	**409859**

Source: ACEA 2011 (National automobile associations)

http://www.acea.be/images/uploads/files/20110921_Pocket_Guide_3rd_edition.pdf

Table 2: **Vehicle registrations in the EU by Country in 2010**

	Trucks	Coaches & buses	Total
Austria	5250	760	6010
Belgium	7649	1019	8668
Bulgaria	1180	85	1265
Czech Republic	5445	751	6196
Denmark	2749	657	3406
Estonia	368	125	493
Finland	2870	513	3383
France	35859	5906	41765
Germany	80405	5219	85624
Greece	1307	403	1710
Hungary	2278	272	2550
Ireland	1020	47	1067
Italy	18130	3769	21899
Latvia	528	137	665
Lithuania	1369	90	1459
Luxembourg	784	174	958
Netherlands	9487	684	10171
Poland	13815	1072	14887
Portugal	3122	491	3613
Romania	2350	344	2694
Slovakia	2364	504	2868
Slovenia	883	142	1025
Spain	13601	2428	16029
Sweden	4876	1672	6548
United Kingdom	34458	6562	41020
Total EU (*)	**252147**	**33826**	285973
Iceland	33	25	58
Norway	4078	1482	5560
Switzerland	3439	531	3970
Total EFTA	7550	2038	9588
EU + EFTA	**259697**	**35864**	**295561**

Source: ACEA 2011 (National automobile associations)
http://www.acea.be/images/uploads/files/20110921_Pocket_Guide_3rd_edition.pdf

Table 3: **New Vehicle (HDV) registrations in the EU-15**

EU-15 data	2009	2010	% change
Goods vehicles total HDVs	212726	219681	3,3%
HDVs >3,5t & < 16t	69379	69013	-0,5%
HDVs > 16t	143347	150668	5,1%
Buses and Coaches	33312	30034	-9,8%
HDVs >3,5t & < 16t	11842	10881	-8,1%
HDVs > 16t	21470	19153	-10,8%
Total HDVs	**246038**	**249715**	1,5%

Source: Eurostat

Table 4: EU Automotive industry trade

Trade in value (Euro million)	Year 2009 Imports	Year 2009 Exports	Year 2009 Trade balance	Year 2010 Imports	Year 2010 Exports	Year 2010 Trade balance
Passenger cars	21965	48240	26275	22006	76460	54454
Commercial vehicles (< 5 tonnes)	2567	1897	-670	3461	3220	-241
Commercial vehicles (> 5 tonnes) + buses & coaches	798	2514	1716	716	3616	2900
Total	**25330**	**52651**	**27321**	**26183**	**83296**	**57113**

Source: Eurostat & ACEA

Table 5: Employment by Mode of Transport

In 1,000 employees 2009	**Road Freight**	**Road Passenger**	Rail	Pipelines	Inland Water Transport	Sea Transport	Air Transport	Warehousing and support activities	**Total**
BE	**64**	**36,2**	30,3	0	0,6	0,6	6,2	50,2	**188,1**
BG	**45,2**	**37,4**	16	0	1,1	4,3	2,6	34,8	**141,4**
CZ	**108,8**	**42,4**	46,4	0,5	0,6	0	5,8	38,9	**243,4**
DK	**24,6**	**27,2**	8,3	0,8	0,1	14	5,1	20,7	**363**
DE	**357,6**	**323,1**	75,7	1,6	8,5	28,4	56,6	548,5	**1400**
EE	**13,6**	**5,8**	1,6	0	0,1	1,1	0,7	10,3	**33,2**
IE	**20,4**	**11,9**	5,2	0	0	1	8,5	16,5	**63,5**
EL	**41,8**	**74,4**	5,3	0	0	17,6	3,8	34,2	**177,1**
ES	**382**	**191,8**	20,7	0	0,4	7,4	34,2	209,4	**845,9**
FR	**359,9**	**311,5**	126,8	3,9	3	13,5	72,1	254,7	**1145,4**
IT	**332,8**	**171,3**	49,4	2,6	3,1	28,7	23,5	345,7	**957,1**
CY	**3**	**3,1**	0	0	0	4,8	2,2	9	**22,1**
LV	**17,9**	**13,2**	4,9	0,3	0	1	1,6	24,6	**63,5**
LT	**40,1**	**16,4**	8,5	0	0,1	1,8	0,6	14,1	**81,6**
LU	**8,7**	**3**	2,4	0	0,1	0	3,9	2,9	**21**
HU	**64,4**	**49,4**	12,1	0,6	0,9	0,1	2,1	54,9	**184,5**
MT	**1**	**1,4**	0	0	0	0,1	2	2	**6,5**
NL	**120,4**	**126,8**	20,6	0,1	13,7	11,6	30,1	78	**401,3**
AT	**58**	**52,3**	12,8	0,4	0,5	0	9,3	50,3	**183,6**
PL	**254,9**	**149,8**	111,6	3,2	1,4	2,2	6,3	79,5	**608,9**
PT	**65**	**36,3**	6	0,1	0,8	1,3	8,6	32,6	**150,7**
RO	**91,8**	**80,2**	41,9	7,1	2,5	0,8	4,7	62,8	**291,8**
SI	**22,4**	**7,9**	6,3	0	0,1	0,2	0,9	8	**45,8**
SK	**14,3**	**13,5**	25,9	1,2	0,5	0	0,9	30,4	**86,7**
FI	**45,7**	**27,8**	8,8	0	0,3	9,4	7	28,1	**127,1**
SE	**71,6**	**64,9**	10	0	1,1	16,4	6,9	49	**219,9**
UK	**321,8**	**231,4**	54,8	0,5	1,5	13,3	73,6	289,1	**986**
EU 27	**2951,7**	**2110,4**	**712,3**	**22,9**	**41**	**179,6**	**379,8**	**2379,2**	**8776,9**

Source: Eurostat

Table 6: Turnover and Number of Enterprises, Freight and Passenger Transport

2009	Freight Transport Turnover (million €)	Passenger Transport Turnover (million €)	Freight Transport Number of Enterprises	Passenger Transport Number of Enterprises	Freight and Passenger Transport Turnover (million €)	Freight and Passenger Transport Number of Enterprises
BE					0	0
BG	1747	456	9178	7811	2203	16989
CZ	6447	891	28324	6048	7338	34372
DK			7057	3724		10781
DE	31878	1725	34790	25000	33603	59790
EE	747	109	2543	320	856	2863
IE	2319				2319	
EL			5044			5044
ES	33109		134915		33109	134915
FR	39360	16568	37587	36686	55928	74273
IT	37366	9257	83524	28194	46623	111718
CY	191	101	1446	1520	292	2966
LV	716		2815	796	716	3611
LT	1723	261	4014	1159	1984	5173
LU	1062		507	180	1062	687
HU	3558	1037	17080	9077	4595	26157
MT						
NL	17981	3392	8977	4434	21373	13411
AT	8440	3594	6824	4983	12034	11807
PL	12865	3209	74836	45784	16074	120620
PT	4584	1318	10114	11317	5902	21431
RO	3690	1025	22504	9130	4715	31634
SI	1847	225	6288	1061	2072	7349
SK	906	274	236	100	1180	336
FI	5309		11232	9538	5309	20770
SE	7875	5543	14773	8883	13418	23656
UK	27482	14996	31657	12027	42478	43684
EU 27	**269535**	**98483**	**600000**	**331722**	**368018**	**931722**

Source: Eurostat

Table 7: Modal Split, Freight Transport (inland modes)

%	Road	Rail	Inland Waterways	Pipelines
1995	67,4	20,2	6,4	6
1996	67,4	20,3	6,2	6,2
1997	67,3	20,4	6,4	5,9
1998	68,3	19	6,4	6,1
1999	69,8	18,2	6,1	5,9
2000	69,6	18,5	6,1	5,8
2001	70,5	17,5	6	6
2002	71,4	17,1	5,9	5,7
2003	71,6	17,3	5,4	5,7
2004	71,8	17,2	5,6	5,4
2005	72,3	16,7	5,6	5,5
2006	72,1	17,2	5,4	5,3
2007	72,5	17,2	5,5	4,8
2008	72,6	17	5,6	4,9
2009	73,5	15,7	5,6	5,2
2010	72,7	16,2	6,1	5

Source: Eurostat

Table 8: Modal Split, Passenger Transport

%	Passenger cars	Powered 2-wheelers	Bus & Coach	Rail	Tram & Metro	Air	Sea
1995	73,1	2,3	9,4	6,6	1,3	6,5	0,8
1996	73,1	2,3	9,3	6,4	1,3	6,8	0,8
1997	73,1	2,3	9,1	6,3	1,3	7,1	0,8
1998	73,2	2,3	9,1	6,2	1,3	7,2	0,8
1999	73,2	2,3	8,9	6,2	1,3	7,3	0,7
2000	73	2,3	8,8	6,3	1,3	7,7	0,7
2001	73,3	2,3	8,7	6,2	1,3	7,5	0,7
2002	73,8	2,3	8,6	6	1,3	7,3	0,7
2003	73,7	2,3	8,5	5,9	1,3	7,6	0,7
2004	73,6	2,3	8,3	5,9	1,3	7,9	0,6
2005	73	2,4	8,3	6	1,3	8,4	0,6
2006	73	2,4	8	6,1	1,3	8,6	0,6
2007	72,8	2,4	8,1	6,1	1,3	8,8	0,6
2008	72,7	2,4	8,1	6,3	1,4	8,6	0,6
2009	73,5	2,4	7,8	6,2	1,4	8	0,6
2010	73,7	1,9	7,9	6,3	1,4	8,2	0,6

Source: Eurostat

Table 9: Compared labour intensities, automotive manufacturing and oil industry

Labour intensity: automotive industry vs oil companies		
	Turnover 2010 (€bn)	Employees
Volvo	30	100000
Scania	9,9	37500
MAN	13	52542
total	52,9	190042
1, ratio : number of employees / 1 bn€ turnover		**3592**
Total	184	96000
Shell	280	101000
BP	277	84000
	741	281000
2, ratio : number of employees / 1 bn€ turnover		**379**
Multiplier 1 / 2		**9,5**

Table 10: EU fleet distribution

EU fleet distribution (trucks) **Proportion of total number of vehicles in the wider fleet %**	
Companies with one truck	38,7%
Companies with 2 to 10 trucks	45,4%
Companies with 11 to 50 trucks	13,3%
Companies with more than 50 trucks	2,7%
	100%

Source AEA Ricardo, based on IRU (2004) and UK Dft (2010) data

Table 11

Refined oil production in the EU

	KT / year (2010)
Austria	10006
Belgium	39907
Bulgaria	8806
Cyprus	0
Czech Republic	9606
Denmark	8680
Estonia	0
Finland	12783
France	99578
Germany	121743
Greece	21264
Hungary	8055
Ireland	3552
Italy	111333
latvia	0
Lithuania	9506
Luxembourg	0
Malta	0
Netherlands	64534
Poland	24667
Portugal	15210
Romania	21388
Slovenia	0
Slovakia	6004
Spain	64315
Sweden	21864
UK	94990
Total (KT)	**777791**

Source: European Commission

ANNEX 7 : SIMULATION TOOL DEVELOPMENT

Determination of CO_2 emissions from HDVs: development of a new simulation tool, VECTO[115]

1. Current situation

Unlike for cars and vans, where pursuant to the existing type-approval regulation the fuel consumption of each new type approved vehicle is tested on a chassis dynamometer, there is no official and comparable determination for the fuel consumption or its equivalent for the CO_2 emissions for a whole new HDV. For a consistent policy on reducing CO2 emissions and measuring the future achievement of fuel efficiency a robust, reliable and cost effective determination of fuel consumption has to be established.

Several approaches for the determination of CO_2 emissions have been investigated:

- Chassis dynamometer
- Portable Emission Measurement Systems (PEMS) and
- Component testing and computer simulation

Due to multiple combinations of axle type, number of driven axles, gear boxes, engines and cabins, the number of variations within one HDV model range can exceed 1000. Therefore measuring every possible configuration on a chassis dynamometer or with PEMS would be a very burdensome approach.

2. Development of a simulation tool of whole HDV CO_2 emissions

The Commission has since 2009 engaged with main industry stakeholders in the development of a simulation tool for whole vehicles CO_2 emissions and fuel consumption that should be applicable to all main categories of HDVs.

In the project “Reduction and testing of Greenhouse Gas Emissions from Heavy duty vehicles” - (**call for tender ENV.C.3/SER/2009/0038)** a simulation based test procedure where the relevant components of the HDV were tested and based on this data a simulation tool calculating the fuel consumption and the CO_2 emissions in vehicle class specific test cycles was chosen as the method that delivers robust results of CO_2 figures for HDVs and appears manageable for the manufacturers and public administrations that have to deal with a test procedure.

The relevant data needs for the simulation of HDV CO_2 data that have been identified include the engine fuel efficiency map, vehicle weight, rolling resistance coefficients, aerodynamic drag specifications, moments of inertia from the vehicle including standardised bodies or trailers, the specifications of the gear boxes and efficiency of the auxiliaries.

[115] VECTO = Vehicle Energy Calculation Tool

Such a simulation based approach should allow cost efficient testing of multiple HDV variations by compiling the measured component data in the simulator. This approach also makes it possible to easily assess the CO_2 emissions impact of improved trailer and body structure design. The proposed test procedure has been applied experimentally on three HDV categories and appears to give reliable results.

The simulation-based method consists of:

- On-road measurement of driving resistances
- Determination of drivetrain losses
- Determination of power demand of engine auxiliaries and other consumers
- Measurement of the engine fuel consumption map as extension to the engine's type approval tests
- Simulation of the fuel consumption and the resulting CO_2-emisions from the vehicle using the aforementioned input data for predefined representative driving cycles.

The single steps described in brief:

The driving resistances of the vehicle will be measured during constant speed or coast down rides on a test track. Standardized bodies and trailers will be used to obtain reliable air resistance values. For reproducible results, corrections for influences of road gradient, wind speed, ambient temperature and air pressure as well as for velocity unsteadiness have to be applied to the measured driving resistance values.

For the body and trailer manufacturers an option for a less extensive procedure can be applied. Improved bodies or trailers (aerodynamics, curb weigh) can be tested in comparison to the standard components via constant speed tests or via coast down tests at high velocities. The relative change against the standard body or trailer can then be introduced into the simulation tool to calculate the fuel consumption and the CO_2 emissions of the alternative vehicle and body-configuration.

Drivetrain friction losses and the power demand of engine auxiliaries like fan, air compressor or air conditioning, will be defined as default functions. If OEMs use more efficient components, the default values can be replaced by component specific efficiency maps.

Since several technical options to improve the fuel efficiency of HDV have different reduction potentials at varying driving conditions, the definition of representative driving cycles is important for a realistic ranking of the specific fuel consumption. Driving cycles for the different categories and usage of HDVs are newly developed to give more realistic results on fuel consumption.

It is desirable for the methodology to address all characteristics that are relevant to the efficiency of the entire vehicle. Realistic values for the fuel efficiency of various HDV in different mission profiles will improve customer information and incentivise manufacturers to develop and apply fuel saving technologies. In future a standardised test procedure could support other measures in the HDV sector including CO_2 emissions monitoring, labelling or programmes for HDV customers to calculate HDV fuel efficiency.

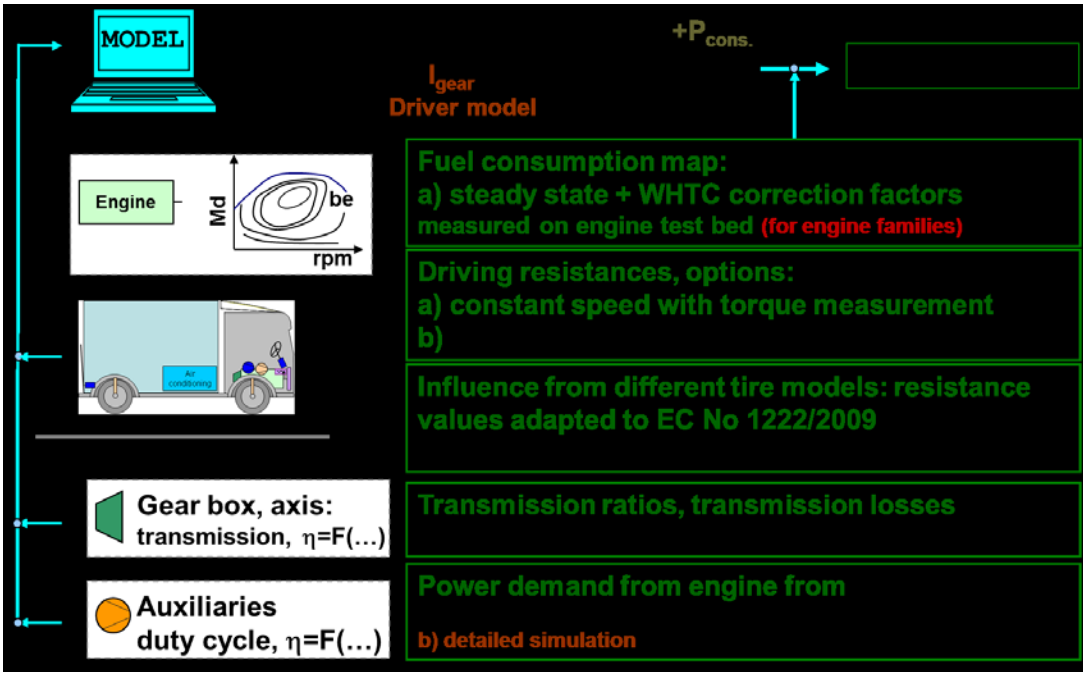
The main targets for the test procedure are:

1. Repeatable (within same laboratory) and reproducible (between different laboratories)
2. Incentive to apply efficient technologies and to optimise the entire vehicle set-up
3. High sensitivity for fuel saving measures
4. Reasonable costs and efforts to run and examine the procedure
5. Simple and robust

Schematic overview of simulation model and computational programme

Figure 1 below gives an overview of the test procedure. Rolling resistance, air resistance, power to accelerate translational and rotatory moved masses, power resulting from road gradients, losses in the transmission system and power demand from auxiliaries are considered in the simulation.

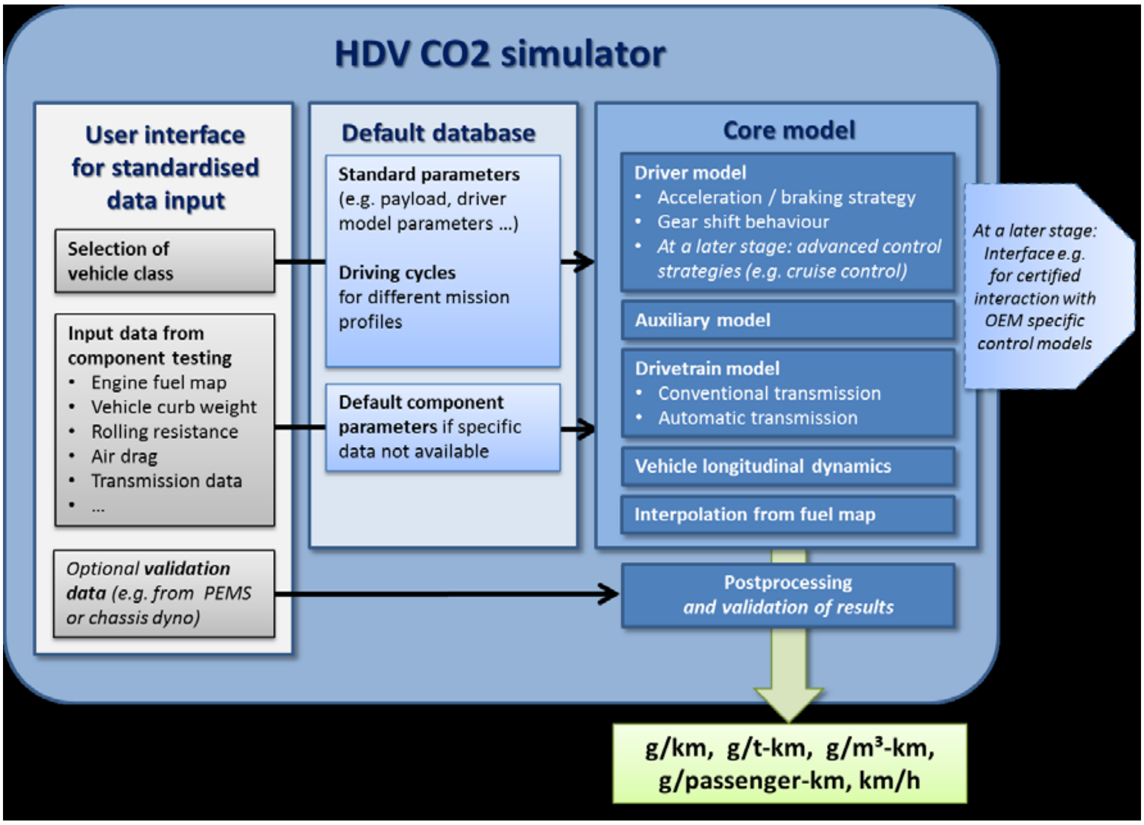
Figure 1: Schematic picture of the test procedure



All the measured data of the components / subsystems of a HDV will then be used as input data in a HDV energy/CO_2 simulation.

Figure 2: **Structure of the simulation tool**

The structure of the simulation tool is shown below:



The simulation tool will calculate the energy consumption of the whole HDV and give as a result the fuel consumption or CO_2 emissions in g/km, g/t*km, g/m3*km, g/passenger*km.

3. On-going and future development steps of the VECTO tool.

The development of the VECTO tool entered in October 2012 in a new phase with tests of the methodology with an active participation of the manufacturers to prove the reliability of the test procedure and simulation.

Until May 2014:

This phase (on-going), based on currently contracted assignments, is expected to last until May 2014, and includes:
- the current development and test of the VECTO tool which covers three categories of HDV vehicles, i.e. long haul, regional/city delivery, and coaches (completion May 2014);
- and the preparation of the required documentation of certification/registration process (already started, to be defined and finalised in 2014 upon completion of the VECTO tool).

By May 2014 the model is expected to be validated for the above mentioned three categories of vehicles that represent more than 50% of new HDV registrations.

Mid-2014 until end 2015 (tentatively):

The VECTO tool thereafter will have to be extended to other categories of HDVs (e.g. city and inter-city buses, municipal utility trucks, service and urban delivery trucks, construction trucks). Moreover, the IT platform of VECTO will have to be created. The next and last phase of development of the VECTO tool is thus expected to include:

- the further development and finalisation of VECTO to cover other categories of HDVs;
- the IT development of a user-friendly software platform to support the deployment of the VECTO tool ;
- and the adaptation of the required documentation of the certification/registration process for all relevant categories of vehicles.

Option 3.i. Setting HDV engine-only emission limits

Table 1 Improved (diesel) engine, potential for CO2 emissions abatement

CO2 emissions reduction as :	% of whole CO2 HDV emissions (*)	% of achievable CO2 emissions savings (*)	average cost €	marginal cost in € / tCO2
Service	4,10%	28%	1213	-158
Urban delivery	9,60%	22%	3920	-194
Municipal utilitty	10,20%	29%	3920	-243
Regional delivery	8,70%	25%	3920	-249
Long haul	13,10%	36%	10953	-276
Construction	9,50%	21%	3920	-229
Bus	10,60%	24%	3920	-271
Coach	14,60%	58%	10953	-178
Average (weighted)	**10,83%**	**32,0%**	**6.826 €**	**-244,57**

(*) in terms of tailpipe (tank-to-wheel) emissions

Source: CE Delft / TIAX

Table 2. Indicative distribution effects of reduced fuel consumption in 2030

Regulation option : setting CO2 limits on HDV engine-only emissions (target 2030, new vehicles)	Fuel savings vs baseline (fleet) TTW 2030	Fuel cost savings inc excises vs baseline TTW bn euro 2030	Tax loss for MS vs baseline bn euro 2030	Turnover loss for oil companies (**) bn euro 2030	Gross margin loss for oil companies (***) bn euro 2030	EU Import savings vs baseline TTW + refining (*) bn euro 2030
Low value: 10% fuel savings vs baseline	5,5%	14,4	7,6	6,7	1,7	5,8
High value: 12% fuel savings vs baseline	6,6%	17,3	9,2	8,1	2,0	6,9

(*) assuming an additional 13% of the fuel consumed by HDV transport is used in refining the fuel
(**) turnover without excises and VAT taxes on fuel
(***) Gross margin = turnover (withour excises and VAT), deducting fuel import costs

Option 3.i. Setting HDV engine-only emission limits

Table 3 Indicative EU HDV fleet emissions reduction by 2030 with regulated CO2 emission limit

CO2 emission limits option for new registered HDVs	2010	2015	2020	2030	2050
Baseline scenario, HDV emissions tank-to-wheel krCO2	299451	320300	316699	296882	299374
Reduced fleet emissions with -35% objective 2030 vs 2015				260189	
HDV fleet emission savings due to regulated limit (ktCO2)				36693	
HDV fleet emission savings due to regulated limit (% savings vs baseline)				-12,4%	

Source: European Commission

Table 4: Indicative cost of HDV technical upgrades vs. baseline scenario

	Project name	Capital cost (€)	Additional fuel saving percentage (%)	Cumulative carbon savings (%)
Baseline	1, Fuel efficiency improvements		6,9%	baseline
assumed	2, Predictive cruise control	81	1,4%	17,9%
improvemt	3, Low resistance tires	873	9,6%	improvement
Additional	4, transmission friction reduction	202	1,0%	
upgrades	5, Advanced engine	3920	8,7%	Regulated
triggered	6, Automatic tire inflation trailer	283	0,4%	CO2 limit :
by option	7, Boat tail	1114	2,2%	15,6%
regulating	8, Full gap fairing	1011	0,1%	
CO2 limits	9, Full skirts	2425	1,7%	improvement
	10, Material substitution	2401	1,5%	vs baseline
	11, Gen.II dual hybrid	18794	6,6%	
	12, Automatic tire inflation tractor	3738	0,4%	
				33,5%
	Individual vehicle cost of upgrades vs baseline scenario (2010€)	11356		
	Annual HDV 2030 registrations baseline scenario	808000		
	Annual EU cost of upgrading HDVs meeting regulation by 2030 (bn2010€)	9,2		
	(assuming Regional delivery vehicles are average ones)		Source: European Commission	

Comment: this table is a conventional allocation of vehicle innovations for a Regional delivery vehicle (used as "average" vehicle) along (i) the baseline scenario and (ii) option 3 on regulated limits. The baseline scenario assumes vehicle energy efficiency improvements of around 1% per year over the period 2014-2020 (which would conventionally by 2030 correspond to the first three lines' benefits under the assumption of 100% implementation). Additional conventional improvements are listed in the seven following lines (4 to10) and have marginal costs that are negative, i.e. they all allow for breakeven levels to be reached. The last two lines would not be cost effective –they have positive marginal costs, see in annex 10 table on regional delivery vehicles - and would not allow to reach breakeven. If the regulatory CO_2 emissions limit applying in 2030 under option 3 is set around breakeven levels, this would imply that only innovations of lines 1-10 would be implemented by 2030, and not the last two ones (Gen.II dual hybrid & Automatic tire inflation). Summing up marginal costs of lines 4-10 one concludes that the cost of individual vehicle upgrades to comply with the regulatory limit is around 11.356 euros, with the latter set at -33.5% of its 2014 level, or below 15.6% the level that would be reached in 2030 under the baseline scenario (right column). The reality would differ from this conventional allocation of innovations with a broader match of innovations implemented under the baseline scenario, with different penetration rates (and not 100% as assumed here for the first three lines).

Setting regulatory emissions target levels, possible policy methods

One important policy decision to be made under this option relates to the method to be used in due course for setting the CO_2 emissions reduction target, with several main options:

- (i) either setting the policy target around the estimated breakeven level of technology uptake based on marginal costs (this would mean a 30% to 35% emissions reduction level under the present CE Delft estimates, i.e. not requesting technology uptakes with positive marginal abatement costs), thus in the worst case neutralising the economic impact and cost of this regulatory requirement for the HDV fleet operators. This would ensure that regulatory requirements concur with the cost incentive structure. The HDV industry would be expected to benefit from this method since most technical upgrades considered have significantly negative marginal abatement cost. If the sector is also included in ETS, the breakeven level of technology would shift due to inclusion in ETS, notably if carbon prices were to rise significantly. The latter combined option requires further research and is not analysed in detail within this Impact Assessment.
- (ii) or neutralising the overall cost of regulation for HDV operators, which implies that marginal costs of technology uptakes would be averaged, ensuring that upgrades with positive marginal abatement rates may be required as long as their net cost is covered by gains made on other upgrades at negative costs. In spite of its overall fairness, the disadvantage of this method is a disconnection between regulatory and marginal cost incentives, with high risks of missing the regulation's target, with those technical upgrades that have a negative marginal cost not being introduced.
- or (iii) requesting an additional effort from HDV transport by setting an even more stringent limit, with –in order to ensure a level playing field with other sectors of the economy - this effort being made financially equivalent to a carbon emissions ETS price contribution from HDV operators, thereby equalising marginal costs with those of sectors and enterprises that belong to the ETS.

This neutralising or equalising objective under options (ii) and (iii) would however require high non-compliance penalties adding, beyond breakeven levels of marginal costs, a regulatory ad-hoc incentive.

The option retained on an indicative basis in the quantitative analysis of the present Impact Assessment is the first one, i.e. the setting of emission ceilings at the breakeven point of emission abatement marginal cost curves. The method to be eventually followed in setting emission limit value(s) would have to be endorsed in due course as part of policy choices to be made.

Table 5: Indicative distribution effects of reduced fuel consumption in 2030 vs. baseline

		Fleet operators (benefits)	Member States (loss)		Oil companies ("loss")	Balance of payments (benefit)
All euro estimates in 2010€ Regulation option : setting CO2 limits for new HDVs below 35% of 2015 levels	Fuel savings whole fleet % 2030% TTW	Fuel cost savings inc excises TTW 2030 bn euro	Tax loss for MS 2030 bn euro	Turnover loss for oil companies (**) 2030 bn euro	Gross margin loss for oil companies (***) 2030 bn euro	EU Import savings vs baseline TTW + refining (*) 2030 bn euro
HDV fleet emissions reduction by 2030:						
- vs 2015 baseline HDV fleet emission level	33,3%	87,1	46,2	40,8	10,0	34,9
- vs 2030 baseline HDV fleet emission levels	12,4%	32,4	17,2	15,2	3,7	13,0

(*) assuming an additional 13% of the fuel consumed by HDV transport is used in refining the fuel
(**) turnover without excises and VAT taxes on fuel
(***) Gross margin = turnover (withour excises and VAT), deducting fuel import costs

ANNEX 9 : INTERNATIONAL COMPARISON

International experience in setting HDV CO_2 emission limits

Japan

Japan was the first to introduce in 2007 a fuel consumption based rule for HDVs. The Japanese provisions and limits expressed as Reference Energy Consumption Efficiency are laid down in the Japanese Energy Conservation Standards. The corresponding test procedure, called the TRIAS, was also published in 2007. The standards are given as km/litre and become applicable form April 1st, 2015. The Japanese law also provides provisions for vehicle sticker in the case that a vehicle to be type approved over-fulfils / under runs the CO2-standard.

Based on the "Top Runner Programme" (that requires current best in class performance to become the average performance level by a target date), manufacturers are required to improve the fuel economy of heavy duty vehicles from the year 2015. Target values are set by category of gross vehicle weight. For some categories, there are sub-categories based on payloads.

The simulation method uses a computer programme that converts a vehicle-based driving cycle into an engine-based operation cycle using vehicle specification data, and thereby calculates fuel efficiency using the data from engine-based tests. This test method mainly measures the fuel efficiency of engines, but factors such as aerodynamics and tyre rolling resistance that could have an impact on on-road fuel efficiency are calculated by standard values. Japan is preparing further developments of the test method and with the possible inclusion of important real world factors like rolling resistance and aerodynamics.

United States

In September 2011 the U.S. adopted legislation on HDV CO_2 emissions. These rules, which have been supported by the trucking industry, set standards for new vehicles of model years 2014 through 2018 and will require manufacturers to improve fuel economy and greenhouse gas emissions by up to 20 per cent for the targeted models by 2018.

This rulemaking was directed by the U.S. government to EPA (Environmental Protection Agency) and NHTSA (National Highway Traffic Safety Administration) in order to develop a joint national program for reducing GHG and fuel consumption in the U.S. Heavy-Duty Sector. The regulation includes testing and verification provisions as well as standards for CO2 emissions and the fuel consumption of heavy-duty trucks and vehicles. The CO2-emission standards are set to values in gram/ton-mile and the standard for the Fuel Consumption is expressed in gallon/1000 ton-miles. The CO2 standard is set by EPA and the fuel consumption standard by the NHTSA as a part of the U.S. Department of Transportation (DOT). Along with the CO2, EPA is also regulating CH4 (Methane) and N2O (Nitrous Oxide) in a set of greenhouse gases (GHG). CO2 credits from an ATB (Averaging, Trading and Banking) program can be used if the CH4 or N2O limit values are “slightly” exceeded. In addition the proposal comprises new engine standards with respect to CO2 in g/bhp-hr and Fuel Consumption in gallon/100 bhp-hr. As the U.S. truck market allows the vehicle buyer to choose between different engines (also by means of manufacturer) a dual approach applying to engine and vehicle emissions was applied.

The rule does not set separate standards for the trailers themselves. However, EPA and NHTSA are reflecting on ways to include them in regulations beyond model year 2018. For heavy-duty pickup trucks and vans, the final rules require improved fuel consumption and greenhouse gas emissions by 15% by 2018 with separate standards for diesel and gasoline engines. For delivery trucks, buses, and garbage trucks, known as "vocational vehicles," the final rules require improved fuel economy and greenhouse gas emissions by 10% by 2018.

Manufacturers of heavy-duty trucks and vans will also have a fleet-wide averaging system similar to that used by passenger vehicle manufacturers to meet their fuel economy requirements.

The standards for combination tractors and vocational vehicles include both engine and vehicle based CO2 and fuel consumption limits. Compliance with the engine emission limits will be determined through engine dynamometer testing, while compliance with vehicle-based standards will be determined based on a customized vehicle simulation model, called the Greenhouse gas Emission Model (GEM), developed by EPA specifically for this regulation. Instead of using a chassis dynamometer as an indirect way to evaluate real-world operation and performance, various characteristics of the vehicle are used as inputs to the model, such as aerodynamic features, weight reductions, tire rolling resistance, the presence of idle-reducing technology, and vehicle speed limiters.

Canada

The Canadian rule was adopted in 2012 and is based on the US one.

China

China recently defined an approach on how to measure and report fuel consumption and CO2 emissions, without however yet any limits or declaration procedures. The standard is applicable to all heavy-duty vehicles with a gross vehicle weight above 3.500 kg. The Chinese CO2 standard is based on vehicle chassis-dynamometer testing for the so-called "basic" vehicle type. All other vehicles characterised by the "basic" vehicle are called "variant" vehicles. For the "variants", a simulation model can be used as alternative to the chassis-dynamometer. Nonetheless all variants can be tested on the chassis-dynamometer too. The simulation model will make use of the above mentioned engine test data as well as of the driving resistance data. The standard allows determining the fuel consumption either by a carbon balance or direct mass or volumetric measurement.

ANNEX 10 : COMPETITIVENESS ASSESSMENT

Impacts on competitiveness

Introduction

Policy measures assessed in the present competitiveness analysis are those that would legislate on HDV CO_2 emissions levels, i.e. the inclusion of HDVs in the Emissions Trading Scheme (ETS, option 4 in section 5 of the present Impact Assessment) or the mandatory introduction of emission limits (option 5 in section 5). In analysing impacts of the considered policy measures on competitiveness a distinction should be made between different affected sectors and different markets. There may be an effect on the competitiveness of European businesses, relative to each other or to companies from outside the EU, on the European market and on other, global markets. Impacts on competitiveness may be viewed from the perspective of the European economy as a whole based on the competitiveness of European companies on global markets. Overall economic impacts of legislative measures for reducing Heavy Duty Vehicle (HDVs) emissions would not directly lead to impacts on competitiveness. To analyse these one needs to assess, for different categories of companies, whether various economic impacts are different for different companies operating on the same market.

All affected sectors will be discussed but the focus of this annex will mainly be on competitiveness impacts in the HDV sector of the automotive industry: if new legislative measures require the production of new HDVs with lower fuel consumption and reduced CO_2 emissions, the onus will primarily be on the automotive industry to produce vehicles that meet the new requirements. Due to limited data, in some aspects it has been difficult to obtain specific figures and indicators for the HDV sector as a separate entity and as such an analysis of the overall automotive industry in the EU is presented.

This annex first identifies the sectors which are possibly affected. Then an assessment is given of impacts with respect to general drivers that may affect competitiveness. In addition to that impacts on the capacity of affected companies to innovate are assessed. Based on these general evaluations and additional information from available studies the impacts on competitiveness of businesses in different affected sectors are analysed in more detail. Some analysis is also paid to the impacts on SMEs.

Which are the affected sectors?

The main sectors affected by the impact of legislative measures that are examined and assessed in the present Impact Assessment for reducing HDV fuel consumption and CO_2 emissions would be HDV manufacturers and automotive component suppliers. Other major stakeholder groups affected include freight and passenger transport operators and logistics companies.

Buyers of HDVs, including companies for their own use, logistics operators and transport operators of freight and passengers services are affected. CO_2 emissions are strictly proportional (except if fuel includes an increasing proportion of non-fossil fuel) to fuel consumption with a currently stable conversion parameter (1 litre fuel being equivalent to around 2.6 kg CO_2 emissions). High HDV CO_2 emissions hence translate to high fuel consumption and operating costs. Conversely, significant savings in fuel consumption and CO_2 would reduce operating costs and increase competitiveness. The benefits of increased fuel efficiency and lower CO_2 emissions need to be assessed against the background of additional investment costs required in manufacturing more efficient HDVs.

Vehicle manufacturers would be affected by the obligation to comply with a new legislative framework to reduce CO_2 emissions from HDVs. This should be seen against the background of recent regulatory developments which required manufacturers to upgrade their vehicles to comply with European pollutant regulations (the latest one being the Euro VI regulation that will enter into force in 2014). Manufacturers may over time have to introduce technical CO_2 reduction measures, either under the option of the inclusion of HDV transport into the EU Emissions Trading Scheme (ETS) –Option 4 in the present Impact Assessment-, or if emission limits are in due course introduced in the same way as for cars and vans –Option 5 in the present Impact Assessment-. In the short-term, this is likely to result in increased production costs and could affect the structure of their product portfolios. However, given that demand for low carbon vehicles is expected to increase throughout the world as climate change policies continue to develop and third countries are increasingly introducing similar CO_2 / fuel efficiency standards, manufacturers have an opportunity to gain first mover advantage, providing them with a possibility to export advanced low carbon HDVs to other markets. Component suppliers would also be affected by increasing demand for advanced technologies and are expected to benefit from this higher demand. As with the vehicle manufacturers they would benefit from the possibility to export these advanced technologies to other markets around the world.

Fuel suppliers would also be affected by policies to lower HDV C02 emissions as they are likely to see lower demand for transport fuels in the future as a result of reduced HDV fuel consumption and CO_2 emissions. Other users of fuel and oil-related products (e.g. chemical industry, heating) are expected to benefit from lower prices if demand from the transport sector decreases. All end-users of freight transport, i.e. industry and trade sectors in the economy, and eventually consumers, would benefit from lower fuel consumption in transport provided overall transport costs, including the cost of HDVs, does not increase. In the same way, all passenger clients from bus and coach transport services would benefit from lower bus and coach fuel consumption provided the overall operating cost of passenger transport, including amortisation of HDV equipment cost, remains lower. Finally, reduced CO_2 emissions would also have health benefits for the overall population.

Overview of the most affected sectors

The automotive industry is one of Europe's key industrial sectors, and its importance largely derives from its linkages within the domestic and international economy and its complex value chain. In 2007, the automotive sector (enterprises involved in the manufacturing of motor vehicles, trailers and semi-trailers) had a turnover of over €780 billion[116] and value added in the automotive sector amounted to around €140 billion, representing about 8% of European manufacturing value added. The sector directly employs more than 2.3 million people (or around 6% of manufacturing employment) and is responsible in total for more than 12 million jobs across Europe, about 5.5% of EU-27 employment. Most of the employees (ca. 60-70%) are engaged in skilled (or semi-skilled) manual work, while 30-40% are trained

[116] Eurostat

professionals or technicians (e.g. engineers, business and sales specialists, IT, quality control, marketing, management).

Automotive industry employment in manufacturing is particularly important in Germany (≈ 13% of manufacturing employment), Sweden (≈ 9%) and in France, Belgium, the Czech Republic and Spain (≈ 8% each). Before the financial crisis, there had also been a trend of increasing employment in the automotive sector in the new Member States, where some manufacturers have been installing substantial additional production capacity, while declines have been observed in some EU-15 countries. A decline in demand and production in the automotive industry (and HDV sector) since mid-2008, due to the financial crisis, brought a significant number of job cuts. The industry has strived to preserve its core and most-skilled staff by reducing its temporary and agency workforce and short-term measures (temporary shut-downs, shorter working weeks, salary cuts, voluntary departures and early retirement). Although job losses at this time were heavily impacted by the crisis they also reflected the restructuring effort undertaken by the industry. Recent statistics, such as those in the European Competitiveness Report 2011, have indicated that market conditions improved in 2010 with a subsequent increase in production following the decline in the previous two years.

In terms of the general HDV sector, it is estimated that almost 3 million people work directly for the trucking transport industry: drivers, logistics experts, dispatchers, operations managers, etc. Another 3.5 million people earn their living in directly related industries[117], such as truck manufacturing, repairing, selling, leasing and insuring. Even those figures do not give the full picture, because jobs that depend on the trucking industry are far more numerous than those related directly to it. The importance of road freight to the overall transport industry is also clear: about 75% of the freight volume and 90% of the value of all goods in Europe are transported by road (this includes freight by heavy and light duty vehicles)[118]. Eurostat estimates suggest that over one third of people employed across all transport modes are employed in road freight transport. The freight and passenger transport industry is to a large extent an SME industry with almost one million enterprises across the EU (925.000 according to Eurostat in 2008), most of which are very small firms operating just a few trucks or buses/coaches: the average turnover of enterprises was in 2008 EUR 537,000 in the area of freight transport and EUR 337,000 for passenger transport firms.

The number and distribution of firms in the HDV sector including the share of SMEs

In general terms, the automotive sector can be divided into suppliers (who, in turn are split into different "tiers" depending on the complexity of the contribution to the automotive product) and Original Equipment Manufacturers (OEMs, who are responsible for the final product itself). Supply chain management (process innovation) is one of the key strengths of the European automotive industry and major European suppliers are among the world leaders. According to CLEPA (the European Association of Automotive Suppliers), the supplier sector includes some 3000 companies, of which 2500 are SMEs employing over 3 million people. European suppliers are recognised as world leaders in technology and innovation, particularly in electronics, powertrain and driveline components. The automotive value-chain provides an important outlet for sectors such as mechanical and electrical engineering,

[117] International Road Transport Union

[118] Eurostat, 2009

electronics, steel, metal-working, chemicals and rubber. It is estimated that for €1 of value added by the automotive industry itself, supporting industries generate approximately €2.7 of additional value added. The automotive aftermarket consists of approximately 665,000 companies[119], the vast majority of which are SMEs and employs approximately 3.5 million people and provides around €82 billion worth of components (spare parts, tyres, accessories, etc.).

The HDV sector is more complex than that of passenger cars and Light Commercial Vehicles (vans), in that, although there are a relatively small number of major manufacturers, the OEMs are for the most part not responsible for the final vehicle configuration (at least for rigid vehicles) other than the powertrain, chassis and cabin. Essentially all rigid trucks go through (sometimes several) bodybuilders to provide the additional body/superstructure and any additional auxiliaries (e.g. tail lifts, cranes, cement mixers, refuse collection systems, etc.) for most cases specific customer requirements. Road tractors in contrast are essentially finished products although there may be some additional modifications (e.g. for alternative layout of fuel tanks/capacity, cooking facilities for overnight cabs, etc.). In addition, the end performance /characteristics of the full articulated vehicle (= road tractor + semi-trailer) will be highly dependent on the characteristics of the semi-trailer type pulled by the tractor unit. Engine manufacturers (beyond the major manufacturers) only have a very limited role to play in the EU HDV market, as the vast majority of the engines used in EU HDVs are produced by the major manufacturers.

While the EU HDV market is dominated by seven major European manufacturers (DAF Trucks, Daimler, M.A.N., Renault, Scania, Volvo, Iveco Trucks), the trailer and body-builder sector is highly diverse with thousands of organisations (Daimler alone has over 5000 in its database), most of which operate only in local markets. Consequently very little information is available on the EU market as a whole.

Labour productivity

The EU HDV market is dominated by the seven major European manufacturers (accounting for 93% of EU registrations), which also account for an estimated 40% of worldwide HDV production[120].

The production of HDVs worldwide increased by over 90% between 2000 and 2008, before a sharp 19% fall in 2009 due largely to the global recession. Production in the EU increased by just over 50% in the same 2000-2008 period and accounted for 17.5% of all HDV production in 2008 before dropping by over 60% in 2009. In contrast the proportion of production outside of the EU has risen significantly since 2000 (more than doubling in production to 2008) and had a more modest fall in production (at -10%) in 2009. Total HDV production is dominated by trucks, which account for almost 91% of all HDVs manufactured worldwide (and over 94% in the EU). The reduction in production in the bus and coach markets between 2008 and 2009 was slightly lower (at -15%) with EU production fairing slightly better (at -12%) compared with production in the rest of the world. In terms of global production by manufacturer, the major European manufacturers account for over 40% of total global

[119] According to CECRA (customer services, repair and servicing, spare parts, accessories and tuning) statistics

[120] AEA- Reduction and Testing of Greenhouse Gas (GHG) Emissions from Heavy Duty Vehicles – Lot 1: Strategy - Final Report to the European Commission – DG Climate Action

production(of all vehicles above 3.5 tonnes) according to OICA[121] statistics, with Daimler being the largest European HDV manufacturer (and the second largest worldwide after Isuzu) and the Volvo Group (which includes Volvo Trucks and Renault Trucks) being the second largest. In the buses and coaches subsector the proportion of production by the major EU manufacturers is lower at around 28%.

In 2010, the European automotive industry produced about 380,000 commercial vehicles (>3.5 tonne) and around 32,000 buses and coaches(>3.5 tonnes) in the EU,[122] equivalent to about 15% of total production worldwide (based on figures from the LMC Automotive Global Commercial Vehicle Forecast, Quarter 1, 2012). The sector has on average produced around 490,000 heavy duty commercial vehicles (>3.5 tonne) and 28,000 buses/coaches over the period 2007-2010 in the EU, which, considering that this covers the financial downturn and particularly a significant decline in production in 2009, is an indication of overall strength and robustness.

New truck registrations

Following the decline in production and sales in 2009, improvements in the market could be seen in 2010. In 2010, a total of 249,869 new trucks were registered in the EU, or 6.4% more than in 2009. Results were mixed across countries as registrations slipped by 0.8% and 0.9% in the UK and France, while they were down 5.0% in Italy and up 12.1% and 19.7% in Spain and Germany. Six months into 2011, all significant markets expanded, leading to an overall 43.6% increase of new truck registrations in the region. France saw its demand for new trucks rise by 52.2%, Germany by 38.1%, the UK by 36.4% and Spain by 35.9%. In total, 158,947 new vehicles were recorded in the EU in the first six months of 2011.[6]

New bus & coach registrations

In 2010, registrations of new buses and coaches fell by 10.4%. New registrations of buses and coaches were down 9.6% in 2009, amounting to 37,533 units in the EU. From January to June of 2011, EU markets performed diversely, resulting in an overall 2.4% contraction with a total of 16,364 new registrations.

Registrations of trailers

In 2008, EU wide new registrations of trailers equalled approximately 250,000, of which 200,000 were semi-trailers and 50,000 were drawbar trailers[123]. In terms of manufacturers, the European trailer manufacture is highly diverse with thousands of organisations, most of which operate only in local markets. However, the top seven suppliers produced over 53% of the trailers manufactured in 2008 and the top 69 suppliers produced over 90% of the total trailers produced.

For the recent past, it is difficult to disentangle the evolution of the entire automotive industry from the effects of the economic downturn. In view of this the figures given below for the period 2005-10 (which cover HDVs and passenger cars) should be treated with caution since they cover the period of extreme turbulence.

- Average annual growth rate of employees was -2.4%.

[121] OICA (Organisation Internationale des Constructeurs d'Automobiles), is the International Organization of Motor Vehicle Manufacturers. Compiled vehicle production data is available from OICA's website at: http://oica.net/category/production-statistics/

[122] ACEA EU Economic Report July 2011

[123] CLEAR International Consulting (2010)

- Average annual growth rate of hours worked was -2.6%.
- Average annual growth rate of labour productivity per person employed, which measures output divided by the number of people employed was 1.4%.
- Labour productivity per hour worked average annual growth rate was 1.5%.
- Average annual growth rate of unit labour cost, which measures the average cost of labour per unit of output was 0.3%.

Market share of the world market

In 2007, the overall EU automotive industry held a global market share of about 27% and this remains relatively stable. In terms of HDVs, in 2010 it was estimated that EU-27 exports of Commercial vehicles (over 5 tonnes) and Buses & Coaches amounted to €3.6 billion and imports €716 million, giving a trade surplus of €2.9 billion[124]. This included a 43% growth in exports and a 69% growth in trade balance as opposed to 2009, which was a poor year for the worldwide HDV industry. In 2007, around 22% of worldwide (new) truck (>6 tonne) sales were in Europe while this figure was closer to 27% for trucks heavier than 16 tonnes. These percentages fell due to the financial downturn and the strength of the Asian commercial vehicle market in 2009 and 2010, although estimates for 2011 and 2012 indicate that sales figures were returning to somewhere approaching pre-2009 levels. The overall market share of EU companies in the HDV sector remained above 20% in 2010 with Daimler Trucks having a 9.7% worldwide market share[125].

The major European manufacturer groups dominate the EU market, accounting for 95% of all new registrations of trucks and 75% of bus and coach registrations. The major EU manufacturers are also major players globally with EU registrations of their HDVs representing only around 15% of their total global production in 2008. Hence developments within the EU will have the potential for significant impacts more globally, where EU measures have a global relevance (i.e. cost-effective on a global perspective). Other manufacturers play a more significant role in the bus and coaches subsector. Ford accounts for around 7% of this subsector, with the remainder due to smaller specialised manufacturers, such as Alexander Dennis Group and Wright Group, which in particular serve a significant portion of the UK market.

In terms of the overall automotive industry in Europe, the revealed comparative advantage ("RCA") index, which compares the share of a given industry's exports in the EU's total manufacturing exports with the share of the same industry's exports of a group of reference countries, was 1.22 in 2007 and 2008 and 1.3 in 2009. In comparison, the revealed comparative advantage index in the USA in 2009 was 0.96 and in Japan was 2.13. An RCA index greater than one indicates that the EU vehicle manufacturing industry continues to be very competitive at an international level. The implementation of legislative measures to reduce HDV CO_2 emissions (combined with legislation setting CO_2 emission targets for passenger cars and LCVs) is unlikely to change this position. In the long-term, European manufacturers are therefore well placed to take advantage of any market opportunities under the assumption that Community trade policy plays a supportive role in terms of enabling fair market access. In terms of market share, production volumes, value added, employment levels and net trade position, the industry has maintained its global competitiveness in recent years. The EU has traditionally enjoyed a significant trade surplus in automotive industry products

[124] ACEA Pocket Handbook 2011statistics.
[125] KPMG-Competing in the Global Truck Industry *Emerging Markets Spotlight*

and it is not expected that the assessed options for reducing HDV fuel consumption and CO_2 emissions (or passenger cars/LCV targets) would impact on this.

Foreign Direct Investment (ratio of inward/outward FDI stock to value added)

In 2008, Eurostat estimated that the level of inward FDI (stocks), which measures the direct investment from outside the EU in the EU27 in respect of vehicles and other transport equipment to be €22.9 billion. The outward investment, which indicates the level of investment of EU companies in foreign markets, was estimated to be €60.4 billion.

<u>Indirectly affected sectors</u>

Indirect impacts on sectors outside the supply chain are likely to be mainly felt in the fuel supply sector and also by buyers of HDVs and end-users of freight transport. These changes would lead to further more indirect impacts as the cost of energy and the transport elements of business decrease.

Fuel supply sector[126]

In terms of the fuel supply sector, the two main types of enterprises which would be affected are filling stations and fuel refineries. In 2006 there were around 74,000 enterprises classified as being involved in the retail sale of automotive fuel in the EU-27, less than 10% of all motor trade enterprises (which includes the wholesale, retail sale and repair of motor vehicles and motorcycles, as well as the retailing of automotive fuels and lubricants). These enterprises generated €178 billion of turnover, from which resulted €14 billion value added, 13.4 % and 8.6 % of the motor trades total respectively. The sector employed half a million people, 11.8 % of the motor trade workforce. Contributions from some Member States (e.g. France) may be low, due to a large proportion of fuel being sold through service stations that belong to retailers classified under retail trade rather than retailing automotive fuels.

The pattern of turnover for the retail sale of automotive fuels in the EU-27 was less steady than the motor trade as a whole, particularly between 1998 and 2005. The retail sale of automotive fuels grew strongly to 1999 and flattened out from 2000 to 2002, at a time of continued growth across motor trades as a whole. This was followed by much stronger growth through to 2005. However oil prices changes should be taken into account when analysing these findings, as the volume of automotive fuel may have fallen while sales in value terms rose (due to significant price increases).

In 2006 there were around 1100 enterprises classified as concerned with fuel processing and the refining of petroleum products in the EU 27, of these around 100 are refineries. Turnover was estimated to be around €476 billion with around €30 billion value added. Over 128,000 people were employed in the sector. Between 1997 until 2007 average growth for the refined petroleum products sector was 0.8% per year.

It is likely that implementing legislative measures to reduce HDV CO_2 emissions would impact negatively on the fuel supply sector due to a lower demand for fuel. However, in the case of the filling stations, there is a trend of steadily reducing numbers of filling stations and increasing diversification with a major part of their revenues coming from activities other than selling fuel.

[126] Source of figures on the retail sale of fuel - EUROSTAT

What is the overall effect on cost and price competitiveness?

The impacts on costs are extensively discussed in section V of the main text. The total impact on costs comprises changes in the costs of manufacturing HDVs, possible additional compliance costs for manufacturers and changes in the usage costs of HDVs, mainly associated with possibly increased purchase prices and reductions in fuel consumption.

Do the envisaged policy measures cut or increase compliance costs of the affected sector(s)?

For HDV manufacturers there may be, on top of investments to produce more fuel efficient & CO_2 efficient HDVs, administrative costs related to the registration of CO_2 emissions that are expected to be minor in relation to the latter. For the HDV transport industry (freight industry), subject to the calibration of legislative requirements, benefits (fuel savings) are expected to outweigh costs (more expensive HDVs meeting higher efficiency requirements).

Do the envisaged policy measures affect the prices and cost of intermediate consumption?

Intermediate consumption is an accounting flow which consists of the total monetary value of goods and services consumed or used up as inputs in production by enterprises, including raw materials, services and various other operating expenses. A distinction needs to be made between impacts on the amount of intermediate consumption (amount of products or services used in production) and the costs or price of intermediate consumption (cost or price of a given product or service used in production).

For HDV manufacturers the amount of intermediate consumption is expected to increase relative to a situation without the implementation of the reduction targets through legislative measures, as a significant part of the additional technologies to be applied to new vehicles is likely to be purchased from suppliers. Whether this leads to a net increase in the cost of intermediate consumption depends on the extent to which additional technology costs are compensated by reductions in the costs of other supplied products and services due to other drivers. As part of the applied technologies may also provide added value to the user the gross added value may increase. If manufacturers are able to increase the sales price accordingly, an increase in the cost of intermediate consumption, therefore, does not necessarily lead to an increase in the share of intermediate consumption in the gross turnover.

For sectors that use HDVs the costs of intermediate consumption –mainly fuel that represents some 25-30% of road transport operating costs- are expected to decrease as the net cost of using HDVs decreases. Subject to the level of requirements of the legislative measures that are assessed in the present Impact Assessment, this impact may be significant and lead to net benefits (costs being outweighed by savings).

Do the envisaged policy measures affect the cost of capital?

As the implementation of legislative measures to reduce HDV emissions does not directly affect the financial sector, there are no direct effects to be expected on the cost of capital. Indirect impacts could occur if the examined legislative measures would lead to drastic (i.e. sudden or very large) changes in the need for investment capital by automotive manufacturers, suppliers or other affected sectors or if the risks associated with providing such investment capital would increase.

As there may be an acceleration in terms of innovation and the application of new technologies, an increased demand for investment capital is to be expected. However, compliance only involves the introduction and gradual increase in the level of application of additional technical adaptations in HDVs. It does not require a major restructuring of the automotive sector's operations or structure. There are no negative impacts expected on the demand for HDVs and there is no reason to believe that the implementation of legislative measures for reducing HDV emissions would lead to significant impacts on the cost of capital.

Do the envisaged policy measures affect the cost of labour?

The only possible changes in the cost of labour would be those resulting from the additional or new labour demand (e.g. due to new skills requirements). In the automotive R&D departments there may be some shift in competences from mechanical to electrical engineering to prepare the development of hybrid HDVs for some segments of the market, but if shortages in new engineering disciplines would affect wages the impact on average labour costs for vehicle manufacturing of the manufacturing industry in general would be small. As far as requirements for labour skills in the actual manufacturing of components and vehicles are concerned, no significant deviations from the existing situation are expected.

As the implementation of legislative measures for reducing HDV emissions does not affect labour law or labour conditions, there would be no additional compliance costs related to employment.

Do the envisaged policy measures affect the cost of energy?

The objective of the legislative measures assessed in the present impact assessment is to reduce CO_2 emissions. The implementation of legislative measures to reduce HDV emissions does not directly affect the costs of producing energy carriers for the transport sectors or for other sectors. Achieving the CO_2 reduction goal, however, would indirectly contribute to reduce energy use. This would have a dampening or even lowering effect on energy prices, which would be beneficial to the transport sector as well as to other sectors of the economy.

Do the envisaged policy measures affect consumer's choice and prices?

The measures would not limit consumer choice directly. Cost assessments as presented in section 5 of the present Impact Assessment are carried out under the assumption that fuel consumption and CO_2 emission reductions are achieved without affecting the other performance of HDVs and the distribution of new vehicle sales over different marketing segments, and show that meeting a number of target levels examined in the options assessment is technically and economically feasible without violating this assumption.

Companies using HDVs are likely to benefit indirectly since their costs of vehicle operation are expected to decrease.

It is likely that the implementation of legislative measures to reduce HDV emissions would increase costs of manufacturing HDVs and is thus in the end expected to lead to increased HDV prices, as increased costs can only temporarily be absorbed by manufacturers and at some point need to be passed on to consumers. However, benefits from fuel savings are expected to outweigh these increased purchasing costs.

Would the impacts above require a major restructuring of affected enterprises' operations?

For some of the technologies that are expected to be applied, some innovations in production processes may be necessary. But there is no reason to believe that any major restructuring of the HDV sector's operations would be required.

Effect on enterprises' capacity to innovate

The automotive sector invests significantly in R&D. According to the 2011 EU Industrial R&D Investment Scoreboard, the R&D expenses of European automotive manufacturers were just over €21 billion in 2010, 4.4% of their turnover. According to CLEPA, component suppliers invest about €15 billion in R&D, which is approximately 5% of turnover and receive the majority of the patents. This is complemented by investments in the production process and fixed assets amounting to over €40 billion per annum. European automotive firms are leaders in some transitional drive-train and fuel technologies and are investing in ground-breaking technologies, such as battery-powered hybrid vehicles, electric vehicles and hydrogen. As products are becoming increasingly complex from a technological point of view (e.g. the role of electronics), the industry is focusing increasingly on advanced, high technology products which necessarily rely on a highly skilled workforce.

Overall the implementation of legislative measures to reduce HDV fuel consumption and CO_2 emissions should promote innovation in that sector and may as such be expected to increase rather than decrease the automotive sector's capacity to innovate. The issues are what the size of the additional demand for innovative capacity is that the measures require, whether the sector would be able to mobilise this in time, or whether increased focus on innovation with respect to efficiency improvement and CO_2 emission reduction would go at the expense of innovation in other important areas.

There is no evidence of a shortage of skills needed either for the development of the potential technologies required or for their application in HDV production. There does not appear to be any issue relating to IPR protection specific to the automotive sector. The automotive sector is constantly innovating by bringing new products to the market. Marketing new vehicle types and new technologies forms a key aspect of encouraging vehicle purchase. This would continue and as a part of this trend CO_2 reducing technologies would be incorporated in a somewhat higher pace than before. Overall it is considered that the additional demand for innovation with respect to CO_2 reducing technologies can be catered for within the industry's R&D capacity or by a manageable increase in this capacity.

Distribution, marketing and after-sales services are also well developed in the automotive sector and the necessary management and organisational skills and talents are demonstrably available and are expected to be able to adequately deal with the new technologies applied to reduce CO_2 emissions of vehicles. In the on-line consultation in the context of the present Impact Assessment, 72% of stakeholders and 83% of individuals supported the view that EU regulation of road vehicle emissions stimulates innovation in the automotive sector and helps keep Europe's automotive industry competitive. It is likely that the sector would continue to invest in similar levels of R&D to remain competitive and to develop more efficient vehicles.

What is the effect on the competitiveness of HDV manufacturers?

There would be different impacts on different manufacturers. The additional manufacturer costs per vehicle for implementing legislative measures to reduce HDV emissions depend on the actual reduction level required and the current level of investment and focus by the manufacturer on reducing emissions.

Estimates indicate that truck production may increase from the second half of 2012 onwards due to customers increasingly starting to place orders in the build-up to the Euro 6 emissions mandate which will be effective from January 2014.[127] This suggests that the introduction of tighter standards and stricter limits can be positive for those manufacturers of HDVs who can produce more efficient vehicles and should enable them to retain a strong position in terms of competitiveness.

For manufacturers of HDVs who have further to go to comply with and implement measures to reduce emissions, the costs associated are likely to be larger. This would possibly result in a longer payback period (or higher increase / lower reduction of the total cost of ownership-TCO) for the users of their vehicles and thus a reduced attractiveness of these vehicles compared to products from other manufacturers. Changes in TCO can thus be a basis for assessing impacts of the implementation of the legislative measures for reducing HDV emissions on mutual competitiveness of HDV manufacturers on the EU market.

In principle therefore the implementation of legislative measures to reduce HDV emissions may affect the mutual competitiveness of HDV manufacturers on the European market. Such changes in mutual competitiveness may in turn affect the extent to which different companies are able to pass through the costs of additional technologies applied to meet the targets contained in legislative measures to reduce HDV emissions. These impacts on the profitability of HDV manufacturers may more indirectly also affect their competitiveness on global markets.

TIAX[128] concluded that, in spite of an expected HDV fleet growth in the EU of close to 30% over the period 2010-2030, emission levels could be substantially reduced by 2030, with emissions cut by 22% (versus business-as-usual levels, as defined in the AEA-Ricardo Lot1 report) if only technologies with a payback period of a maximum of 3 years are introduced in the HDV fleet. Without this 3-year payback constraint fuel consumption reduction and emission cuts would potentially be larger, estimated at some 28% below business-as-usual levels. A reduction in emissions of this level would help to ensure that the EU HDV sector remains competitive going forward. These estimates apply to the whole HDV fleet emissions in the EU. They assumed even much higher levels of improved fuel and CO_2 emissions performance of new vehicles and have been considered over-ambitious by some OEM stakeholders.

<u>What is the effect on competitiveness of incumbents compared to new entrants?</u>

Incumbents on the EU market have the advantage of large sales and an established product portfolio allowing them to optimise costs for complying with legislative measures to reduce HDV emissions through internal averaging. This option is generally not or less available to new entrants.

[127] LMC Automotive Global Commercial Vehicle Forecast, Quarter 1, 2012

[128] In a report commissioned and financed by the International Council for Clean Transportation (ICCT), "*European Union Greenhouse Gas Reduction Potential for Heavy-Duty Vehicles*",

What is the effect on the competitiveness of component suppliers?

The implementation of legislative measures to reduce HDV emissions would have positive economic impacts for component suppliers in the automotive industry, resulting from the demand for additional components. Implementation of legislative measures to reduce HDV fuel consumption and CO_2 emissions is therefore expected to have negligible impacts on the mutual competitiveness of European component suppliers.

Impacts on competitiveness between European suppliers and companies from outside on the European market and on foreign markets may depend on the extent to which other regions adopt similar measures in terms of CO_2 reduction. The demand for new advanced components may spur competition among suppliers, whereby the most innovative companies are expected to be able to capture a larger share of the market. This is to be considered an indirect but generally positive consequence of the implementation of legislative measures to reduce HDV fuel consumption and CO_2 emissions.

What might be the effect on the HDV sector's international competitiveness?

What is the likely impact of the assessed measures on the competitive position of EU firms with respect to non-EU competitors?

According to the Porter hypothesis advanced national / regional environmental policy stimulates innovation which in the longer term improves the competitiveness of the region / country. Whether this is also true for regulation on a market with a large number of foreign suppliers is debatable. Nevertheless, as a result of EU legislative measures to reduce HDV emissions, HDV manufacturers might have a competitive advantage over non-EU companies, as the measures affect their home market where they generally dominate total sales. For manufacturers without or with less stringent CO_2 regulation on their home market it might be more expensive to adapt a small share of their production to comply with the EU regulation. However, CO_2 standards in different markets are rapidly converging. Outside of Europe, Japan is already regulating for the fuel efficiency of HDVs (since 2007) and the US (2011) and Canada (2012) recently adopted rules on HDV CO2 efficiency. In the US, mandatory heavy-duty fuel consumption reductions of up to 23% by 2017 are moving OEMs to adopt improved technologies, including aerodynamic improvements, engine friction reduction, advanced fuel injection, advanced turbocharging, parasitic loss reduction, waste heat recovery, light-weighting, low rolling resistance tyres, and idle reduction.

It is also important to take into account regional differences when considering the applicability of experiences in other regions to Europe. For example, the European HDV market is already more significantly focused on improving fuel efficiency due to high fuel prices compared to the rest of the world. As a result, the European manufacturers of HDVs are at the forefront of efficient HDVs. Nonetheless, an increased focus on HDV emission reductions across the globe (as described above) means that non-EU manufacturers have to achieve CO_2 emission reductions on their home markets, which reduces the possible competitive advantage of EU manufacturers on the EU market. At the same time, however, this also implies that the EU regulation does not place EU manufacturers in a disadvantageous position in markets outside the EU.

The competitive position of European component suppliers relative to non-EU competitors might be improved by the introduction of legislative measures to reduce HDV emissions. If

EU measures and targets are more ambitious than those in other countries the technology-readiness of suppliers based in these countries may be expected to lag behind that of European companies. This improves the attractiveness of European suppliers for EU HDV manufacturers and might also provide them a competitive edge in other markets. Given that EU manufacturers may need the new technologies to comply with reduction measures examined in the present Impact Assessment, this might also allow EU-based suppliers to increase their margins and improve their profitability. This would bring them in a better position to expand business to other markets. However, as with manufacturers, further efforts, legislation and initiatives to reduce HDV emissions in the US and in Asia, may limit the potential competitive advantage for EU suppliers.

As argued above the impacts of the implementation of legislative measures to reduce HDV fuel consumption and CO_2 emissions on the costs of purchasing and using vehicles affects the costs of business operations for all similar vehicle users alike. For EU firms using HDVs therefore no change in competitive position with respect to non-EU competitors on the EU market is to be expected.

What is the likely impact of the assessed measures on trade and trade barriers?

In line with what is argued under the previous point, the regulation is not effectively causing trade barriers for non-EU manufacturers. The regulation is not expected to have an impact on existing trade barriers.

Possible impacts on trade volumes and balances could result from changes in the competitiveness of vehicle manufacturers and component suppliers as described above. Improved competitiveness of EU-firms on the EU market may lead to lower imports, while improved competitiveness of EU-firms on non-EU markets may lead to higher exports.

Do the considered policy options concern an area in which international standards, common regulatory approaches or international regulatory dialogues exist?

There are no international standards for new HDV CO_2 emissions.

Are the considered policy options likely to cause cross-border investment flows, including the relocation of economic activity inward of outwards the EU?

There are no constraints on cross-border investments in the automotive sector. Since projections are for a generally consistent level of growth in the market for HDVs in the EU and considering the dominance of EU HDV manufacturers in the home market, it is unlikely that there will be substantial inward or outward investment as a result of the considered policy measures. Investment flows do not seem likely to be affected by measures to reduce HDV emissions.

What is the effect on the competitiveness of other sectors in the automotive supply chain?

The TIAX report suggested that the main technologies which could drive efficiency and reductions across multiple HDV segments include low rolling resistance tyres, transmission friction reduction, and predictive cruise control. Among the least cost effective technologies are automatic tyre inflation and material substitution for light weighting. There may be indirect impacts on other sectors in the vehicle manufacturing supply chain which might arise due to demand for different components. For example, if hybrid technology takes off for some vehicle categories, some component manufacturers that innovate and come up with the most competitive offers may benefit from this. It is difficult at this stage to predict where the possible indirect impacts on the vehicle manufacturing supply chain may occur.

What is the effect on the competitiveness of HDV dealers and distribution networks?

While the implementation of legislative measures to reduce HDV emissions may have economic impacts on HDV dealers and distribution networks (e.g. through pressure on dealer margins) it is not expected that their mutual competitiveness will be directly affected. Indirect effects could result from the impacts of the measures on the HDV manufacturers represented by these dealers, but such effects are not considered intrinsic to the nature of the assessed measures.

What is the effect on the competitiveness of suppliers of complementary or alternative goods and services?

It is not expected that there will be major impacts on markets for complementary goods, i.e. suppliers of alternative forms of multiple passenger transport or goods transport. For multiple passenger transport, alternatives are collective transport services such as rail or aviation. Given the impact of the assessed measures on costs of operating HDVs and the strength of the road freight sector overall relative to other transport modes, it is unlikely to have significant impacts on the modal split, unless new emission requirements would make HDV transport significantly more costly : this is not the conclusion of the cost/benefit analysis in section V of this Impact Assessment, which suggests that required CO_2 emission abatements would be more than compensated by savings on fuel purchases. For goods transport by means of heavy commercial vehicles there are few alternatives other than those mentioned above.

What is the effect on the competitiveness of vehicle users?

The implementation of legislative measures to reduce HDV emissions may also directly or indirectly affect the competitiveness on the EU market of European businesses which use HDVs. Direct effects could exist for companies with a large share of transport activities in their operations. The use of HDVs for passenger (buses/coaches) or goods transport or for providing other types of services, however, will mainly be part of operations undertaken by such companies on the European market or even on national markets. Possibly affected competitiveness of such companies using HDVs will thus mainly concern competition relative to each other on the European and national markets. The implementation of legislative measures to reduce HDV CO_2 emissions impacts on the costs of purchasing and using HDVs and may thus affect the costs of business operations, but it affects the costs of HDVs for all similar users alike, as companies competing on the same market will have similar fleets and vehicle use patterns. Consequently a change in overall costs resulting from the measures is not expected to have significant impacts on the mutual competitiveness of companies which use HDVs.

Users of HDVs will benefit from the lower fuel costs and the lower total cost of vehicle ownership. As shown in the cost/benefit analysis in section V of this Impact Assessment, the cost of compliance with new legislative measures assessed may more than compensated by fuel savings realised with more efficient vehicles. These changes will lead to further indirect impacts as costs of using energy and of carrying out the transport elements of business will decrease. As mentioned above this is not expected to affect the competitiveness of companies competing on the European market, but may to some extent benefit the global competitiveness of internationally operating companies and of the European economy as a whole.

What is the effect on the competitiveness in the fuel supply sector?

The assessed policy measures would lead to a reduction in the consumption of oil-based fuels by HDVs. This is to be considered a desired consequence of achieving the policy's goals with respect to reduction of GHG emissions. It will also contribute to an improvement of energy security. In first order this reduced demand is expected to affect different fuel producers alike.

The consequences for individual companies in terms of the resulting impacts on business (profitability, market share, etc.) would be different and would depend on their individual ability to respond to the challenge of declining sales in Europe. As such the impacts on individual fuel producers can be considered a consequence of the companies' current competitiveness rather than an impact of the measures on their competitiveness. Nevertheless oil companies with a large market share in Europe might be affected more strongly than oil companies that are mainly focussed on the US or Asia. So from a global perspective, regulation may affect the competeveness of these companies. Table 1 below shows that there is a large number of smaller fuel supply companies that operate largely or entirely on the European market. These companies might be expected to be affected more than larger, globally operating companies such as ExxonMobil, BP and Shell.

Table 1 Sales of petrol and diesel in Europe as share of the total petrol and diesel sales of various fuel supply companies[129]

[129] Based on information from companies' websites

	European fuel sales as share of total fuel sales
BP	38%
Cepsa	100%
Chevron / Texaco	-
Eni	100%
ExxonMobil	25%
Galp	100%
Hellenic Petroleum	100%
MOL	100%
Neste	95%
Omv	100%
Petroplus	-
PKN Orlen	100%
Repsol	90%
Shell	33%
Statoil	100%
Total S.A.	63%

What is the effect on the competitiveness of other businesses?

More generally the implementation of legislative measures to reduce HDV fuel consumption and CO_2 emissions may change the costs of intermediate products and hence also the costs of final products through changes in transport costs. On the EU market this would only affect the competitiveness of companies operating in the same market if they have very different shares of transport costs in their product costs. For products offered on a global market, the change in transport costs due to measures aimed at reducing HDV CO_2 emissions may also affect the global competitive position of European companies. For both situations, however, it must be stated that transport costs are generally a small share of overall product costs. Direct or indirect impacts on competitiveness in the EU market through changes in the cost price of intermediate and final products are therefore assumed negligible. In any case, impacts on other businesses from the implementation of legislative measures to reduce HDV CO_2 emissions can generally be considered positive due to the fact that the regulation reduces the total cost of ownership of HDVs in Europe. If at all significant, the impact on the competitiveness of European companies on the global market would improve as a result of this.

What is the effect on SME competitiveness?

There are two main categories of SMEs that might be affected by the implementation of the measures to reduce HDV emissions. One category is SMEs operating as small volume HDV manufacturers (of which there are only a small number) or as suppliers to the automotive industry. The other category consists of SMEs which use HDVs.

The main indirect effects could arise for SMEs that supply components to vehicle manufacturers. SMEs represent a significant number of companies in the overall automotive sector. The main impact would be an increased demand for CO_2 reducing technologies and other measures to be deployed in HDVs. However, it is difficult to foresee how that would affect the competitiveness of such SMEs.

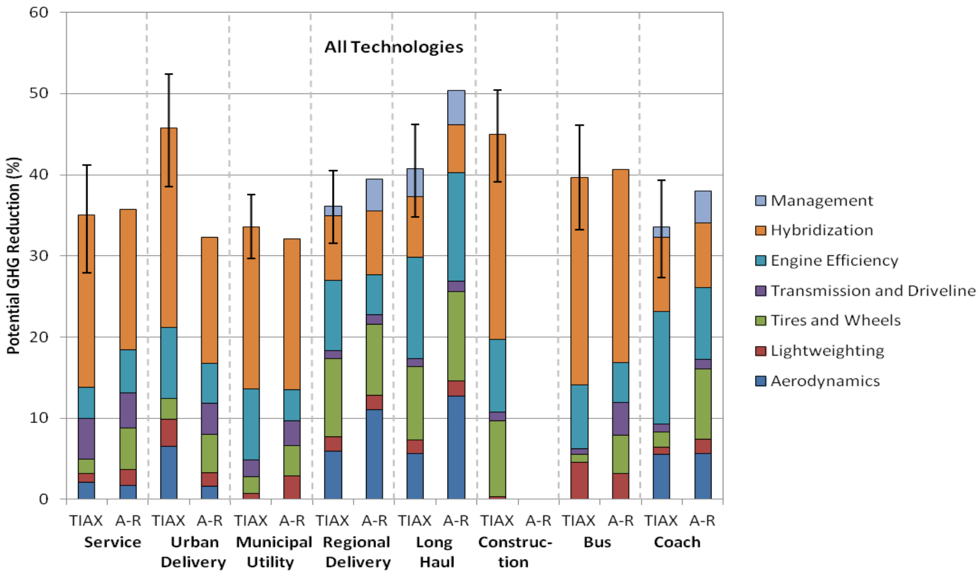
First of all it should be noted that the technologies required to enable compliance with measures and targets for reducing HDV emissions only concern a limited share of all components supplied to the automotive manufacturing industry. And many of the key-technologies, especially those related to engine, tyres and powertrains, may be expected to be produced by the larger Tier-1 suppliers. SMEs seem equally well placed to cater for such innovations as large companies. In general SMEs are more flexible with respect to minor changes in products and production processes. On the other hand they may have more difficulty to obtain financial means to deliver more radical product innovations or invest in major changes their production process.

Other indirect effects can arise from the use of HDVs. Since the impact of the implementation of measures to reduce HDV emissions is likely to be beneficial in terms of total vehicle cost of ownership, this indirect effect is likely to benefit SMEs along with other vehicle operators. Overall their competitiveness compared to other SMEs or to larger companies is not expected to change as a result of this regulation.

As European SMEs may be assumed to be mostly operating on the European market, impacts on competitiveness in other, global markets is less relevant for this category of companies.

Emission abatement potential

Figure 1 : Potential New EU Vehicle GHG Reductions from All Technologies



(A-R: AEA-Ricardo) **Source: TIAX**

Table 1: Potential for EU HDV (fleet) GHG reduction per segment

	2030 emissions relative to B-A-U assuming all applicable technologies % TIAX	A-R	2030 emissions relative to B-A-U, assuming only technologies with 3-Y payback TIAX	A-R
Service	76%	77%	92%	88%
Urban Delivery	71%	80%	87%	89%
Municipal Utility	79%	81%	90%	91%
Regional Delivery	74%	75%	80%	82%
Long Haul	70%	65%	73%	71%
Construction	67%	Unknown	68%	Unknown
Bus	75%	76%	78%	93%
Coach	75%	75%	80%	82%
All Segments	**72%**	**75%**	**78%**	**82%**

B-A-U : AEA Ricardo "business as usual", using baseline vehicle technologies
"All Segments" totals for AEA-Ricardo technologies do not include reductions from the Construction segment, which were unspecified in the AEA-Ricardo report

Source: TIAX

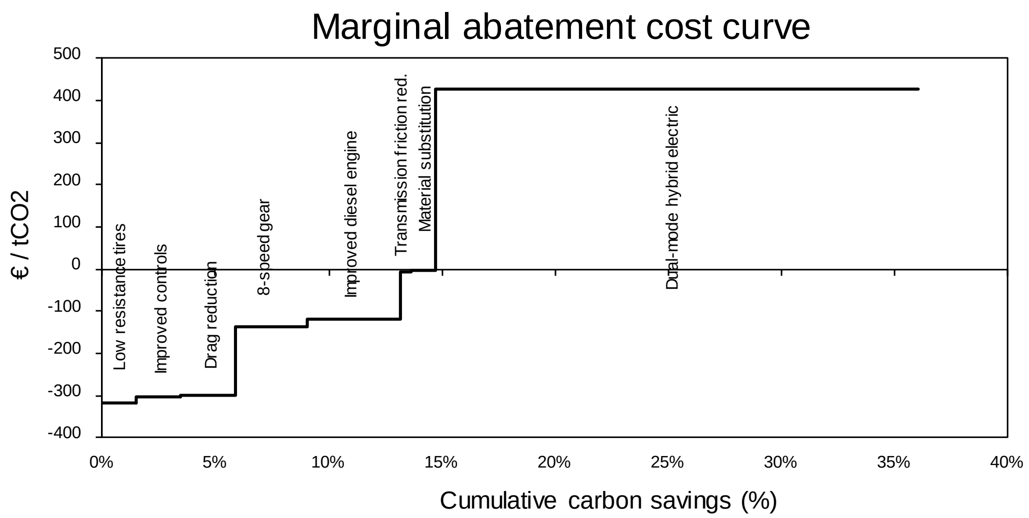
Table 2 Breakeven levels of technology uptakes: % cuts of CO_2 emissions for new HDVs

CO2 emission cuts (*) HDV categories	Societal perspective Lifescycle	End-user perspective Lifescycle
Service	13%	15%
Urban delivery	44%	44%
Municipal utility	36%	36%
Regional delivery	31%	35%
Long haul	36%	36%
Construction	45%	45%
Bus	43%	44%
Coach	25%	25%
Average (weighted)	**34%**	**35%**

Source: CE Deflt

Cost curves per vehicle category

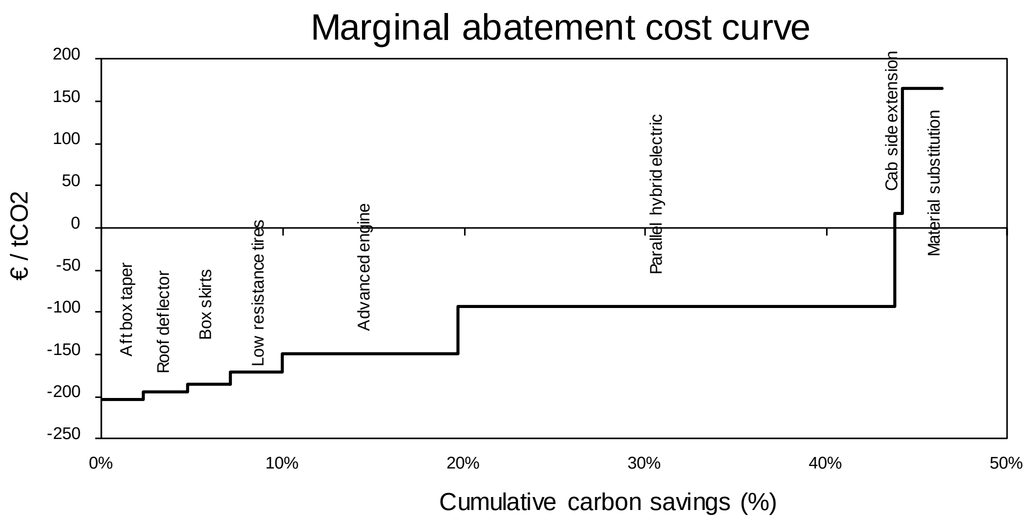
Service



Project name	Capital cost (€)	Additional fuel saving percentage (%)	NPV (€)	Marginal abatement cost (€/tCO2)	Cumulative carbon savings (%)
Low resistance tires	10	1,5%	699	-316,76	1,5%
Improved controls	48	2,0%	882	-304,51	3,5%
Drag reduction	81	2,4%	1.059	-298,39	5,9%
8-speed gear	869	3,2%	643	-136,66	9,1%
Improved diesel engine	1.213	4,1%	721	-119,73	13,2%
Transmission friction red.	202	0,4%	5	-8,15	13,6%
Material substitution	505	1,1%	5	-3,41	14,7%
Dual-mode hybrid electric	23.441	21,3%	-13.364	426,01	36,0%

Source: CE Deflt

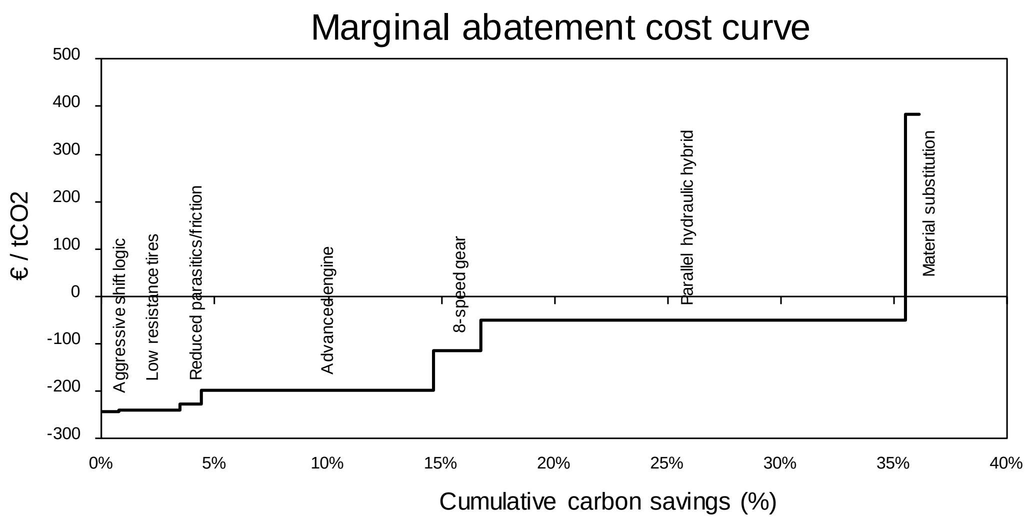
Urban delivery



Project name	Capital cost (€)	Additional fuel saving percentage (%)	NPV (€)	Marginal abatement cost (€/tCO2)	Cumulative carbon savings (%)
Aft box taper	404	2,3%	1.913	-202,83	2,3%
Roof deflector	526	2,4%	1.991	-194,32	4,7%
Box skirts	606	2,4%	1.848	-185,00	7,1%
Low resistance tires	922	2,9%	2.092	-170,52	10,0%
Advanced engine	3.920	9,6%	5.996	-148,53	19,6%
Parallel hybrid electric	15.358	24,1%	9.470	-93,70	43,7%
Cab side extension	465	0,4%	-30	17,14	44,2%
Material substitution	3.855	2,2%	-1.555	166,12	46,4%

Source: CE Delft

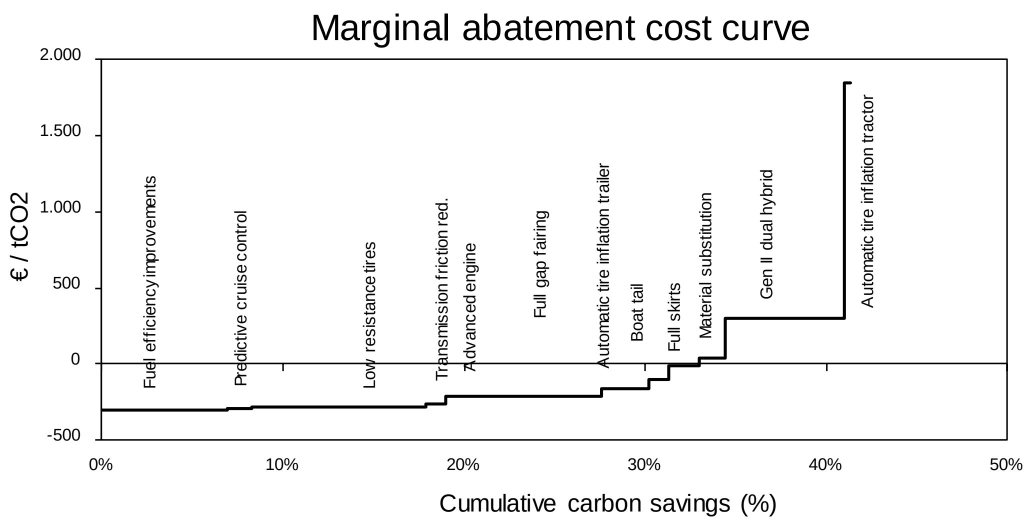
Municipal utility



Project name	Capital cost (€)	Additional fuel saving percentage (%)	NPV (€)	Marginal abatement cost (€/tCO2)	Cumulative carbon savings (%)
Aggressive shift logic	81	0,7%	1.120	-242,37	0,7%
Low resistance tires	344	2,7%	3.947	-239,05	3,4%
Reduced parasitics/friction	202	1,0%	1.345	-225,96	4,4%
Advanced engine	3.920	10,2%	12.462	-197,70	14,6%
8-speed gear	1.899	2,1%	1.519	-115,49	16,8%
Parallel hydraulic hybrid	24.249	18,7%	5.745	-49,78	35,5%
Material substitution	2.425	0,6%	-1.444	382,24	36,1%

Source: CE Delft

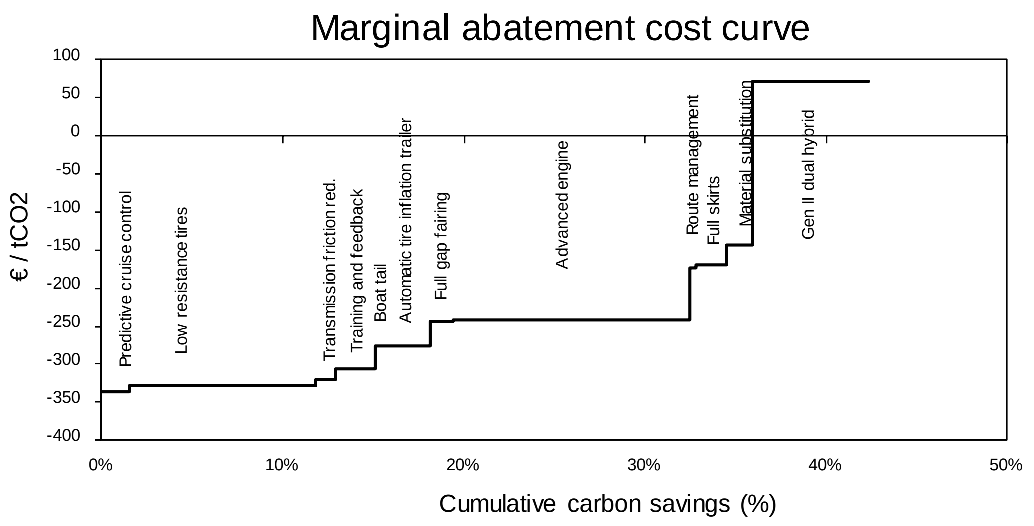
Regional delivery



Project name	Capital cost (€)	Additional fuel saving percentage (%)	NPV (€)	Marginal abatement cost (€/tCO2)	Cumulative carbon savings (%)
Fuel efficiency improvements	-	6,9%	9.959	-301,64	6,9%
Predictive cruise control	81	1,4%	1.935	-289,52	8,3%
Low resistance tires	873	9,6%	13.024	-282,68	17,9%
Transmission friction red.	202	1,0%	1.279	-260,50	19,0%
Advanced engine	3.920	8,7%	8.596	-207,16	27,6%
Automatic tire inflation trailer	283	0,4%	344	-165,49	28,1%
Boat tail	1.414	2,2%	1.701	-164,67	30,2%
Full gap fairing	1.011	1,0%	500	-99,86	31,3%
Full skirts	2.425	1,7%	55	-6,70	33,0%
Material substitution	2.401	1,5%	-273	38,68	34,5%
Gen II dual hybrid	18.794	6,6%	-9.334	297,62	41,0%
Automatic tire inflation tractor	3.638	0,4%	-3.127	1.846,28	41,4%

Source: CE Delft

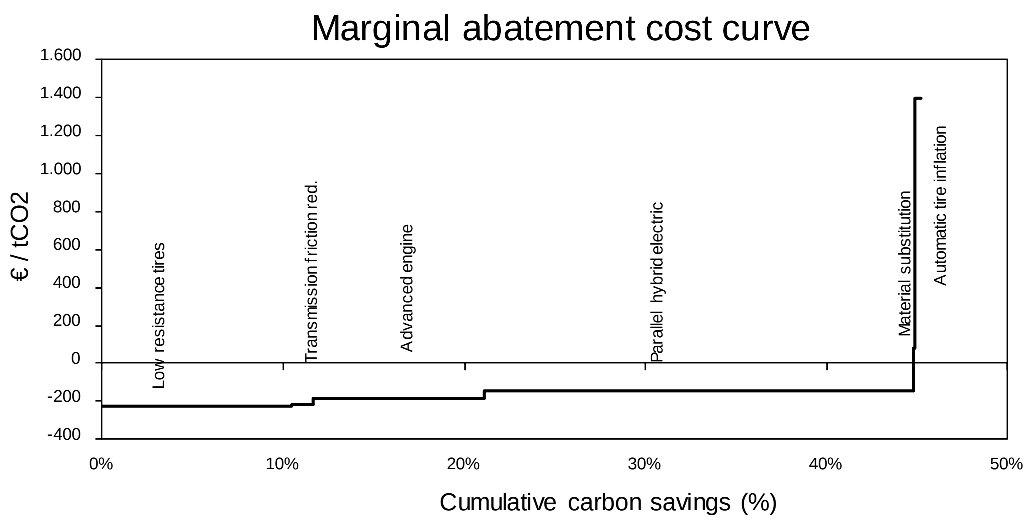
Long Haul



Project name	Capital cost (€)	Additional fuel saving percentage (%)	NPV (€)	Marginal abatement cost (€/tCO2)	Cumulative carbon savings (%)
Predictive cruise control	81	1,5%	4.217	-336,29	1,5%
Low resistance tires	1.261	10,3%	28.371	-328,16	11,8%
Transmission friction red.	202	1,1%	2.955	-320,83	12,9%
Training and feedback	647	2,2%	5.589	-307,20	15,1%
Automatic tire inflation trailer	283	0,5%	1.176	-276,30	15,6%
Boat tail	1.414	2,5%	5.837	-275,90	18,2%
Full gap fairing	1.011	1,2%	2.507	-244,27	19,4%
Advanced engine	10.953	13,1%	26.578	-242,73	32,5%
Route management	485	0,3%	492	-172,64	32,8%
Full skirts	2.425	1,7%	2.386	-169,99	34,5%
Material substitution	2.401	1,4%	1.727	-143,41	35,9%
Gen II dual hybrid	22.228	6,4%	-3.877	72,41	42,4%

Source: CE Delft

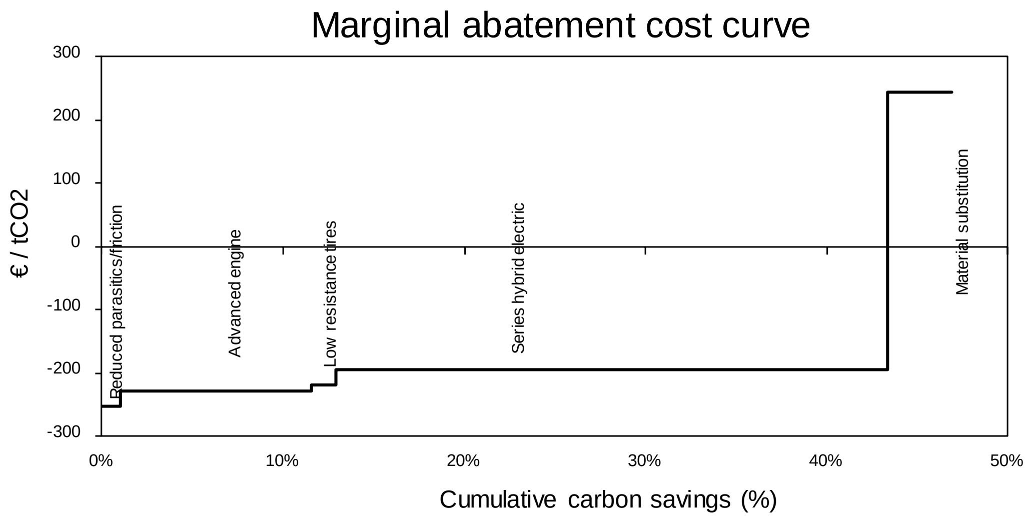
Construction



Project name	Capital cost (€)	Additional fuel saving percentage (%)	NPV (€)	Marginal abatement cost (€/tCO2)	Cumulative carbon savings (%)
Low resistance tires	1.152	10,5%	16.097	-229,23	10,5%
Transmission friction red.	202	1,1%	1.636	-218,65	11,6%
Advanced engine	3.920	9,5%	11.615	-183,65	21,1%
Parallel hybrid electric	15.358	23,7%	23.538	-148,65	44,8%
Material substitution	364	0,2%	-92	82,63	44,9%
Automatic tire inflation	3.638	0,3%	-3.095	1.400,19	45,2%

Source: CE Delft

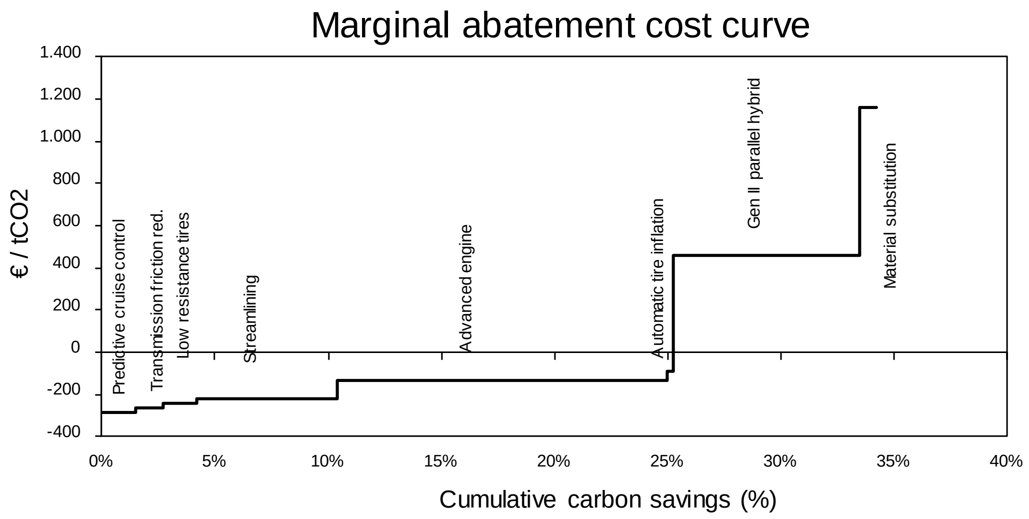
Bus



Project name	Capital cost (€)	Additional fuel saving percentage (%)	NPV (€)	Marginal abatement cost (€/tCO2)	Cumulative carbon savings (%)
Reduced parasitics/friction	202	1,0%	1.677	-253,28	1,0%
Advanced engine	3.920	10,6%	15.978	-227,88	11,6%
Low resistance tires	567	1,3%	1.924	-219,21	12,9%
Series hybrid electric	17.783	30,5%	39.470	-195,64	43,4%
Material substitution	12.367	3,5%	-5.722	244,34	46,9%

Source: CE Delft

Coach



Project name	Capital cost (€)	Additional fuel saving percentage (%)	NPV (€)	Marginal abatement cost (€/tCO2)	Cumulative carbon savings (%)
Predictive cruise control	81	1,5%	1.973	-289,75	1,5%
Transmission friction red.	202	1,2%	1.484	-265,52	2,7%
Low resistance tires	402	1,5%	1.596	-240,88	4,2%
Streamlining	2.223	6,2%	6.306	-223,01	10,4%
Advanced engine	10.953	14,6%	8.983	-135,92	25,0%
Automatic tire inflation	283	0,3%	128	-94,02	25,3%
Gen II parallel hybrid	28.291	8,2%	-17.034	456,44	33,5%
Material substitution	4.850	0,7%	-3.848	1.158,61	34,2%

Source: CE Delft

ANNEX 12: INDICATIVE ASSESSMENT OF ADMINISTRATIVE COSTS UNDER OPTION 3.II

Administrative costs of HDV CO2 certification

Indicative assessment

A, Administrative costs for MS type approval authorities (*)

A1 OEMs	Low case	High case	
Number of class/vehicles registered by OEM	20	100	
Frequency : every second year	2	2	
Number of OEMs	7	7	
Marginal cost of registration for approval authority	1000	1000	
Total annual cost for type approval authorities	80000	400000	€

A2 Body/trailer manufacturers	Low case	High case	
Number of class/vehicles registered annually	200	1000	
Frequency : every 4th year	4	4	
Marginal cost of registration for approval authority	1000	1000	
Total annual cost for type approval authorities	50000	250000	€

Total annual cost for approval authorities (A1+A2)	**130000**	**650000**	€

(*) part or the totality of these costs would be charged to OEMs.

B, Administrative costs (internal) for the Commission & EEA

	Number staff	(annual cost of 1 staff)		
B1 current (2 ADs in CLIMA, 1 in JRC)	3	90000	270000	(€ annual)
B.2 As of 2016 (4 ADs in COM + 1 in EEA)	5	90000	450000	[€ annual)

C. VECTO Tool development and operation (Commission cost)

C,1 Development 2010-2015	2700000	(€ total)
	450000	(€ average annual)
C.2 Annual maintenance and upgrades as of 2016	300000	(€ average annual)

D. Total annual administrative cost

	Low case	High case	
EU and Member States	850000	1370000	Until 2015
EU and Member States	880000	1400000	As of 2016
- EU	720000	720000	Until 2015
- Member States	130000	650000	Until 2015
- EU	750000	750000	As of 2016
- Member States	130000	650000	As of 2016
		(euro)	

ANNEX 13 : METHODOLOGY.

Methodology

Emission abatement potential. The present analysis examines the EU potential for HDV fuel consumption savings and CO_2 emission abatements based on expert analysis (see above mentioned AEA-Ricardo, TIAX studies) that to a large extent relies on industry information. This allowed for an indicative assessment of the range of fuel consumption and CO_2 emission improvements (in % terms) that are technically achievable by 2030 with state-of-the-art technologies[130].

Cost/benefit analysis. A second step was to carry out a cost-benefit analysis: a cost was associated to ***each*** technical innovation contributing to emission abatements (see above mentioned TIAX ***report***). Based ***on*** these costs, marginal cost abatement curves have been established in the CE Delft study[131] from the perspective of HDV users (i.e. transport operators mainly, or companies' owned fleets).

Externalities. To complete the cost benefit analysis, a second group of abatement cost curves were produced by CE Delft taking a societal perspective by eliminating distributional effects of taxation. It was not deemed possible to include environmental benefits of lower fuel consumption and CO_2 emissions as the relationship between reduced fuel consumption and exhaust emissions is not a straightforward one : OEM manufacturers can adjust in several ways their engine parameters, and there is no simple relationship and accounting rule between fuel savings due to HDV upgrades and potential benefits in terms of exhaust gas emissions levels.

Modelling. In the context of the present Impact Assessment, recourse to modelling (with the PRIMES/TREMOVE model) was limited to the baseline, not being feasible for the assessment of each single policy action. PRIMES/TREMOVE modelling provided a quantification of the reference baseline scenario, and rather than predicting the effect of each policy option, provided an illustration of potential developments along a few generic scenarios. These generic scenarios (see annex 4), including the baseline scenario, must be considered with caution: they are a projection -not a forecast- whose results are partially dependent on assumptions such as GDP and fuel price developments, which are uncertain by nature. Each scenario is differentiated from the others by exogenous inputs based on experts' views. Modelling was further useful in carrying out a sensitivity analysis on a number of variables (see section 2.3 above).

Quantitative estimates on the effect of each alternative option to the baseline, for those for which this has been deemed feasible (options 3.i and 3.ii) are thus not the result of alternative runs of the PRIMES-TREMOVE model but *indicative* estimated variants of the baseline scenario, with so-called second round or rebound effects (e.g. a possible increase in road

[130] See above-mentioned TIAX report, notably tables 5-1 to 5-9 and 6-3.

[131] Marginal abatement cost curves for Heavy Duty Vehicles, CE Delft, September 2012, http://ec.europa.eu/clima/policies/transport/vehicles/heavy/docs/hdv_2012_co2_abatement_cost_curves_en.pdf

transport demand linked to lower transport fuel consumption and operating costs) not being quantified (see section 5.3).

Addressing CO_2 emissions as a proxy for GHG emissions. CO_2 is not the only vehicle exhaust gas with a global warming effect. Methane (CH_4) and nitrous oxide[132] (N_2O) are both pollutant emissions with high global warming potential (GWP) (on a 100 year horizon their GWP is 25 and 298 respectively compared to 1 of CO_2)[133]. For road transport they constitute the two most important GHGs after CO_2 and can originate either as fuel combustion by-products (or incomplete combustion products) or either during processes involved in the fuel production phase. However, their relative share versus CO_2 is a very minimal: for conventional diesel and gasoline HDVs CH_4 emissions comprise between some 0.1% and 0.7% of the total HDV GHG emissions; N_2O represents 0.6% as a share of the total GHG potential in real driving conditions[134]. Additionally, even though as stated above there is no straightforward relationship between reduced fuel consumption and (reduced) exhaust gas emissions, measures to curb fuel consumption and CO_2 emissions should over time also contribute to reducing CH_4 and N_2O emissions. For all these reasons, the present strategy is primarily considering a reduction of CO_2 emissions as a satisfactory proxy for total GHG emissions. While CH_4 emissions are already curtailed pursuant to the Euro VI Regulation, this does not exclude also targeting, at a later stage, N_2O emissions as such.

Targeting CO_2 tank-to-wheel (tailpipe) emissions rather than well-to-wheel emissions (see definitions p1). Current emission standards applying to cars and vans' CO_2 emissions focus on tank-to-wheel emissions: upstream "well-to-tank" GHG emissions are actually already to large extent addressed in the EU through the inclusion of the oil industry and energy production sector into the EU Emissions Trading Scheme, and the same remark would apply to HDV emissions. While the uptake of technological change – notably the progressive increase in ***alternative*** power modes, including electricity, in new vehicles' production - may in due course require a re-assessment of this mainstream tank-to-wheel approach, it is the one followed in the present Impact Assessment.

[132] Commonly known as "laughing gas" or "sweet gas".

[133] IPCC (2007). IPCC fourth assessment report: climate change 2007. Working group I: The physical science basis, www.ipcc.ch, 2007.

[134] Source: Joint Research Centre estimates.