ACEA | European Automobile Manufacturers Association

# ACEA Position Paper

# Reducing $CO_2$ Emissions from Heavy-Duty Vehicles

## EMPOWERING CUSTOMERS, STRENGTHENING MARKET FORCES AND WORKING IN AN INTEGRATED APPROACH

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ACEA European Automobile Manufacturers Association

# KEY MESSAGES

a. The heavy-duty vehicle sector is the backbone of efficient freight transport in Europe and has a clear leading position in global competition. As part of an automotive industry which generates 12.1 million direct and indirect jobs in Europe (5.6% of total EU employment), heavy-duty vehicle manufacturers make a significant contribution to the European economy.

b. An integrated approach for the road transport sector is an effective way to significantly improve the fuel efficiency of road transport, and with that $CO_2$ emissions. Given that these emissions are influenced by a variety of factors besides the vehicle alone, heavy-duty-vehicle manufacturers are working closely together with all relevant stakeholders in the transport sector to identify, and where possible leverage, all touch points which affect $CO_2$ emissions from heavy-duty vehicles.

c. This integrated approach holds the potential to cut 20% of $CO_2$ emissions from road transport by 2020 compared to 2014. This is a very promising way to unlock the full potential of joint $CO_2$ reduction efforts.

d. Market forces are clearly the best way forward. Fuel efficiency is one of the most important competitive factors in developing and selling heavy-duty vehicles, such as trucks and buses. Considering the maturity and complexity of heavy duty vehicles with several thousand shapes and sizes, a simplified 'one-size-fits-all' policy is not the most suitable way to address $CO_2$ emissions.

e. Combined with the integrated approach, ACEA supports the development of an EU-funded standardised simulation tool to certify the fuel efficiency of complete heavy-duty vehicles and vehicle combinations. This tool, called VECTO, will enable vehicle manufacturers, to calculate the specific $CO_2$ emissions data for each individual bus or truck configuration. VECTO will empower customers to compare customised offers and choose the most fuel-efficient vehicle combination based on their specific needs.

f. ACEA supports the 2018 time frame to start the mandatory heavy-duty-truck $CO_2$ declaration in a first step for long-haul trucks and city delivery vehicles (buses and coaches will be included in a second step).

g. Manufacturers must dispose of an appropriate 18-months lead time for the certification of input data after entering into force of all concerned legislation.

# INTRODUCTION

## Heavy-duty vehicles keep society moving

As part of an automotive industry which generates 12.1 million direct and indirect jobs in Europe (5.6% of total EU employment), heavy-duty vehicle[1] manufacturers make a significant contribution to the European economy. Around 320,000 heavy duty vehicles (N2/M2 with >3.5t GVW and N3/M3 vehicle categories) were produced in the EU in 2014. On top of that, heavy-duty vehicles generated a €5.1 billion[2] trade surplus for the European Union last year alone, while all motor vehicles generated €396 billion[2] of fiscal income for 14 EU member states[3]. Moreover, the automobile and parts sector has established itself as Europe's number one investor in R&D, spending around €41.5 billion on innovation in 2013[4]. All this keeps Europe's heavy-duty vehicle manufacturers ahead of global competition.

The heavy-duty vehicle sector is the backbone of efficient freight transport in Europe, with the sector contributing €550 billion in gross value added (GVA) to Europe's economy in 2011. The industry creates a large share of Europe's wealth and prosperity, while creating a relatively small share of Europe's greenhouse gas emissions.

Buses improve the quality of life in cities by generating lower emissions per passenger transported. Today's buses are powered by diverse propulsion technologies and OEMs will continue developing alternatively-fuelled buses. For the time being, diesel buses make up by far the largest part of the bus fleet[5]. For city-bus applications biodiesel, natural gas and electricity are gaining importance.

## A benchmark for fuel efficiency

Heavy-duty vehicles account for roughly 5% of Europe's greenhouse gas emissions. Given that they are responsible for transporting 75% of all land-based freight in Europe, their share of greenhouse gas emissions is relatively small. Driven by market forces, truck manufacturers have delivered a 60% reduction in fuel consumption since 1965.

As a result of continued investments by the industry, modern trucks are the benchmark for fuel

[1] 'Heavy-duty vehicles' in this paper refer to trucks and buses (N2/M2 with >3.5t GVW and N3/M3 vehicle categories).

[2] The Automobile Industry Pocket Guide, 2015-2016, ACEA.

[3] These include: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden and United Kingdom.

[4] The Automobile Industry Pocket Guide, 2015-2016, ACEA.

[5] 90% of the bus fleets in Europe, according to the results of the 3iBS survey representing 70,000 buses operated in 63 European cities and regions.

efficiency thanks to technologies such as common rail injection, automated gearboxes, high efficient exhaust after treatment systems together with further improvements of combustion and air handling, aerodynamics, tyres and advanced control systems. Per tonne transported, this innovation has resulted in a fuel consumption of as little as nearly one litre of diesel per 100 tonne-km, delivering a significant reduction of $CO_2$ emissions.

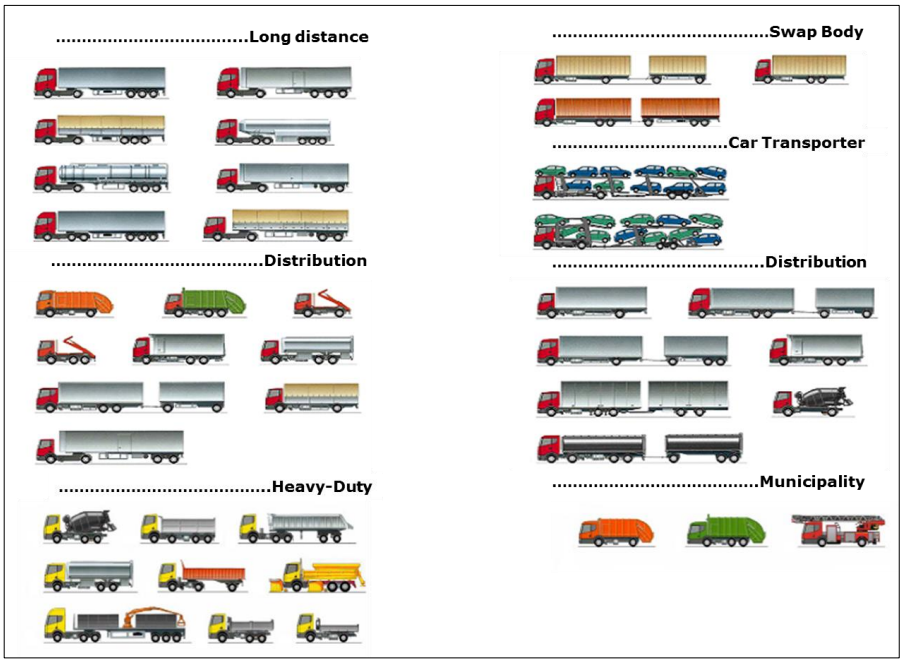
The same counts for buses and coaches. Transport by buses and coaches contributes to improved air quality with less $CO_2$ per passenger than other modes of transport. Further improving fuel efficiency of heavy-duty vehicles tops the agenda of Europe's manufacturers.

## No truck or bus is like another

Trucks and buses are not consumer goods, instead they are economic goods for business needs. Most heavy-duty vehicles are custom-built to meet specific and unique customer requirements. These personalised features extend to virtually every facet of a truck or bus, from the number of axles, the size of the engine and fuel tank to the design of the cab or passenger compartment. Considering the complete vehicle – that is tractor plus semi-trailer, body rigid or rigid plus trailer – the heavy-duty vehicle market becomes even more complex, with several thousand shapes and sizes of trucks and buses, as well as a variety of power train configurations.

Truck manufacturers generally only deliver a chassis and cab to an intermediate or a final stage manufacturer, who then configures the vehicle for its intended use. Given this multi-stage construction process, it is difficult to introduce cost-efficient binding $CO_2$ targets for complete vehicles. The multitude of custom features to cater customers' individual needs, means that introducing legislation suitable for all variations is extremely challenging. There simply is no 'one-size-fits-all' approach for heavy-duty vehicles.

**No one truck is like another**




# INTEGRATED APPROACH

## An integrated approach to reducing $CO_2$ emissions

According to a recent study[6] by independent research institute Transport & Mobility Leuven (TML), European truck manufacturers are expected to reduce the fuel consumption of new vehicles by 20% in the period from 2005 to 2020. This translates into an annual reduction rate of 1.3%. European truck manufacturers will continue to do their part.

Further improving the fuel efficiency and $CO_2$ emissions of trucks and buses tops the agenda of heavy-duty vehicle manufacturers. However, manufacturers advocate a far more ambitious approach to reducing $CO_2$ for the future. In order to reach the full potential of reducing $CO_2$ emissions from EU road transport, all relevant stakeholders of the road transport sector must join forces. After all, there is much more than new vehicles alone that determines $CO_2$ emissions.

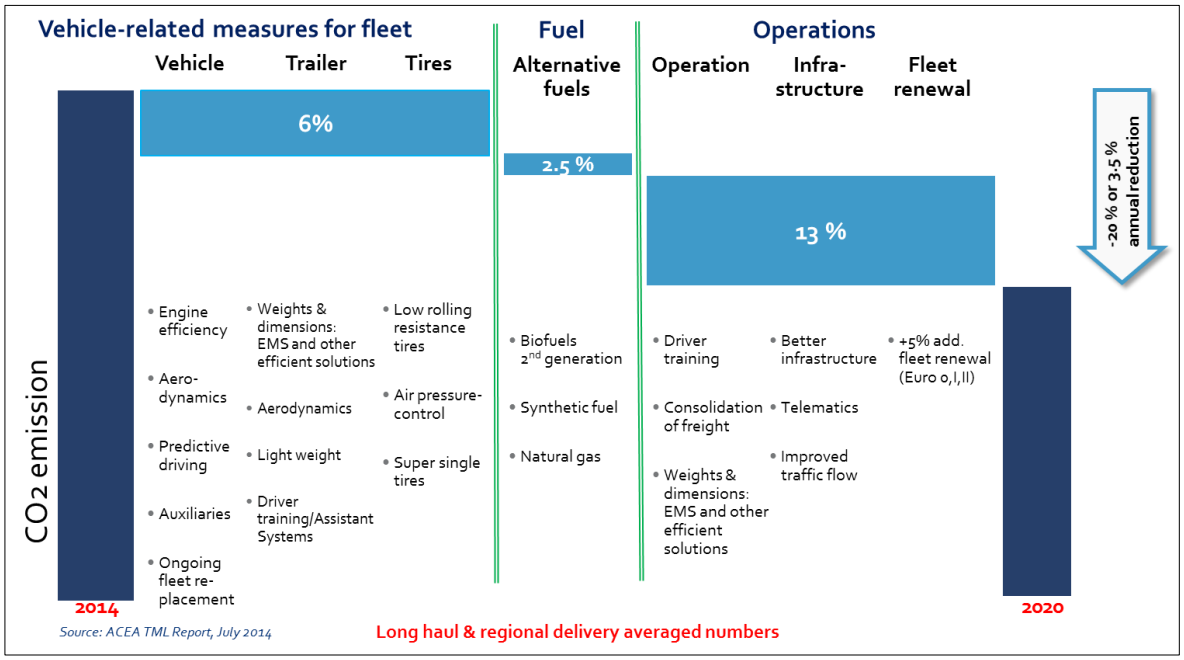
There are many other factors that can contribute to large-scale $CO_2$ reductions: permitted vehicle

[6] GHG reduction measures for the Road Freight Transport sector up to 2020, An integrated approach to reducing $CO_2$ emissions from heavy-duty goods vehicles in Europe, updated with input from key stakeholders, Transport & Mobility Leuven, 2015.

length and weight, trailer designs, alternative fuels, driver behaviour, transport operations and infrastructure all play a decisive role. Only if we move from a 'new-vehicle-only' approach to a fully integrated approach, can Europe significantly reduce $CO_2$ emissions from the heavy-duty vehicles on its streets. TML estimates the potential gains from this integrated approach to be more than double the current annual $CO_2$ reduction rate from road freight transport, amounting up to 3.5%.

By 2020, new vehicles and trailers will have the potential to be 15-17% more fuel efficient than they were in 2014. Most of the benefits come from improvements to the engine, tyres and aerodynamics of the complete vehicle with main contribution from the trailers and bodies, while driver assistance systems will also contribute by guiding vehicle users to a more efficient driving style.

Truck manufacturers, led by ACEA, have been working together with key stakeholders[7] of the road transport sector to further reduce $CO_2$ emissions within the context of such an integrated approach.




*Source: ACEA and TML, 2015*

[7] ASECAP, CEDR, CLCCR, CLECAT, CLEPA, EAPA, ECG, ERF, ESC, ETRMA, EUPAVE, EUROBITUME, FuelsEurope, Green Freight Europe, IRU, NGVA.

## The reduction potential of vehicle-related measures

The total HDV $CO_2$ reduction potential for vehicle-related measures via an integrated approach is estimated at 5.05% for long haul and 4.56% for regional delivery by 2020, with reference year 2014.

Vehicle-related measures represent about a quarter of the potential improvement. Vehicle manufacturers themselves (and automotive suppliers) can achieve two-thirds of that – the rest coming from tyre manufacturers and body or trailer builders:

- Improving the aerodynamic characteristics of vehicle combinations can effectively contribute to bringing $CO_2$ emissions down by 3% to 4% by 2020 when compared to 2014 – of which 1.5% to 2% can come from the trailer.
- Reducing the rolling resistance of tyres can also reduce $CO_2$ emissions, a reduction of up to 4% for long haul and 3% for regional delivery by 2020.

## Alternative fuels: biofuels and gaseous fuels

The additional greenhouse gas (GHG) reduction potential of biofuels by 2020 (compared to 2014) is estimated to be 0.5% to 1.4%, according to discrepancies in projections and assessment of the fuel industry. In the long term, biofuels have the potential to realise a much higher reduction, but there is great uncertainty about how fast technology will advance and to which extent their increased usage will reduce (well-to-wheel) $CO_2$ emissions.

For gaseous fuels, the time horizon of 2020 is probably too short to achieve a significant $CO_2$ reduction, particularly given the need for an extensive network of refuelling infrastructure and the low market shares of gas vehicles for the time being. Shifting to gaseous fuels decreases dependency on crude oil, but still requires the construction of a refuelling network throughout Europe. When it comes to local transport, a single refuelling point can supply an entire fleet.

## Vehicle operations: driver training, high capacity vehicles, speed reduction, load factor and empty running

Over half of the potential improvement is attributed to the more efficient use of vehicles, particularly from driver training. The operation of HDVs can thus make a substantial contribution to reducing $CO_2$ emissions, for example through improvements in driving style, optimised speeds, efficient route planning and better loading.

Both heavy-duty vehicle manufacturers and transport companies actively contribute to improving the behaviour of drivers through 'eco-driving' training and driver assistance systems. These

measures are expected to deliver a $CO_2$ emissions reduction of up to 7% for regional delivery by 2020 and 6% for long haul, when compared to 2014. Examples of in-vehicle technology include GPS-based, automated gear-shifting strategies.

Advanced transport systems can also make a significant contribution, although maximum weight and dimensions would need to be revised to allow for innovation. High-capacity vehicles (HCVs), such as the European Modular System (EMS) and other highly-efficient solutions increasing the loading length of trailers and semitrailers, have proven their added-value in several EU countries over the past years. HCVs can deliver the same transport capacity with less vehicles, resulting in lower total fuel consumption and emissions, as well as less congestion (in case of EMS combinations, for example, two 16.5-meter standard trucks are replaced by one 25-meter truck). Various studies[8] on infrastructure and road safety confirm the positive societal impact of such solutions, without any negative effect on road safety.

## Road infrastructure

The capacity, condition and efficient use of road infrastructure are directly linked to $CO_2$ emissions, and can therefore potentially reduce $CO_2$ emissions by around 4% by 2020, compared to 2014. Improving infrastructure is thus crucial; this goes from proper maintenance of roads with low-rolling resistance pavement (-1% $CO_2$ emissions) to further improvements to the infrastructure. Other measures with significant potential include the roll-out of smart and connected transport networks using intelligent transport systems (ITS), which can significantly improve traffic flow (-2% $CO_2$ emissions).

## Quick wins

The measures described vary greatly in their pathway to $CO_2$ reduction, technological maturity and maximum technical reduction potential. In some cases, significant quick wins can be made, while other measures would take significant efforts and investments with little potential for the future. Short-term measures at little cost include:

- One of the most prominent candidates for a quick win is driver training. At a

[8] Mid-term report of EMS Pilot, BASt (Bundesanstalt für Straßenwesen), 2014; A Review of Megatrucks, European Parliament Transport & Tourism Committee report, 2013; Monitoring Traffic Safety, Longer and Heavier Vehicles, Ministry of Infrastructure and Environment Netherlands, 2011; Longer and Heavier Vehicles in the Netherlands: facts, figures and experiences in the period 1995-2010, Ministry of Transport Netherlands, 2010; Moving Freight With Better Trucks, ITF, 2010; UK Department for Transport: Evaluation of the Longer Semi-Trailer Trial: Annual Report 2014 - July 2015..

minimal cost, the potential $CO_2$ reduction is as high as 7%;

- Low rolling resistance tyres can be retrofitted to any vehicle at little cost and provide fuel efficiency improvements of around 4%.

**Assessment of total $CO_2$ reduction potential for heavy-duty freight vehicles by 2020 via an integrated approach (fleet average values, reference year is 2014)**

| | | Long haul | Regional delivery |
|---|---|---|---|
| Vehicle | OEM | -2.7% | -2.6% |
| | Other parties | -2.3% | -1.9% |
| **Vehicle Total** | | **-5.0%** | **-4.5%** |
| Alternative Fuels | Gaseous fuels | >0% | >0% |
| | Biofuel | -0.5% | -0.5% |
| **Alternative Fuels Total** | | **-0.5%** | **-0.5%** |
| Vehicle Operation | Driver training | -6.0% | -7.0% |
| | EMS | -2.0% | 0.0% |
| | Speed reduction | -3.8% | -5.9% |
| | Improve load factors | No reliable estimates found | |
| | Cabotage | -0.5% | 0.0% |
| **Vehicle Operation Total** | | **-11.8%** | **-12.5%** |
| Road Infrastructure Management | Rolling resistance pavement | -1.0% | -1.0% |
| | Reduced inclination | 0.0% | 0.0% |
| | Improved flow | -2.0% | -2.0% |
| | Platooning | -0.4% | 0.0% |
| | Road pricing (HDV only)* | -1.0% | -1.0% |
| **Infrastructure Total** | | **-4.3%** | **-4.0%** |
| $CO_2$ legislation | | Can strengthen market forces but does not create gains itself. Most direct option is fuel tax. | |
| **Integrated Effects** | | **-20.4%** | **-20.2%** |

*Source: TML, 2015*

# REAL-WORLD RESULTS

Using technologies readily available on the market the fuel consumption, and therefore the $CO_2$ emissions, of modern truck combinations can be reduced by a double-digit percentage. The real-world potential of the integrated approach was confirmed by two pilot projects recently conducted by ACEA members[9].

Daimler found up to 14% reductions in $CO_2$ emissions and improved fuel economy using a comprehensively optimised truck as part of the company's 'Efficiency Run' project. Using efficient technology that involved all parts of a vehicle and trailer rather than focusing on a single component, Daimler found that each truck consumed around 12% to 14% less fuel than standards vehicles. The tests also explored the potential of the long combination vehicle and found that fuel consumption was reduced by around 17% when compared with standard combinations.

With its 'Transport Laboratory' Scania seeks to optimise all factors that affect emissions, from vehicles and logistics to drivers and alternative fuels. Simply by using products and services available today, Scania has delivered some impressive results. For five years, the company ran a fleet of up to 25 vehicles between Sweden and the Netherlands. The results of applying the integrated approach to these vehicles are impressive: by combining all measures they reduced the fuel consumption of the test fleet by a full 50 percent between 2008 and 2013!

These real-word results underline that the integrated approach is not just a futuristic idea or theoretical concept, the approach can make a significant contribution to cutting $CO_2$ emissions in the near future.

# MARKET DRIVEN FORCES AND VECTO

## Fuel efficiency and $CO_2$ reductions are market driven

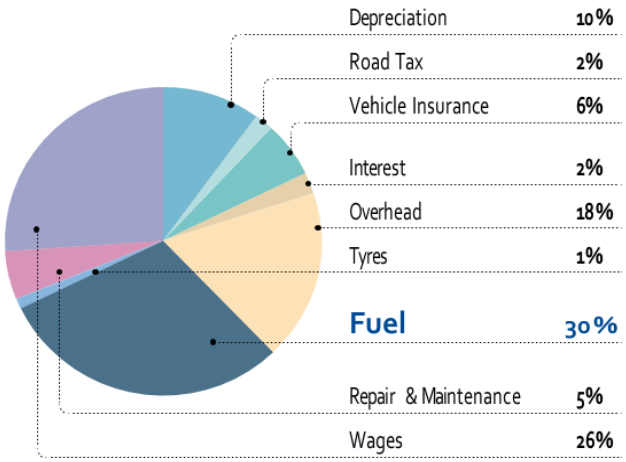
Fuel efficiency is one of the most important competitive factors in developing and selling trucks and buses. Trucks and buses are economic goods, which makes fuel efficiency a key element in the purchase decision. Accordingly, market forces ensure continuous progress in improving fuel economy and further reducing $CO_2$ emissions in the most efficient way.

Fuel represents 30% of the running costs in the transport sector, which is more than the cost of employing drivers. Given the competition between transport service providers for goods and

[9] Daimler's 'Efficiency Run' and Scania's 'Transport Laboratory'

people, strong economic incentives already exist for fuel efficiency improvement through market forces. The business case for fuel efficiency is clear.

**Total operating costs of a 40-tonne tractor-semitrailer combination**




*Source: ACEA Commercial Vehicles and CO2, 2010*

## Improving customer information means strengthening market forces

Giving customers transparent and reliable fuel consumption information based on a common testing method will allow customers to select the most $CO_2$ efficient vehicle and therefore contribute to further reducing $CO_2$ emissions. Industry wants to supply end-users with information on the real-life $CO_2$ and fuel consumption performance, rather than demonstrating compliance with an 'artificial framework'. Therefore, any product-oriented legal measure regarding fuel efficiency and $CO_2$ emissions should aim to further strengthen these market forces.

To assist customers in their product selection, ACEA supports the European Commission-led development of a tool: the Vehicle Energy Consumption Calculation Tool (VECTO). Using computer models based on real world data, VECTO will allow customers to have information on the fuel efficiency of complete heavy-duty vehicles and vehicle combinations based on the grams of fuel used and $CO_2$ generated per tonne-km, cubic meter-km of transported goods or passenger-km of transported persons. The metrics are chosen in such a way that they reflect the real transport performance of the vehicle.

This simulation tool will allow customers to choose the most fuel-efficient vehicle specification. Specific, and often custom-built, configurations (such as the engine-gearbox combination, aerodynamic features and tyre specification) will be taken into account.

The Commission is already actively developing the simulation tool in close cooperation with the industry. VECTO is scheduled to be used for certification of vehicles by 2018, providing an 18-month lead time after entering into force of all concerned legislation for the start of mandatory heavy-duty truck $CO_2$ declaration for the most important configurations with respect to $CO_2$ (classes 4, 5, 9 and 10). The VECTO simulation tool provides the real $CO_2$ emissions values of heavy-duty vehicles to customers and thus strengthens market forces. As a result, heavy-duty vehicle manufacturers are actively encouraged to innovate and produce the most $CO_2$ efficient vehicles for the market.


*Source: ACEA*

## Why a computer simulation tool?

The advantage of using simulation, rather than a complete test-based approach, is that each vehicle can be evaluated efficiently while taking their intended use into account. It has to be underlined that input data for such a computer simulation are still obtained through very precise physical tests of the components influencing the $CO_2$ and fuel consumption of vehicles. After measuring the actual efficiency of the main components, this simulation can generate the results for a complete vehicle in specific mission. This transparent approach ensures that the most $CO_2$-efficient vehicles will see a quick uptake by end-users. Society will benefit most from such a method. Complying with artificial frameworks based on legal limits would not support the real $CO_2$ emissions values.

# EU-US $CO_2$ PERFORMANCE COMPARISON

## Targets (United States) versus real-life values (European Union)

The challenge for any regulatory approach is to obtain the expected $CO_2$ reductions in real-life vehicle usage. A legal limit does not by default deliver the expected results in real traffic. Unlike the regulatory approach to NOx and PM reductions, the starting point for reducing $CO_2$ emissions is to further improve a mature vehicle characteristic, a unique regulatory situation. $CO_2$ emissions from trucks cannot be addressed via a 'one-size-fits-all' policy due to the fact that trucks come in thousands of different shapes and sizes. Considering the multi-stage manufacturing process of trucks and buses, an additional important issue is the question of who (ie which manufacturer) should be responsible for the legal compliance of a completed truck or bus and for the performance of truck combinations. A traditional approach would require at least 35 different legal limits to cover the most important truck classes. However, these concerns are addressed by the VECTO tool.

## Effectiveness of $CO_2$ legislation: comparing US targets with EU real-world values

With the future legislation on $CO_2$ from trucks, the EU will require a declaration of $CO_2$ values for each and every truck produced. In the US, on the other hand, the EPA requires OEMs to be below an average limit value, based on all vehicles sold every year. Moreover, results can be banked and traded between model years.

In the EU, customers will be able to get a $CO_2$ value for a purchased vehicle, which reflects the real $CO_2$ emissions. This will support the introduction of the most-fuel efficient vehicles on the market. In contrast, the $CO_2$ value is not that specific in the US, due to the fact that the engine used is generic and the number of input parameters is limited (with the introduction of EPA Phase II legislation, the regulation will use input data from specific OEM engines).

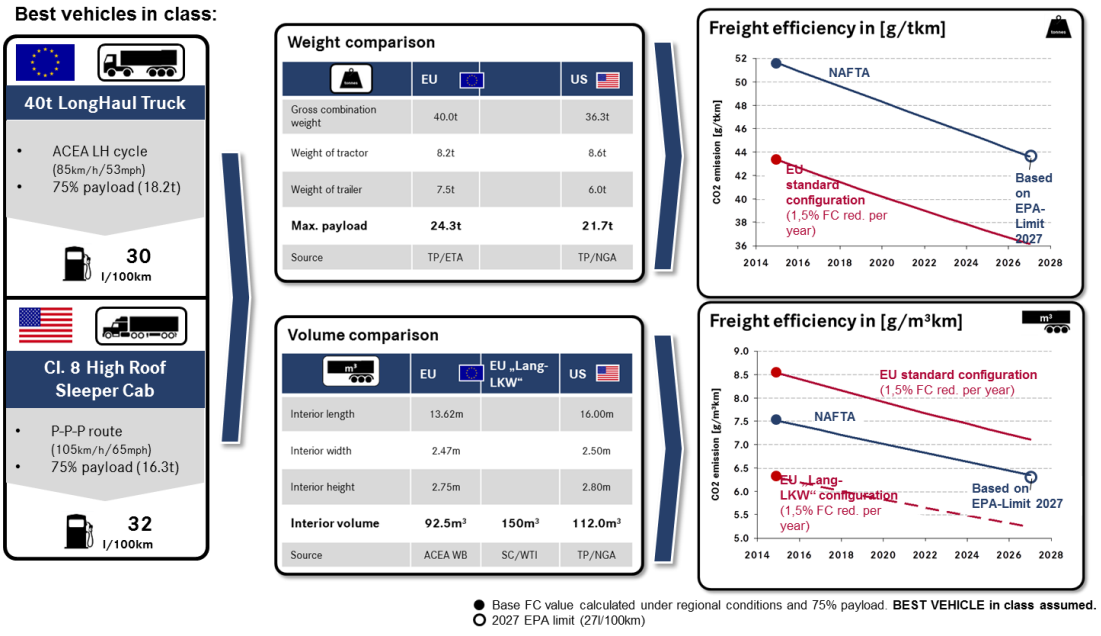
The EU proposes a simulation-based complete vehicle approach, using VECTO. The American EPA works with two separate regulations. One covers the engine (ie measurement of engines in a test cell) and the other regulation the vehicle. The latter also uses a simulation-based complete vehicle approach, but uses a generic engine which is the same for all OEMs, while in Europe input data reflects the real performance of individual vehicles of each manufacturer.

## EU truck manufacturers could perform even better with the necessary changes to the legal boundary conditions

Contrary to some allegations, which are clearly lacking scientific validation[10], European truck manufacturers are on track to reduce the fuel consumption of new trucks by 20% in the period from 2005 to 2020 – translating into an annual reduction rate of around 1.3%. An independent study by research institute Transport & Mobility Leuven confirmed this figure.

As the image below shows, in the current legal framework, EU trucks emit 16% less $CO_2$ than US trucks, when looking at $CO_2$/g/tkm (weight). In terms of $CO_2$/g/m³3km (volume), EU trucks perform less well simply because US trucks can legally transport 21% more volume.

This brings to light another very important measure that can improve road freight efficiency in Europe: vehicle legislation. Efficiency is currently constrained by the legal boundary conditions on maximum permitted weight, dimensions and speed. Therefore, changes to these legal boundary conditions are necessary. For instance, by allowing the cross-border use of longer combination vehicles in Europe, which is already common practice in the US, truck manufacturers would be able to improve fuel efficiency by 14%.




*Source: ACEA*

[10] Review of ICCT report "Overview of the heavy-duty vehicle market and $CO_2$ emissions in the European Union", Transport & Mobility Leuven, 2015.

## ABOUT ACEA

ACEA's members are BMW Group, DAF Trucks, Daimler, Fiat Chrysler Automobiles, Ford of Europe, Hyundai Motor Europe, Iveco, Jaguar Land Rover, Opel Group, PSA Peugeot Citroën, Renault Group, Toyota Motor Europe, Volkswagen Group, Volvo Cars, Volvo Group. More information can be found on www.acea.be.

## ABOUT THE EU AUTOMOBILE INDUSTRY

- Some 12.1 million people - or 5.6% of the EU employed population - work in the sector.
- The 2.3 million jobs in automotive manufacturing represent 7.6% of EU's manufacturing employment.
- Motor vehicles account for €396 billion in tax contribution in the EU15.
- The sector is also a key driver of knowledge and innovation, representing Europe's largest private contributor to R&D, with €41.5 billion invested annually.

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