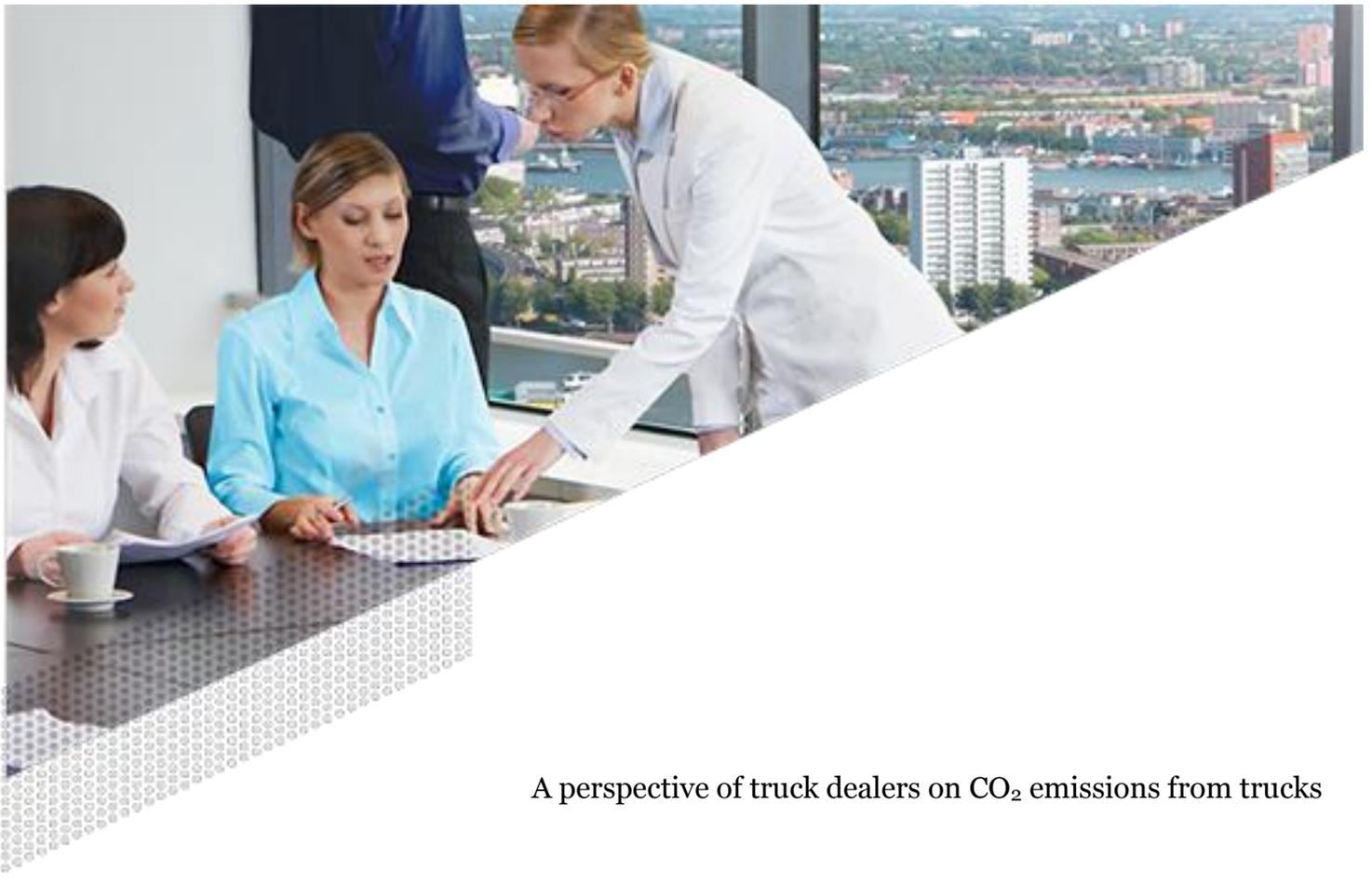


A perspective of truck dealers on CO₂ emissions from trucks





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Author(s)

Renee Kooger
Omar Usmani
Hein de Wilde

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Preface

This research has been commissioned by the Dutch Ministry of Infrastructure and Water Management. It is important to mention that the outcomes of interviews form the basis for this study. This means that the content of this study solely reflects the experiences and opinions of the interviewees. It is therefore subjective. The authors of this study have performed a sanity check in order to filter any factual errors, but the content of this work reflects the outcomes of the interviews. It is possible that other stakeholders in the truck market have different opinions.

Table of contents

Executive Summary	6
1. Introduction	8
2. Data collection	11
3. The five elements determining CO₂ emissions from trucks	13
3.1 Truck activities	14
3.2 Truck base	15
3.3 Fuel-saving add-ons in different truck types	17
3.4 Fuel	21
3.5 Driver behaviour	24
4. Conclusions	27
References	30

Executive Summary

Rationale

Heavy duty vehicles (notably trucks, buses and coaches) account for about 25% of the CO₂ emissions of European road transport¹ and to about a 20%² of the Dutch road transport emissions. Action is needed to curb the emissions. The European Commission is therefore developing a norm for CO₂ emissions from heavy-duty trucks as a part of her low-emission mobility strategy to reduce transport greenhouse gas emissions by at least 60% in 2050 compared to 1990. This target is described in the Commission's 2011 White paper on Transport. However, this target is not ambitious enough to meet the goals set in the 2015 Paris agreement.

To create an effective CO₂ norm for trucks, it is important to create an ambitious yet realistic target for reducing greenhouse gas emissions. This target needs to be technically and economically feasible. In order to determine such a target, it is important to know the (bandwidth of) current emissions from trucks and what additional reductions can be achieved by applying fuel saving technologies.

Despite the economic importance of fuel consumption and the fact that operators closely monitor their consumption, CO₂ emissions from trucks are currently rarely reported. This is why the EC has developed the Vehicle Energy Consumption Calculation Tool (VECTO), which is a tool to simulate CO₂ emissions based on adjustable input data on e.g. fuel, engine type, tires, mass, and types of fuel-saving add-ons. The EC wants truck manufacturers to apply VECTO for the new trucks they produce to gain insight in CO₂ emissions of various truck types. In 2018 the EC will develop a CO₂ norm, based on VECTO, which will incentivize manufacturers to produce more fuel efficient trucks, in order to avoid possible fines. Because VECTO is a simulation tool and does not actually measure CO₂ emissions, it is important to optimize the input data and use of VECTO in such a way that the simulated emissions closely reflect the actual emissions.

Goal and approach

In support of this, our study, based on in depth interview with truck dealers, provides stakeholder opinions on ways to optimize VECTO, and their alternatives for measuring CO₂ emissions from trucks. In addition we analyze the key determinants of a truck's CO₂ emissions, as reported by the dealers. Furthermore, our study provides new insights in the truck market: the sales process, types of customers and general policy recommendations related to reducing CO₂ emissions from trucks.

¹ https://ec.europa.eu/clima/policies/transport/vehicles/heavy_en

² NEO, 2017 <https://www.ecn.nl/publicaties/ECN-O--17-018>

All these findings are based on in-depth interviews with dealers in the truck market. The outcomes of the interviews form the basis for this study. The information provided in this study is therefore subjective. This market based approach can contribute to develop a strategy for reducing CO₂ emissions from trucks in close collaboration with the market sector.

Conclusions

Our analysis has led to three main conclusions based on the opinions of the interviewees:

- According to the dealers, the activities³ from trucks and driving behavior are the most important determinants of a truck's CO₂ emissions. The dealers indicate that the activities from trucks have a (slightly) bigger impact, but driving behavior is more simple to improve.
- Given the importance of the determinants, activities and drivers behavior should be well monitored and taken into account in the overall strategy to reduce truck's CO₂ emissions. Currently the interviewees feel that the input data used in VECTO for both activities and driving behavior is not specific enough. Moreover, it is difficult to estimate the influence of these factors at the manufacturing stage. The dealers say that the impact from truck activities and driving behavior varies greatly, which causes the actual CO₂ emissions to differ as well. Therefore, according to the interviewees, a CO₂ reducing strategy should also take into account activities and driver-related CO₂ emissions in a more detailed way. The dealers feel that a policy based solely on VECTO (in its current state) would insufficiently reflect an effective or fair policy as vehicle operators would not be judged on the two factors that have the largest influence on CO₂ emissions.
- Dealers indicate that most trucks have driver-monitoring systems and some form of tire-pressure management. It is more difficult to draw generic conclusions from the implementation of aerodynamic add-ons. Roof spoilers are most commonly used, but not present in all truck types. This means that in the process of setting norms, a minimum requirement for a truck could be to install driver assistance add-ons (and, if appropriate, a roof spoiler).

³ Activities: what the truck is being used for. This is determined by the transport needs the truck needs to fulfil.

1. Introduction

The first part of this introduction describes the CO₂ policy of the European Commission (EC) related to trucks⁴. The second part describes the specific contribution of our study to further develop this policy.

Heavy duty vehicles (e.g. trucks, buses and coaches) produce around a quarter of CO₂ emissions from road transport in the EU. Specifically heavy-duty trucks are responsible for 20% of the CO₂ emissions of road transport in the Netherlands. Further action is therefore required to curb emissions from HDVs. Despite the economic importance of fuel consumption, CO₂ emissions from trucks are currently rarely reported, which is why the EC wishes to address this gap as a part of her low-emission mobility strategy to reduce transport greenhouse gas emissions by at least 60% compared to 1990 levels by 2050⁵.

These actions include:

- 1) The development of a Vehicle Energy Consumption Calculation Tool (VECTO), a computer simulation tool to measure CO₂ emissions from new trucks above 7.5 tonnes.
- 2) A proposal on new regulation regarding the determination of the CO₂ emissions and fuel consumption of new trucks above 7.5 tonnes based on VECTO (May 2017), the so-called certification regulation.
- 3) Legislative proposal for the monitoring and reporting of these emissions and fuel consumption as part of the Europe on the Move package (31 May 2017), with a view to annual publication of information on the performance of new trucks for the EU market.

These are first steps towards curbing CO₂ emissions from HDVs. As such, they:

- contribute to a more transparent and competitive market and the adoption of the most energy-efficient vehicle technologies
- are a prerequisite for further legislation on CO₂ emission standards for trucks, which the Commission will propose in 2018.

Vehicle Energy Consumption Calculation Tool (VECTO)

Trucks are quite complex vehicles and physically testing each of them to determine the CO₂ emissions would be very burdensome. The Commission has therefore developed a new tool, the Vehicle Energy Consumption Calculation Tool (VECTO), in close cooperation with stakeholders: mainly Original Equipment Manufacturers (OEMs) aka truck manufacturers, and national

⁴ https://ec.europa.eu/clima/policies/transport/vehicles/heavy_en

⁵ <http://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX:52016DC0501>

registration authorities of various nation states as these stakeholders are initially most involved in using and applying VECTO (outcomes). This is further explained in the section below. VECTO is a simulation software that can be used to measure the CO₂ emissions and fuel consumption of HDVs based on input data from relevant vehicle components.

Monitoring and reporting of CO₂ emissions from trucks

The Commission has proposed that, as of 1 January 2019, truck manufacturers will have to calculate the CO₂ emissions and fuel consumption of new vehicles they produce for the EU market, using VECTO. The new system will complement the existing EU reporting scheme for cars and vans. According to the draft certification regulation, manufacturers will have to determine the CO₂ emissions and fuel consumption of new trucks above 7.5 tonnes.

A simulation of CO₂ emissions and fuel consumption using VECTO will have to be carried out for each new HDV falling under its scope. Vehicle manufacturers themselves will perform the simulation on the basis of the certified input data of the vehicle components. Information on the performance of a specific vehicle will be made available only to the individual purchaser of this vehicle and to the national authorities where the vehicle is registered. However, the Commission is now proposing to monitor and report CO₂ emissions from new HDVs subject to this certification procedure, to create full market transparency. Through this step, all relevant data calculated by manufacturers would be monitored, reported and published at EU level. In this way the data would be made available to all stakeholders.

This would give transport operators access to information on the performance of lorries of different makes with similar characteristics, allowing them to make better informed purchasing decisions. Vehicle manufacturers would be able to compare their vehicles' performances with those of other makes, providing increased incentives for innovation.

To create an effective CO₂ policy for trucks it is important to create an ambitious yet realistic target for reducing greenhouse gas emissions. This target needs to be technically and economically feasible. In order to determine such a target, it is important to know what the current emissions are and what corresponding level of reduction can be achieved.

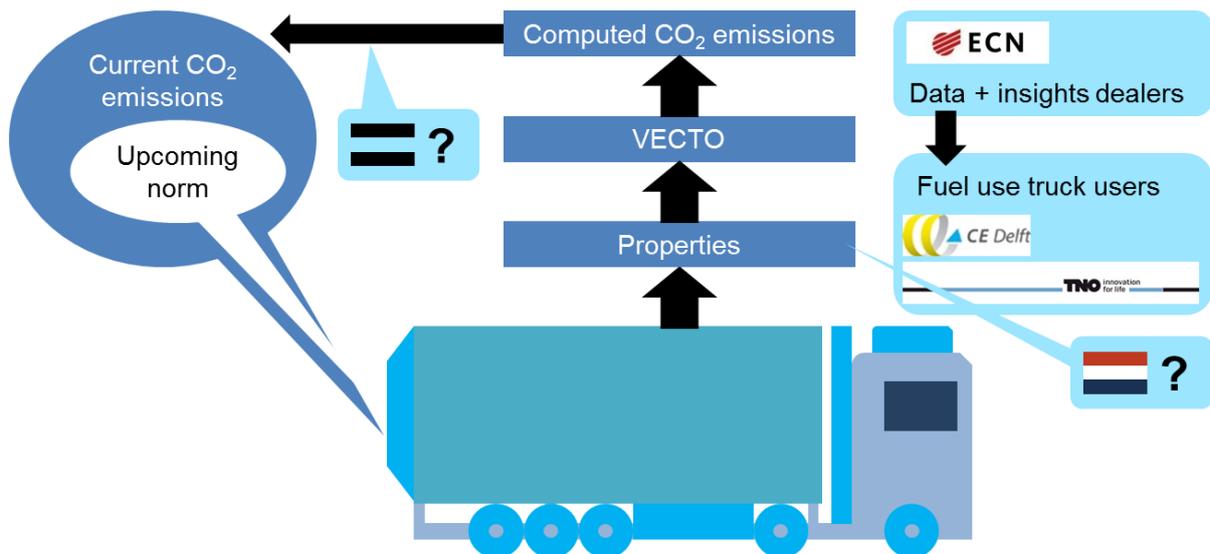


Figure 1: Shows how this research contributes to the upcoming European CO₂ norms. This study provides insights on how to increase the accuracy of determining CO₂ emissions from trucks and what specific element(s) have the largest influence on these CO₂ emissions.

Contribution ECN study to EC norm development: VECTO

CO₂ emissions can be computed with VECTO, which is a simulation tool to calculate both the fuel consumption and the CO₂ emissions from a vehicle. To correctly reflect the emissions and reduction potential of Dutch trucks, VECTO needs:

- A)** Detailed information about the characteristics of trucks in the EU member States
- B)** To process this information in a proper way.

Our study, based on in-depth interviews with Dutch truck dealers, contributes to both aspects by delivering:

- A)** A qualitative analysis of the Dutch truck market, with a focus on the factors that determine the CO₂ emissions from trucks. Further insights in the factors that determine CO₂ emissions from trucks can aid the development and improvement of VECTO and its forthcoming output reports.
- B)** Current VECTO limitations and its applicability according to the interviewees. Understanding possible limitations can aid the optimization process of VECTO.

In addition our study delivers quantitative data on the adoption of fuel saving options for various truck types, to be used in a parallel study conducted by TNO, CE Delft and the TU Graz. This parallel study compares the output of VECTO with the actual emissions from truck users.

Contribution ECN study to EC norm development: understanding truck market

To develop an effective CO₂ policy with realistic targets, it is crucial to understand how the truck market works.

Our study has therefore analysed:

1. To what extent the five truck elements (activities, truck base, add-ons, fuel, and driver) contribute to CO₂ emissions⁶.
2. Insights in the sales process of trucks, types of costumers and different types of trucks. Dealers can provide valuable insights in the various truck users. They are an essential link between the OEMs and the end-users of trucks.
3. Policy recommendations regarding alternative fuels and fuel-saving options as proposed by the interviewees.
4. Methods to determine actual CO₂ emissions for users.

⁶ These five elements will be discussed in section 3.

2. Data collection

To get a proper understanding of the Dutch truck market and gather information on VECTO input data, interviews have been conducted with key truck dealers, a truck importer and a large fleet owner. The interviewed businesses are listed in Figure 2.

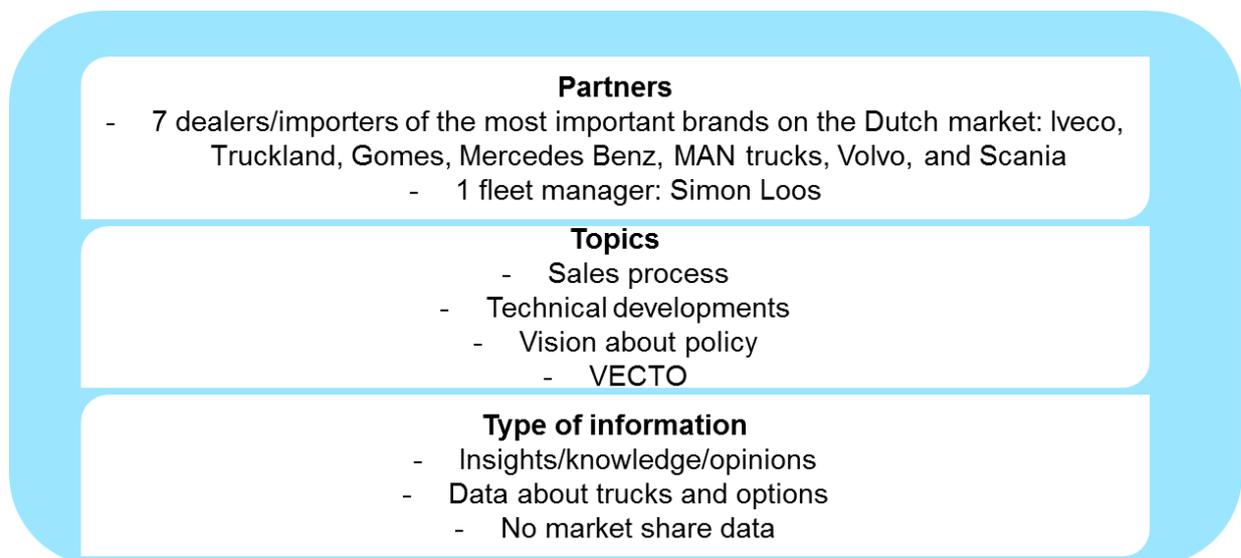


Figure 2: Is an overview of the data collection. It shows the interviewees and topics that have been discussed with them. The report before you is based on the information gathered from these in-depth interviews.

The interview protocol consisted of questions related to:

1. The sales process involved with trucks (focused on fuel saving options)

The sales process of trucks is very different from cars. As trucks are always tailor-made, the amount and sort of fuels-saving options varies based on the activities of the truck and the buyers' preferences.

2. Technical developments (focused on fuel saving options)

In addition to understanding the sales process, it is important to learn which (technical) fuel-saving options are available. This questions were related to fuel-saving add-ons, alternative fuels, and fuel saving possibilities in the truck base (motor, gear box, cabin etc.).

3. Policy recommendations (focused on fuel-saving options)

The interviewees were also asked their opinion on what governmental institutions can do to improve fuel efficiency and reduce CO₂ emissions. Stringent regulations or unclear policy focus could hamper the development of fuel savings in trucks.

4. Opinion on VECTO

Interviewees were specifically asked about their opinion on VECTO and other policy options related to reducing CO₂ emissions. Interviewees indicated concerns about the current VECTO design and suggested alternative methods to measure and reduce CO₂ emissions from trucks.

3. The five elements determining CO₂ emissions from trucks

The insights from the interviews have been categorized in five different elements of truck development (see Figure 3). From the moment where a certain transport need arises until the truck is being driven with. Every element has a certain effect on the total CO₂ emissions of a truck.

Activities	What will the truck be used for?
Truck Base	What are the fixed parts of a truck?
Options	Which fuel-saving options are installed on a truck?
Fuel	Which fuel does the truck use?
Driver	How well is the truck driven?

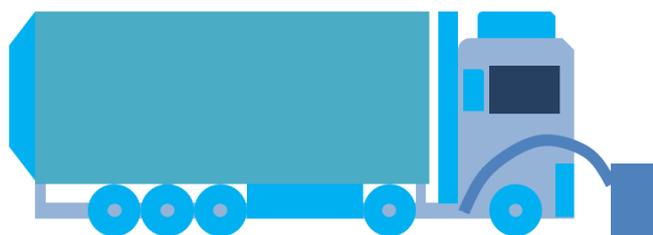


Figure 3: Shows the five elements that have a varying impacts on CO₂ emissions from trucks, which will be discussed accordingly.

Activities

In the following sections the five elements related to truck CO₂ emissions will be discussed. The first thing to consider is the truck's activities, what the truck is being used for. This is determined by the transport needs the truck needs to fulfil.

Truck & options

The intended activities of a truck will determine its design, both for its fixed/basic parts (drivetrain, gear box, cabin) as well as the need for (or the possibility of) potential add-ons (such as a roof spoiler, or driver-assisting software). This report separately discusses the fixed truck parts and potential add-ons.

Fuel

Another key element in the choice of a truck is the fuel that powers it. This chapter discusses available alternatives to diesel and what is needed for a smooth transition to (one or more) alternatives according to the dealers.

Driver

Once the truck has been purchased, it needs to be driven. This section will discuss the impact of the driver on fuel consumption.

3.1 Truck activities

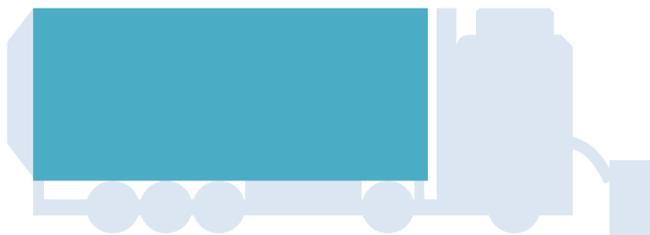
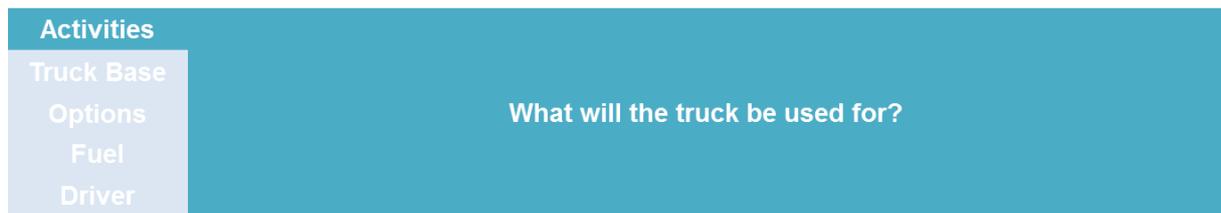


Figure 4: In this section the relation between truck activities and CO₂ impact is described.

The truck's activities have a large influence on its fuel consumption and related CO₂ emissions. Due to the wide variety of truck activities, it is not meaningful to determine an average fuel use of a truck.

For cars, the amount of CO₂ is mostly determined by the travelled distance. For trucks, many other parameters are important as will be analysed in this section. The key parameters are shown in Figure 5.

Height difference

A e.g. mountainous area requires a larger amount of fuel compared to a mostly flat road, as the truck needs more power to carry its cargo uphill.

Speed profile

The driving speed and amount of breaking and accelerating could cause a truck to use more fuel. Traffic lights and other road users in e.g. a city require trucks to alternate between breaking and accelerating.

Whether conditions

Fuel use differs with the weather type. Rain, snow and wind can cause a truck to use extra fuel in contrast to a sunny, windless day.

Weight uncertainty

The weight of a truck is an important determinant of fuel use. The issue here is that the transporter does not always get detailed information about the actual weight of the goods transported from the customer. This means that the actual weight of a 16 tonnes truck will vary between trips.

Cargo temperature

Transport of e.g. fresh food or exotic plants requires specific temperatures, which causes extra fuel use due to heating or cooling of the cargo.

Extra functions

The use of a truck for a specific goal may require extra functions: e.g. a cement mixer, or garbage sorting magnet. Operating these functions leads to increased fuel use.

The trucks activities determine the design of the truck: what basic components it should have. Besides the truck basics, buyers may opt for extra fuel-saving options.

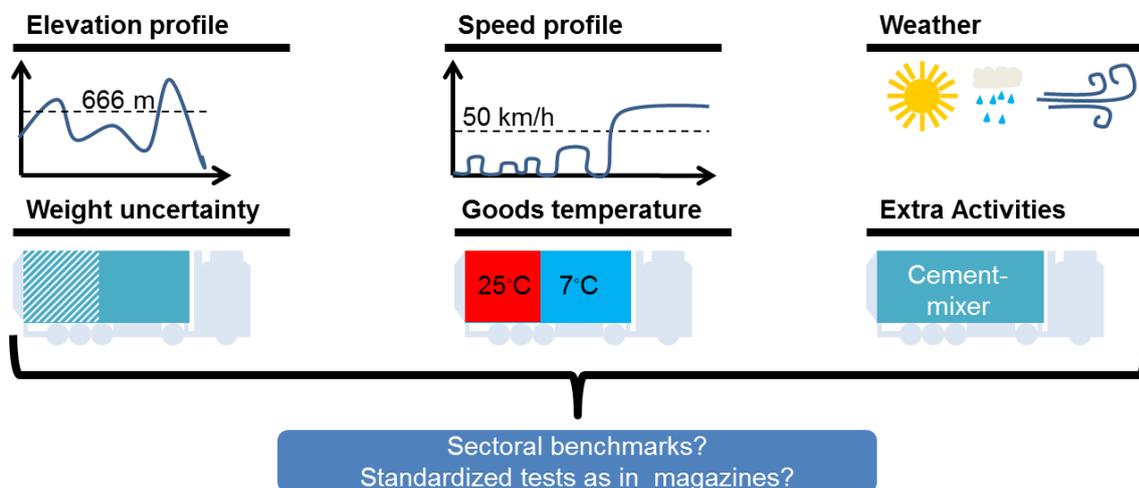


Figure 5: Shows the key parameters which impact CO₂ emissions from trucks. For national transport the elevation profile is less relevant, due to the flat landscape of the Netherlands. However, Dutch trucks also operate internationally.

Better fuel use estimation

To improve the estimation of activity related fuel use, dealers advise creating e.g. sectoral benchmarks, or using standardized tests. Specialized magazines, such as Truckstar⁷, use standardized tests to determine the most fuel-efficient truck among brands. Customers and dealers value these test very highly.

3.2 Truck base

It is important to mention that fuel-saving options in trucks fall into two categories: Options that are part of the base of the truck (drivetrain, motor, cabin, etc.) and options that are added to the truck base. This distinction is shown in Figure 6.

⁷ <https://truckstar.nl/>

Activities	<ul style="list-style-type: none"> Tractor-trailer truck or rigid truck
Truck Base	<ul style="list-style-type: none"> Anything >7,5 tonnes.
Options	<ul style="list-style-type: none"> This research focusses on >16 tonnes, 4 of 6 wheels, 2 drive axles
Fuel	<ul style="list-style-type: none"> Aerodynamic add-ons Fuel-saving tires
Driver	<ul style="list-style-type: none"> Driver assistance (Cruise control and information systems)

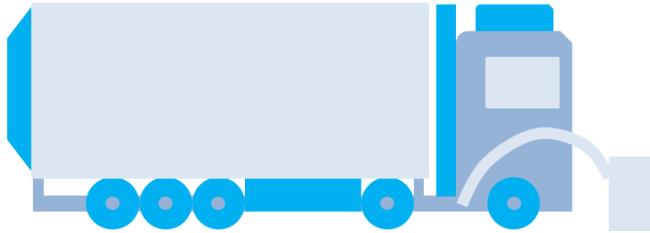


Figure 6: This study separately discusses the fuel savings due to 1) the fixed basis of a truck and 2) optional fuel-saving elements on the truck.

Truck definition

There are two major truck types:

1. Tractor-trailer trucks, where the tractor can be disconnected from the trailer. This way, a different truck can e.g. pick up the trailer from a certain place.
2. Rigid trucks, where the tractor and trailer cannot be disconnected.

A truck is called a truck when it exceeds 7,5 tonnes in weight. As such, vans weighing less than 3,5 tonnes do not classify as trucks. This research focusses on trucks above 16 tonnes with four to six wheels and two drive shafts as these type of trucks make up 50% of the trucks sold in the Netherlands.

Activities	
Truck Base	<ul style="list-style-type: none"> Tractor-trailer truck or rigid truck
Options	<ul style="list-style-type: none"> Anything >7,5 tonnes.
Fuel	<ul style="list-style-type: none"> This research focusses on >16 tonnes, 4 of 6 wheels, 2 drive axles
Driver	

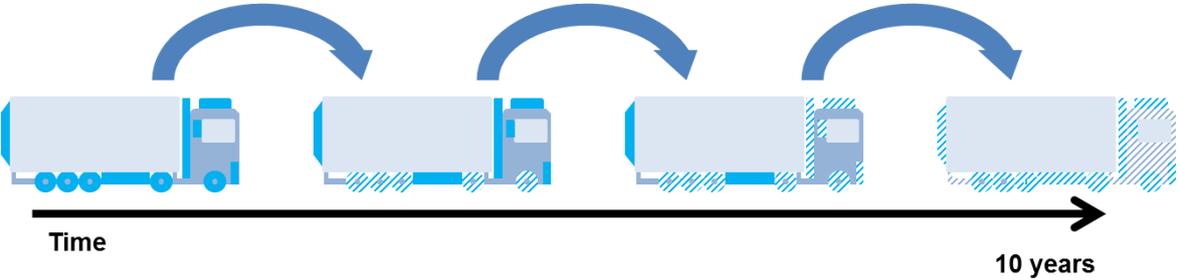


Figure 7: Shows the definition of a truck.

Fuel savings in the truck base

A relevant distinction between fuel saving options in the truck base vs fuel savings due to add-ons, is that their renewal occurs on different time scales. The basic truck components are renewed only once every ten years. Hardly any adaptations are made to e.g. the motor, cabin or gear box once a

certain line of trucks enters the market. It is therefore important to plan innovation in trucks basics very carefully. Manufacturers might resist a proposed innovation to the truck base when they just released a new truck model. Fuel-saving add-ons can be replaced and updated more easily than the truck base, but the potential fuel savings are way lower than fuels saving resulting from e.g. an updated motor.



Truck **Options**

Figure 8: The truck base is renewed only every ten years. Add-ons can be replaced or updated more quickly.

The basic truck components are determined by the activities the truck is being used for. However, the choice for fuel-saving add-ons is based on the owners preferences. That is why the next section looks more closely at two types of fuel-saving add-ons: aerodynamic add-ons and driver assistance add-ons in different truck types.

3.3 Fuel-saving add-ons in different truck types

Activities	<ul style="list-style-type: none"> • Aerodynamic add-ons • Fuel-saving tires • Driver assistance (Cruise control and information systems)
Truck Base	
Options	
Fuel Driver	



Figure 9: Shows examples of fuel-saving add-ons

Fuel-saving add-ons are options that can be added (or removed) based on the owners preference. Examples are: add-ons to reduce air resistance, fuel-saving tires, or software for advanced cruise control. This section first explains the basic, standard and top-truck. Afterwards, aerodynamic and driver-assisting fuel saving add-ons are discussed.

Three truck types

This report distinguishes between a basic, standard and top truck⁸. This distinction is based on the amount and nature of fuel-saving add-ons present on the truck. A basic truck is solely equipped with the most basic add-ons. The standard truck is equipped with the most often chosen add-ons by customers, where a top truck has the most fuel-saving options.

The truck basis is the same for all truck types, as this is determined by the truck activities. However, the sort and amount of fuel-saving add-ons determines whether this report speaks of a basic truck, standard truck or top truck.

Aerodynamic add-ons

Table 1 shows the relation between a certain truck type and the amount and sort of add-ons. At first glance, it can be observed that all the aerodynamic add-ons are present in the top truck as a sharp contrast to the other truck types. The basic and standard truck are only equipped with roof spoilers, and this does not even hold for all brands. Further research is needed to determine why certain clients choose certain add-ons.

Option	Basic	Standard	Top
Roof spoiler	For some brands	For some brands	Installed
Cabin side flaps	Not installed	For some brands	Installed
Side skirts	Not installed	Not installed	Installed
Active grill shutter	Not installed	Not installed	Installed

Installed For some brands Not installed

Table 1: Provides an overview of the adoption of the aerodynamic add-ons (as shown in Figure 8) used in different truck types: basic truck, standard (average) truck and top truck.

The location of the most commonly used⁹ aerodynamic add-ons are shown in Figure 10.

⁸ The mentioned truck types result from the Excel questionnaire developed by the parallel study from TNO, TU Graz and CE Delft.

⁹ The add-ons in Figure 8 result from the Excel questionnaire developed by the parallel study from TNO, TU Graz and CE Delft.

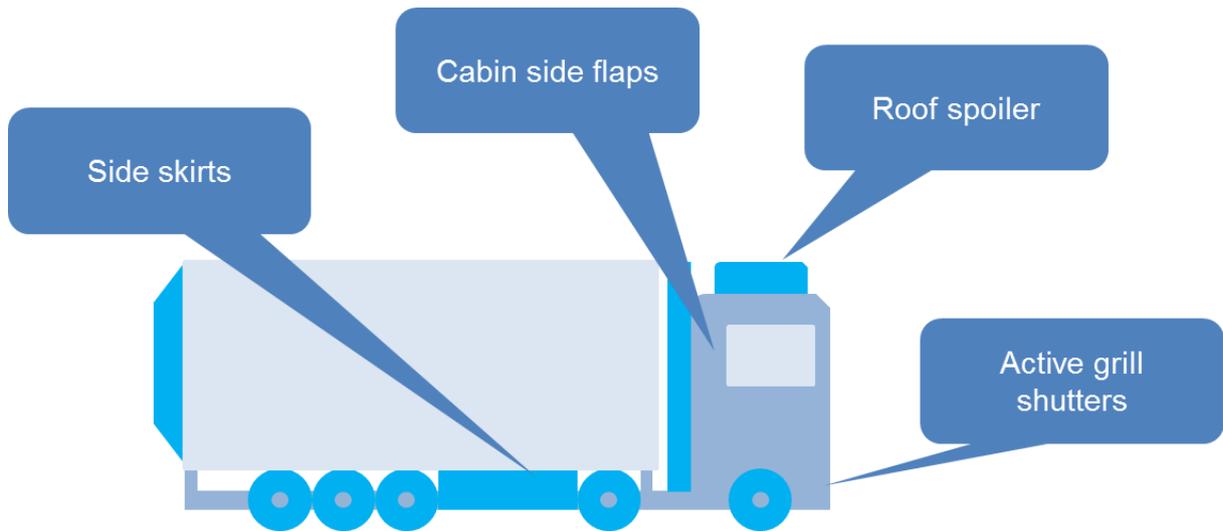


Figure 10: Locations of some more commonly used aerodynamic add-ons.

Dealers vigorously promote driver assistant add-ons, as these are in very high demand among their customers. These systems can help monitor drivers behaviour, which is important due to the influence of the driver on fuel use as will be further explained in Section 3.5.

Driver-assisting add-ons

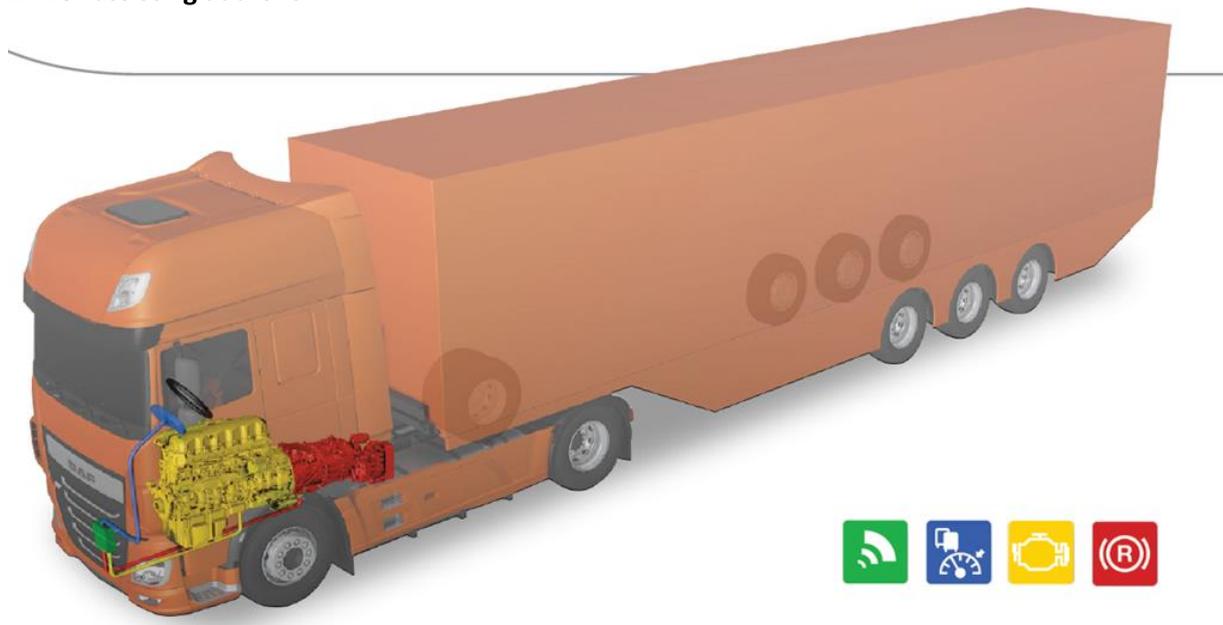


Figure 11: Shows the location of driver assisting add-ons.

Table 2 shows that driver-assisting add-ons are more common in the different truck types. In particular, monitoring software is present in every sort of truck. This is partly due to the vigorous promotion by dealers to install this kind of software. Most trucks are also equipped with tire pressure management systems, however the most commonly used variant only measures the tire pressure. Other, more advanced types- can also alter the pressure when needed. The table also shows a rather high adoption rate across truck types of adaptive cruise control.

Optie	Basic	Standard	Top
Engine start/stop	For some brands	For some brands	Installed
Eco-roll	Not installed	For some brands	Installed
Predictive Cruise Control	Not installed	Not installed	Installed
Adaptive Cruise Control	For some brands	Installed	Installed
Driver assistance software	Installed	Installed	Installed
Tire pressure management systems	Installed	Installed	Installed



Table 2: Driver assistance add-ons on the three different kinds of trucks

Longer trucks, consistent regulation

In addition to these aerodynamic and driver assistance add-ons, dealers indicate two other measures that could reduce fuel use.

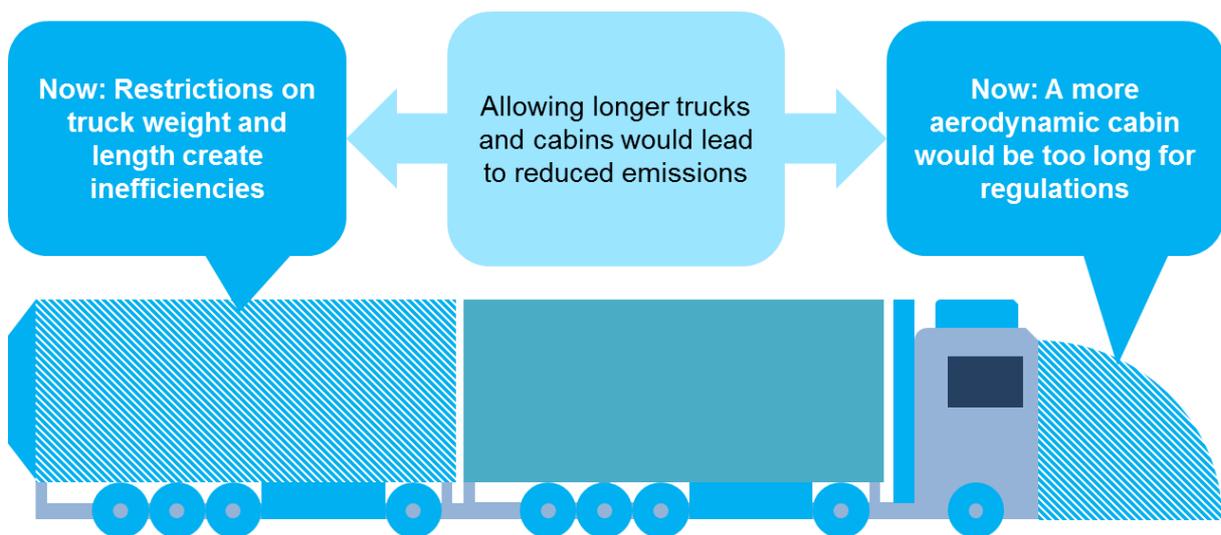


Figure 12: Shows a future, more aerodynamic cabin and increased length (and weight) of a truck (striped blue part) as opposed to the current situation.

Due to regulations¹⁰ regarding the total truck length, the design of the cabin is rather high and narrow in order to reserve as much space as possible for the trucks cargo. Easing these regulations would allow truck producers to design a more aerodynamic cabin as can be seen in Figure 12. The second fuel-saving option proposed by dealers is hampered by incoherent international regulations regarding the total weight and length of a truck. This forces fleet managers to send two trucks delivering cargo that could also be transported by one, larger truck¹⁰.

Different users, different preferences

This study also found that the interest for fuel-saving add-ons differs per user. This section elaborates on the characteristics of these users.

¹⁰ European Parliament, Weights and dimensions of road vehicles in the EU <https://epthinktank.eu/2014/04/10/weights-and-dimensions-of-road-vehicles-in-the-eu/>

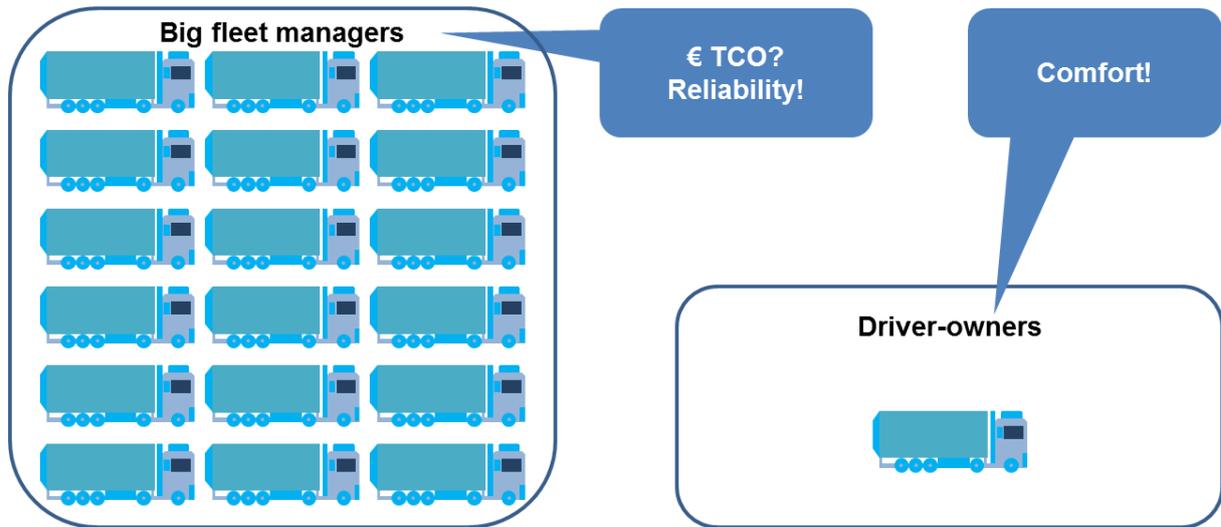


Figure 13: Shows the composition of the truck market and the different focus points of fleet owners vs. owner-operators.

The truck market is divided between large fleet operators which own up to hundreds of trucks and individual driver-owners who usually own one vehicle. These two types of customers have different preferences regarding their trucks. Large fleet owners are very much focused on reliability and achieving a low TCO (Total Cost of Ownership). (Delivery)time and financial margins are very small in the truck operating business. A difference of e.g. 1% in fuel use can amount to gaining or losing thousands of euros on a yearly basis. If a truck is in need of three days unscheduled maintenance, that truck is bound to drive at a loss for the rest of the year.

Driver-owners base their decision on more emotional considerations. The truck is like a second home: It needs to be comfortable and the look and feel needs to make the user feel proud and safe. Fuel savings generally matter less for owner operators as they feel the financial benefits are not considerable enough to justify extra investments in fuel-saving measures.

3.4 Fuel

Specific preferences also relate to the choice of fuel. This section elaborates on several alternative fuels and what determines their uptake in trucks.

Activities	<ul style="list-style-type: none"> • (Drop-in) biodiesel: Almost all trucks use diesel with a small percentage from biological sources (3%) <ul style="list-style-type: none"> • LNG: ~180 trucks on Dutch roads • CNG: ~430 trucks on Dutch roads • Electricity (short distances): Pilots and demos for urban distribution • Hydrogen: Not available at the moment
Truck Base	
Options	
Fuel	
Driver	



Figure 14: Provides an overview of alternative energy carriers currently used in trucks.

Alternative energy carriers

At this time most trucks use (drop-in) biodiesel. However, the current mix consists of about a mere 3% biodiesel¹¹. The ambition for 2020 is to increase this number to 10%. The use of (drop-in) biodiesel is more user friendly than LNG or CNG, as it requires no or minimal adjustments to the motor, whereas driving on natural gas requires a specially designed engine. Currently, about 430 of the Dutch trucks use CNG, about 180 use LNG¹². In addition to these mainly fossil based fuels, there are some pilots with all-electric trucks for deliveries within cities. Hydrogen could potentially be a suitable clean fuel, but this technology is still in the development phase.

The main reason for choosing either LNG or electricity as a main power source are lower levels of noise and local emissions of air polluting compounds, notably particle matter (PM) and nitrogen oxides (NO_x).

Uptake of alternative energy carriers

The colours in Table 3 indicate how the dealers feel about the future development and implementation of these alternatives. Green relates to a positive attitude towards the future of this fuel, yellow indicates mixed feelings red equals great uncertainty about the future of this alternative.

Dealers mainly see opportunities in the further development of biodiesel and natural gas, which are widely available at the moment, and are more sceptical towards electricity and hydrogen.

¹¹ CBS Statline, 2015.

¹² TNO, Truck van de toekomst.

Answers interviewees	LNG/CNG	(Drop-in) bio	Electric	Hydrogen
	Expected to be big		Short distance /light vehicles	Far future
	Is still fossil	Readily available	Unrealistic	The EU lags behind NA
	Not the future		Hybrids first, for last km	
	Only in Italy and NL	Current focus	For urban distribution	Maybe for long distances
	R&D, pilots, and deployment varies per country			

Positive opinion	Mixed opinion	Negative opinion
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Table 3: shows the combined opinions of dealers related to the expected uptake of the alternative energy carriers.

The insights shown in Table 3 are based in more general, strategic considerations. However, this study has also found a number of more practical issues related to the development of alternative fuels.

All dealers indicate that they are open to alternatives if they can compete with fossil fuels on price, availability and performance. In the overview shown in Table 4, it can be observed that often improvements need to be made regarding at least one of these aspects.

One of the objections related to the use of natural gas are issues regarding its availability, due to rather sudden temporarily closures of fuelling stations. Drivers also need to obtain a special fuelling license to take in LNG or CNG.

A problem related to biodiesel is the increased price due to the amount of biofuels in the mix, as the production of biofuels is expensive.

Fuel	Price	Availability	Performance
LNG/CNG	Lower efficiency than diesel, but as efficient models are coming.	Stations somethings closed Special permit required to fuel	
(Drop-in) biodiesel	Twice as expensive as diesel at the moment	Can be used in current trucks	Drop-in is identical to diesel
Electric	Trucks too expensive	Issues charging infrastructure are too complex Trucks available in some segments	Limited to short distances/small segments
Hydrogen	Not profitable in the coming years	Europe is far behind North America, Is for the far future	

Positive opinion	Mixed opinion	Negative opinion
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Table 4: Shows combined opinions of dealers regarding barriers for transitioning to alternative energy carriers.

Demand for clear and consistent policy

Even though dealers seem more favourable towards biodiesel and LNG/CNG, the dealers are not unanimous in their opinions as is shown in Table 3 and Table 4. Dealers develop pilot programs

and demonstration projects for a variety in alternatives, including electricity and hydrogen. The broad focus on multiple alternatives is mainly due to unclear (inter)national policy on alternative fuels.

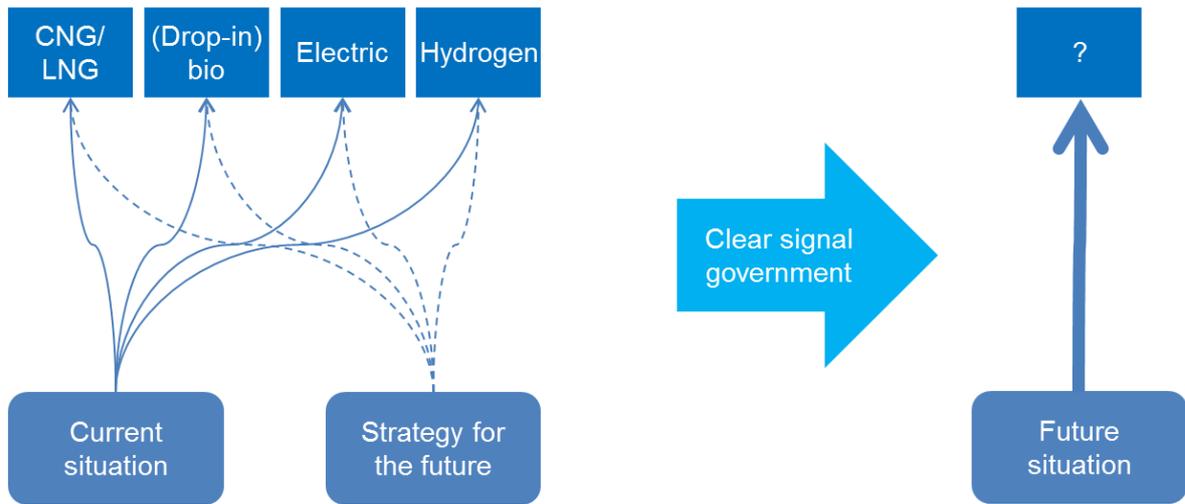


Figure 15: Shows the current strategy of dealers: developing pilots and (research) projects for multiple alternative energy carriers, and a possible future situation where dealers focus on one alternative energy carrier.

As there is no clear, unambiguous international policy related to alternative fuels, dealers spread their bets: they develop multiple alternatives to be prepared for different future scenarios as can be seen Figure 15.

A clear governmental focus on developing a specific alternative will encourage dealers to adopt a similar focus. This will also stimulate other stakeholder e.g. fuel suppliers to invest in this type of fuel in order to increase availability and a decrease in price.

3.5 Driver behaviour

Whatever fuel is chosen, in the end fuel use is largely dependent on the truck driver. That is why the last section of this report discusses driver behaviour.



Figure 16: It is important to analyse how the truck is being driven as the driving behaviour has a large influence on fuel use.

The dealers indicate that fuel use can differ up to 25%, depending on the driver behaviour. The development of driver-assisting software, such as adaptive cruise control and eco-roll is driven by the desire to reduce the drivers impact on fuel use. Even though these systems are useful, further development is needed to optimize their performance.

Currently, drivers can switch off driver assistant software as they please. For example, they may shut down these systems because they think that they are time-consuming. As has been discussed, time margins are very limited. A truck driver may choose to drive faster than the cruise control speed to save time.

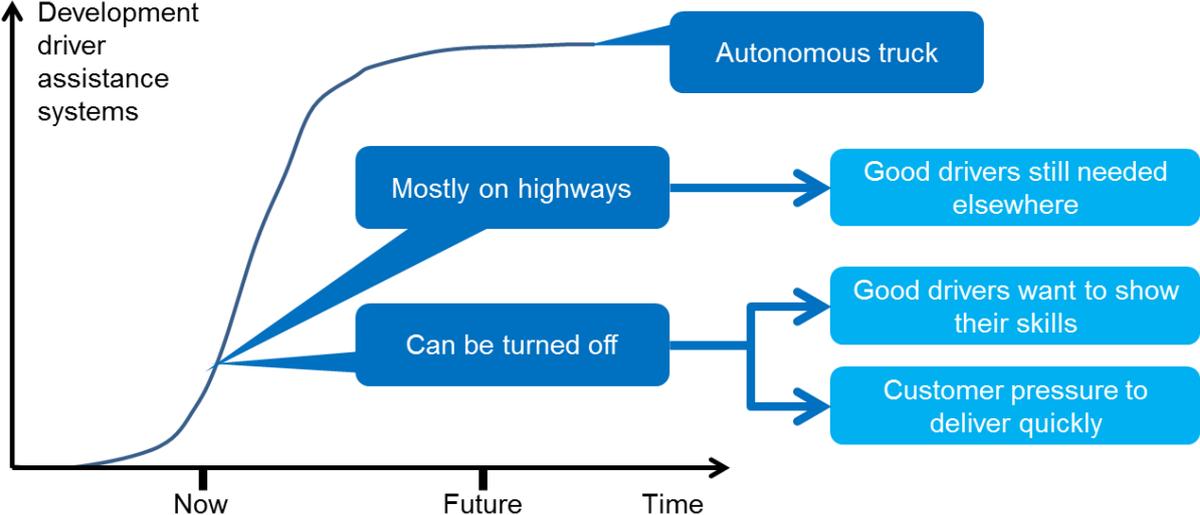


Figure 17: Shows the current obstacles related to the efficient use of driver-assisting systems.

Another relevant factor is the enjoyment of driving a truck. Drivers enjoy the feeling of actually driving the truck themselves, the want to feel in control of its movements. The adoption of more driver assistant software has made the actual driving a lot less interesting. As a consequence, less qualified drivers apply for jobs as skilled drivers lose interest in driving a semi-automatic truck. At the moment the use of driver assistant systems is limited to highways. As drivers become less qualified this can lead to an increase in accidents or reduced efficiency on other types of roads.

It is therefore important for the drivers to get used to this software and to stimulate them to make use of these systems.

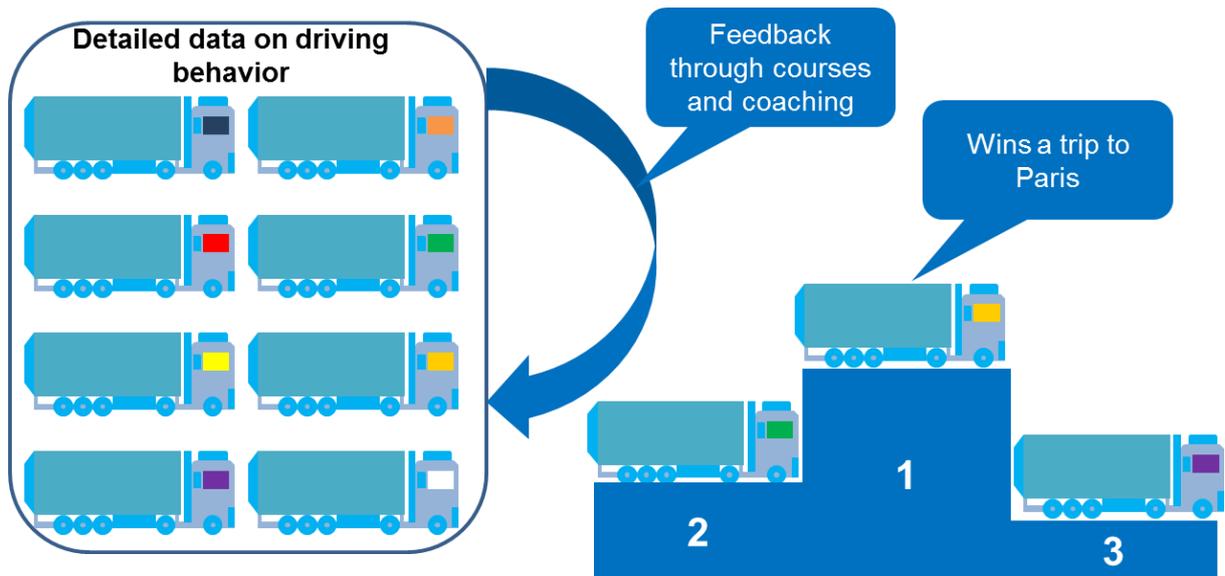
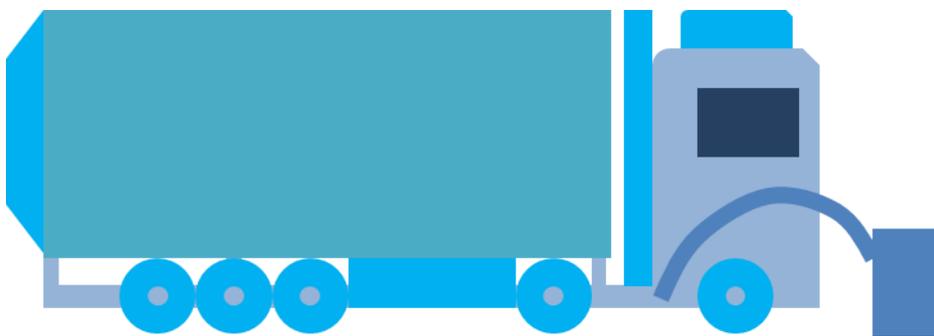


Figure 18: Shows different incentives of increasing the use of drivers-assisting systems.

The usage of driver-assisting systems can be increased by implementing monitoring systems, where data on the drivers behaviour is recorded and can be shared with the drivers superiors. Monitoring systems create the possibility to confront drivers with fuel-inefficient driving behaviour, which can result in extra training or courses. A different way of encouraging the use of these systems is organizing competitions among drivers, where the most fuel efficient driver is rewarded.

4. Conclusions



Our study has successively discussed the trucks activities, parts and add-ons, fuel types and the driver itself in relation to their different impact on CO₂ emissions. The analysis has led to three main conclusions. The first conclusion is related to the development of EC norm for CO₂ in new trucks. The second to the VECTO input data. The last conclusion reveals the most influential factors on fuel use.

1. There are some driver assistance add-ons in most trucks. Aerodynamic add-ons are less common

Most trucks have driver-monitoring systems and some form of tire-pressure management. It is more difficult to draw generic conclusions on the implementation of aerodynamic add-ons. Roof spoilers are most commonly used, but not present in all truck types. This means that in the process of setting a norm, a minimum requirement for a truck could be to have installed the mentioned driver assistance add-ons and perhaps a roof spoiler.

Activities	CO ₂ savings not visible in VECTO
Truck Base	CO ₂ savings visible in VECTO
Options	CO ₂ savings visible in VECTO
Fuel	CO ₂ savings visible in VECTO
Driver	CO ₂ savings not visible in VECTO

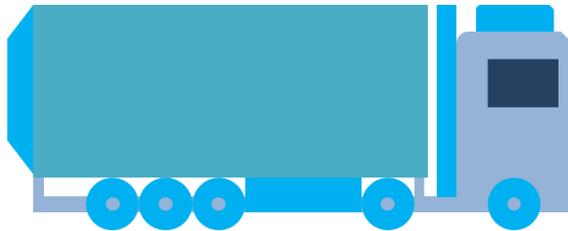


Figure 19: first conclusion, not all CO₂ savings are visible in VECTO.

2. VECTO does not always take into account fuel saving add-ons and (currently) does not consider specific (changes in) activity management and driver performance input

In the current proposition of the EC, manufacturers will have to report the fuel use, CO₂ emissions etc., of every new truck they produce using VECTO. In 2018 the EC will propose an accompanying CO₂ norm, which will incentivize manufacturers to develop more fuel-efficient trucks, to avoid non-compliance fines. However, the interviewees indicate that the main determinants of a truck CO₂ emissions fall outside the (current) scope of VECTO. This can lead to differences between the simulated emissions and actual emissions of a truck.

a) Fuel savings add-ons are not always included in VECTO

The manufacturers that produce the truck base, are not always responsible for installing fuel-saving add-ons. Clients may choose to order side-skirts, or driver-assistant software from a third party. This means that even though the final truck may own several fuel-saving options, this will not turn up in the VECTO-report, because the manufacturer is not the party who has installed them.

b) A CO₂ norm based solely on VECTO (in its current state) would not reflect an effective or fair policy

VECTO assumes data averages for both the truck activities and the driver behaviour even though these two components can vary widely. This means that if a truck owner has invested in a more energy-efficient cooling system for e.g. transporting fruit, this results in less emitted emissions due to fuel savings. However, despite a decrease in actual emissions, the VECTO report does not show this change as it assumes an average for all truck activities (a standard box truck without cargo cooling).

The same holds for changes in the driving behavior. If a driver decreases its trucks fuel use due to, e.g., extra training of drivers, this results in lower actual CO₂ emissions, while the (theoretical) emissions reported in the VECTO report stay the same. In contrast: VECTO does allow specific input based on the trucks characteristics. If a new engine is installed, or a manufacturer replaces tires for more efficient ones, these changes will appear in the VECTO report.

According to the interviewees this means VECTO is not an accurate reflection of a trucks emissions. Two vehicle operators may purchase the same type VECTO category truck but use it for very different activities or have different driver behaviors. Even though the actual emissions may be very different, this will not be flagged by the VECTO output.

Dealers feel that policy makers should consider the impact of drivers and activities as these aspects are important determinants of the total truck emissions as can be seen in Figure 20. As these impacts occur after the manufacturing process, activity and driver related emissions will not show up on the VECTO reports from the manufacturers. The EC may propose a fuel tax to also encourage fuel-efficient driving with truck users. However, it is stressed by the interviewees that a flat fuel tax would be very unfair. Due to the large differences in activities fuel use may differ a lot, even with a fuel-efficient driver behind the wheel. Truckers who deliver frozen foods, drive through mountainous terrain or have to brake and accelerate a lot will have a different fuel use then trucks with less challenging cargo/routes. Interviewees therefore advise to create specific benchmarks e.g. per activity.

3. According to dealers, activities and drivers have the most impact on CO₂ emissions

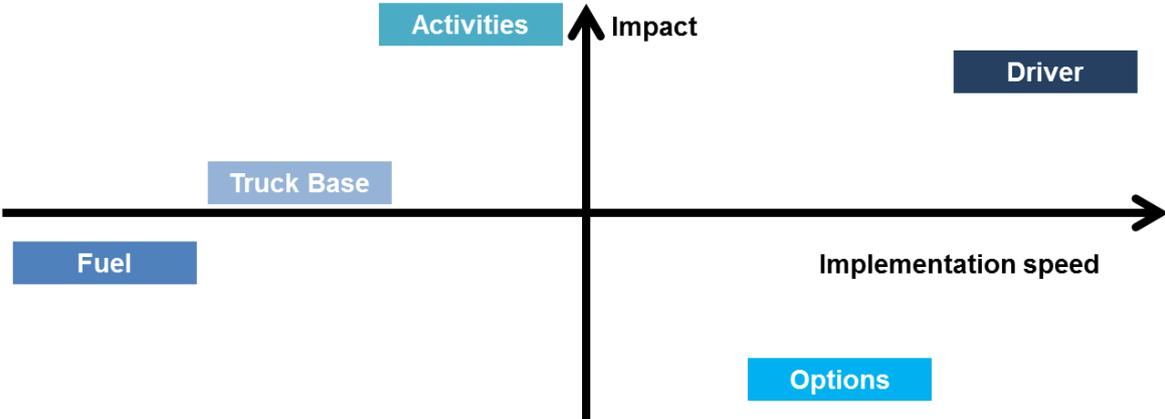


Figure 20: According to dealers, activities and drivers have the most impact on CO₂ emissions.

Figure 20 shows the ranking of the five components related to their level of impact on CO₂ emissions from trucks. It shows the actual impact as well as how long it takes to change the impact (implementation speed). Figure 20 shows that activities and drivers are the most influential, it also shows that the drivers impact can more easily be altered than the trucks activities. This is because it is difficult to change the core business of a company. Fuel saving add-ons can be implemented and changed rather fast, but their impact on CO₂ reduction remains quite low compared to the other four components. The truck basics are difficult to adjust. Alternative fuels take the longest time to change and develop.

References

CBS Statline, 2015

- 1) <http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=71456NED&D1=10-11&D2=l&D3=a&HDR=G1,G2&STB=T&VW=T>
- 2) <http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=80101ned&D1=8&D2=1&D3=44-53,70,87,104,121,138,155,172,189,206,223,240,257,274,291,308,318,325,330-332,334-335&HDR=G1,G2&STB=T&VW=T>

European Commission: Low-emission mobility strategy

<http://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX:52016DC0501>

European Commission: Reducing CO₂ emissions from HDV

https://ec.europa.eu/clima/policies/transport/vehicles/heavy_en

European Parliament, Weights and dimensions of road vehicles in the EU

<https://epthinktank.eu/2014/04/10/weights-and-dimensions-of-road-vehicles-in-the-eu/>

National Energy Outlook (NEO)

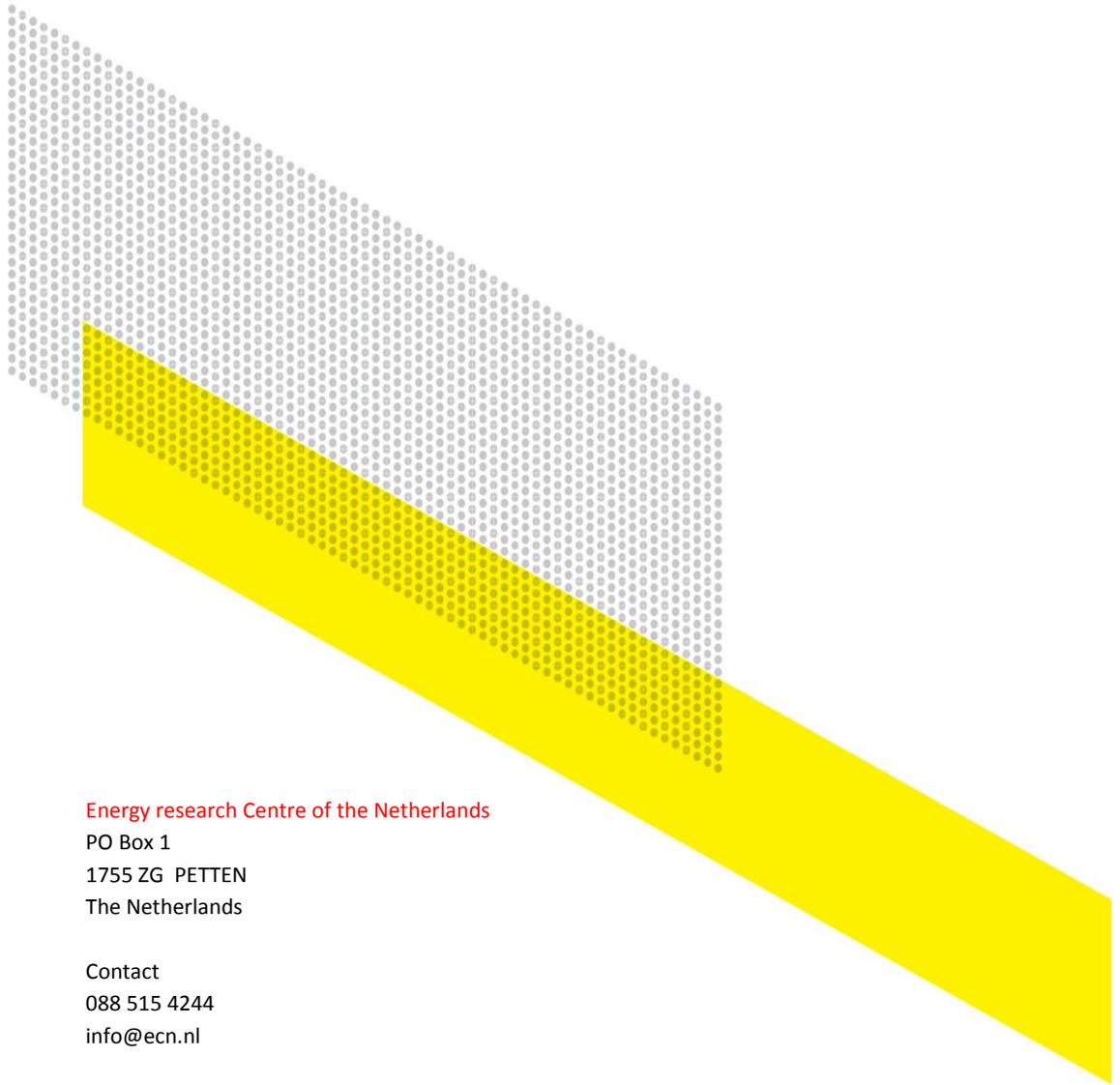
<https://www.ecn.nl/publicaties/ECN-O--17-018>

TNO, Truck van de toekomst

https://www.tno.nl/media/6767/truck_van_de_toekomst_brandstofbesparing_en_co2-reductie_anno_2016.pdf

Truckstar

<https://truckstar.nl/>



Energy research Centre of the Netherlands

PO Box 1
1755 ZG PETTEN
The Netherlands

Contact
088 515 4244
info@ecn.nl

www.ecn.nl