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Revision of the EU Green Public Procurement Criteria for Transport

Technical report and criteria proposal

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Contents

Abstract

Public authorities' expenditures in the purchase of goods, services and works (excluding utilities and defence) constitute approximately 14% of the overall Gross Domestic Product (GDP) in Europe, accounting for roughly EUR 1.8 trillion annually.

Thus, public procurement has the potential to provide significant leverage in seeking to influence the market and to achieve environmental improvements in the public sector. This effect can be particularly significant for goods, services and works (referred to collectively as products) that account for a high share of public purchasing combined with the substantial improvement potential for environmental performance. The European Commission has identified (road) transport as one such product group.

Road transport covers a wide scope of vehicles (cars, LCVs, L-category vehicles, buses and waste collection vehicles) and services (mobility services, public bus services, waste collection services and post and courier services). The main environmental issues at the use phase addressed by the criteria are GHG emissions, air pollutant emissions and noise emissions. The impacts from the manufacture of batteries used in electric vehicle are also considered, leading to criteria on minimum and extended warranty of batteries.

This revision has coincided with the evaluation of the Clean Vehicle Directive and the introduction of new test procedures to measure CO_2 and air pollutant emissions of vehicles (WLTP, Real Driving Emissions in Euro 6). All these policies have been taken into account in the revision process of the EU GPP criteria for transport, to ensure a full harmonisation of the EU policies.

Acknowledgements

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1 Introduction

1.1 Green public procurement

Public authorities' expenditures in the purchase of goods, services and works (excluding utilities and defence) constitute approximately 14% of the overall Gross Domestic Product (GDP) in Europe, accounting for roughly EUR 1.8 trillion annually (European Commission, 2016).

Thus, public procurement has the potential to provide significant leverage in seeking to influence the market and to achieve environmental improvements in the public sector. This effect can be particularly significant for goods, services and works (referred to collectively as products) that account for a high share of public purchasing combined with the substantial improvement potential for environmental performance. The European Commission has identified (road) transport as one such product group.

Green Public Procurement (GPP) is defined in the Commission's Communication "COM (2008) 400 - Public procurement for a better environment" as "a process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when compared to goods, services and works with the same primary function that would otherwise be procured."

Therefore, by choosing to purchase products with lower environmental impacts, public authorities can make an important contribution to reducing the direct environmental impact resulting from their activities. Moreover, by promoting and using GPP, public authorities can provide industry with real incentives for developing green technologies and products. In some sectors, public purchasers command a large share of the market (e.g. public transport and construction, health services and education) and so their decisions have considerable impact. In fact, in the above mentioned Commission's communication the capability that public procurement has to shape production and consumption trends, increase demand for "greener" products and services and provide incentives for companies to develop environmental friendly technologies is clearly emphasised.

EU GPP is a voluntary instrument, meaning that Member States and public authorities can determine the extent to which they implement it.

The development of EU GPP criteria aims to help public authorities ensure that the goods, services and works they require are procured and executed in a way that reduces their associated environmental impacts. The criteria are thus formulated in such a way that they can be, if deemed appropriate by the individual authority, integrated into its tender documents with minimal editing.

GPP criteria are to be understood as being part of the procurement process and must conform to its standard format and rules as laid out by Public Procurement Directive 2014/24/EU (public works, supply and service contracts). Hence, EU GPP criteria must comply with the guiding principles of: Free movement of goods and services and freedom of establishment; Non-discrimination and equal treatment; Transparency; Proportionality and Mutual recognition. GPP criteria must be verifiable and it should be formulated either as Selection criteria, Technical specifications, Award criteria or Contract performance clauses, which can be understood as follows:

Selection Criteria (SC): Selection criteria refer to the tenderer, *i.e.*, the company tendering for the contract, and not to the product being procured. It may relate to suitability to pursue the professional activity, economic and financial standing and technical and professional ability and may- for services and works contracts - ask specifically about their ability to apply environmental management measures when carrying out the contract.

Technical Specifications (TS): Technical specifications constitute minimum compliance requirements that must be met by all tenders. It must be linked to the contract's subject matter (the 'subject matter' of a contract is about what good, service or work is intended to be procured. It can consist in a description of the product, but can also take the form of a functional or performance based definition) and must not concern general corporate practices but only characteristics specific to the product being procured. Link to the subject matter can concern any stage of the product's life-cycle, including its supply-chain, even if not obvious in the final product, *i.e.*, not part of the material substance of the product. Offers not complying with the technical specifications must be rejected. Technical specifications are not scored for award purposes; they are strictly pass/fail requirements.

Award Criteria (AC): At the award stage, the contracting authority evaluates the quality of the tenders and compares costs. Contracts are awarded on the basis of most economically advantageous tender (MEAT). MEAT includes a cost element and a wide range of other factors that may influence the value of a tender from the point of view of the contracting authority including environmental aspects (European Commission, 2016). Everything that is evaluated and scored for award purposes is an award criterion. These may refer to characteristics of goods or to the way in which services or works will be performed (in this case they cannot be verified at the award stage since they refer to future events. Therefore, in this case, the criteria are to be understood as commitments to carry out services or works in a specific way and should be monitored/verified during the execution of the contract via a contract performance clause). As technical specifications, also award criteria must be linked to the contract's subject matter and must not concern general corporate practices but only characteristics specific to the product being procured. Link to the subject matter can concern any stage of the product's life-cycle, including its supply-chain, even if not obvious in the final product, *i.e.*, not part of the material substance of the product. Award criteria can be used to stimulate additional environmental performance without being mandatory and, therefore, without foreclosing the market for products not reaching the proposed level of performance.

Contract Performance Clauses (CPC): Contract performance clauses are used to specify how a contract must be carried out. As technical specifications and award criteria, also contract performance clauses must be linked to the contract's subject matter and must not concern general corporate practices but only those specific to the product being procured. Link to the subject matter can concern any stage of the product's life-cycle, including its supply-chain, even if not obvious in the final product, *i.e.*, not part of the material substance of the product. The economic operator may not be requested to prove compliance with the contract performance clauses during the procurement procedure. Contract performance clauses are not scored for award purposes. Compliance with contract performance clauses should be monitored during the execution of the contract, therefore after it has been awarded. It may be linked to penalties or bonuses under the contract in order to ensure compliance.

For each criterion there is a choice between two levels of environmental ambition, which the contracting authority can choose from according to its particular goals and/or constraints:

The **Core criteria** are designed to allow easy application of GPP, focussing on the key areas of environmental performance of a product and aimed at keeping administrative costs for companies to a minimum.

The **Comprehensive criteria** take into account more aspects or higher levels of environmental performance, for use by authorities that want to go further in supporting environmental and innovation goals.

As said before, the development of EU GPP criteria aims to help public authorities ensure that the goods, services and works they require are procured and executed in

a way that reduces their associated environmental impacts and is focused on the products' most significant improvement areas, resulting from the cross-check between the key environmental hot-spots and market analysis. This development also requires an understanding of commonly used procurement practices and processes and the taking on board of learnings from the actors involved in successfully fulfilling contracts.

For this reason, the European Commission has developed a process aimed at bringing together both technical and procurement experts to collate a broad body of evidence and to develop, in a consensus oriented manner, a proposal for precise and verifiable criteria that can be used to procure products with a reduced environmental impact.

A detailed environmental and market analysis, as well as an assessment of potential improvement areas, were conducted within the framework of this project and presented in the Preliminary Report on EU Green Public Procurement Criteria for Transport. This report can be publicly accessed at the JRC website for Transport (http://susproc.jrc.ec.europa.eu/Transport/index.html). The main findings presented in the Preliminary Report are summarised in the next chapter.

Based on the findings resulting from the Preliminary phase, a first draft of the Technical report and criteria proposal was produced and presented at the 1st ad-hoc working group meeting held in Seville on 23rd November 2016. Apart from the comments received at this meeting, written feedback was conveyed by means of a written consultation. A second draft of the Technical report and criteria proposal was produced taking into account the input received in the course of this consultation process. A second ad-hoc working group meeting was organised by means of four interactive webinars during June 2017, together with a period of written consultation. The feedback received from the stakeholders was taken into account in the third draft of the Technical report and criteria proposal. A final written consultation of the third draft was carried out as the last opportunity for stakeholders to provide their comments. The details of the stakeholders consultation process, and the interim drafts can be consulted at http://susproc.jrc.ec.europa.eu/Transport/documents.html

2 Summary of the preliminary report

2.1 Scope and definitions

The first stage of the revision of the EU GPP criteria for transport was to revise the scope of the 2012 criteria (European Commission, 2012), i.e. the product groups covered by the criteria, and the definition of these product groups. This was informed by:

- An overview of existing legislation, standards and criteria. This included a review of relevant EU legislation, a review of national GPP criteria and relevant labels and a review of relevant standards and guidelines used by the private sector. These reviews were also used to inform the proposals for the revision of the criteria themselves, as presented in Sections 3 to 8 of this report.
- A review of potential definitions. This provided an overview of the statistical and technical categories, such as those in EU legislation, including the Common Procurement Vocabulary (CPV) codes, which could be used to define different product groups for the revised EU GPP criteria.
- A stakeholder survey. This asked stakeholders for their views on the scope of the 2012 criteria and the possible statistical or technical category that might be used to define the respective product groups. The survey also asked stakeholders for their views on revising the criteria, which was used to inform the proposals presented in Sections 3 to 8 of this report.

The 2012 EU GPP criteria for transport covered five products groups, i.e.:

- Passenger cars and light commercial vehicles (LCVs): Purchase or lease.
- Public transport vehicles (buses): Purchase or lease.
- Public transport services: Provision of bus services.
- Waste collection trucks: Purchase or lease.
- Waste collection services: Provision of waste collection services.

On the basis of the information reviewed and the feedback from stakeholders, it was concluded that these five product categories should be retained for the revised criteria, and that two additional product groups should be added.

For all five product categories in the 2012 criteria, no change of their coverage or definitions is needed, although the titles of the two 'public transport' product groups have been amended to explicitly refer to 'buses', as that is their focus rather than on rail-based public transport, for example.

It was concluded that the following definitions would be appropriate for each of these product groups:

1) 'Purchase, lease or rental of cars, light commercial vehicles (LCVs) and L-category vehicles':

The information available regarding short term renting services shows that these services offer very young vehicles, which are usually below one year old. Therefore, renting services are proposed to be part of category 1.

- 'Cars and LCVs': M_1 and N_1 vehicles, as defined by Directive 2007/46;
- 'L-category' vehicles as defined by Regulation 168/2013.

2) 'Mobility services':

It is proposed a new service category covering mobility services involving buses, cars, LCVs and L-category vehicles. As part of these criteria, the following definitions might be applied:

- 'Special-purpose road passenger-transport services' as covered by common procurement vocabulary (CPV) code 60130000-8

- 'Non-scheduled passenger transport' as covered by CPV code 60140000-1. This should cover contracted public transport services (public transport contracted out to taxi companies, i.e. transport carried out for pupils/students who are not able to travel by themselves).
- 'Hire of buses and coaches with driver' as covered by CPV code 60172000-3
- 'Taxi services' as covered by CPV code 60120000-5.
- 'Car sharing': in this category, an organisation owns the vehicles and the platform. It is usually more standardised and reliable than the peer services, and some carmakers have an associated car sharing company.
- 'Combined mobility services' (CMS): services based on a new business model that offer a wide range of combined mobility options and offer it to users based on subscription and unified invoicing, possibly also with the services offered as packages adapted to the customer's needs, for example, a package of the trips usually done along the week. CMS are supported by some form of digital interface for the customer (app, web-based service etc.).
- 'Cycles': bicycles (CPV codes 34430000-0 and 34431000-7), cycle trailers, electrically power-assisted cycles (CPV code 34420000-7),
- 'Light electric vehicles and self-balancing vehicles' whose specific definitions are under development by CEN/TC 354 /WG 4.
- Definitions of cars, LCVs, L-category vehicles and buses also apply to this category

Following the recommendation of a contracting authority, special-purpose bus services and non-scheduled bus services have been included in the scope of 'mobility services', since they are operated similarly and some services are provided using both cars and buses depending on the needs of the passengers in each occasion.

3) 'Purchase or lease of buses':

- 'M_2 and M_3 vehicles, as defined by Directive 2007/46.
    - Category M_2: vehicles designed and constructed for the carriage of passengers, comprising more than eight seats in addition to the driver's seat, and having a maximum mass not exceeding 5 tonnes.
    - Category M_3: vehicles designed and constructed for the carriage of passengers, comprising more than eight seats in addition to the driver's seat, and having a maximum mass exceeding 5 tonnes

Further definitions have been identified in the Consolidated Resolution on the Construction of Vehicles developed by the UNECE (UNECE, 2014)

For vehicles having a capacity exceeding 22 passengers in addition to the driver, there are three classes of vehicles:

- "Class I": vehicles constructed with areas for standing passengers, to allow frequent passenger movement.
- "Class II": vehicles constructed principally for the carriage of seated passengers, and designed to allow the carriage of standing passengers in the gangway and/or in an area which does not exceed the space provided for two double seats.
- "Class III": vehicles constructed exclusively for the carriage of seated passengers.

For vehicles having a capacity not exceeding 22 passengers in addition to the driver, there are two classes of vehicles:

- "Class A": vehicles designed to carry standing passengers; a vehicle of this class has seats and must have provisions for standing passengers.
- "Class B": vehicles not designed to carry standing passengers; a vehicle of this class has no provision for standing passengers.

- Other definitions relevant were found in the UNECE resolution:

- "Articulated bus or coach" is a vehicle which consists of two or more rigid sections which articulate relative to one another; the passengers compartments of each section intercommunicate so that passengers can move freely between them; the rigid sections are permanently connected so that they can only be separated by an operation involving facilities which are normally only found in workshop.
- Articulated buses or coaches comprising two or more non-separable but articulated units must be considered as single vehicles.

The definition of the categories 4), 5), 6) and 7) would also make reference to the definitions of categories 1) , 2) and 3), where relevant, but also to CPV categories, as appropriate, i.e.:

4) 'Bus services':

- 'Bus services' or 'Public transport services': the services should be defined as those covered by CPV codes 60112000-6 (Public road transport services).

It is worth noting that these three CPV categories refer directly to the definition of public transport services in the public procurement Directives with the explicit exception of rail public transport services.

5) 'Waste collection trucks':

- Vehicles of category N_2 and N_3, as defined by Directive 2007/46, that are designed to provide services that fall into the CPV categories of 'Refuse collection services' (CPV code: 90511000-2) and 'Refuse transport services' (90512000-9).

6) 'Waste collection services':

- Services that fall into the CPV categories of 'Refuse collection services' (90511000-2) and 'Refuse transport services' (90512000-9)

7) 'Post, courier and moving services':

- Services that fall into the CPV categories for various postal, courier and moving services:
  - Group 641 Post and courier services, with the exception of rail, airmail and mail transport over water
  - 79613000-4 Employee relocation services
  - 63100000-0 Cargo handling and storage services
  - 98392000-7 Relocation services

As part of the revision process, it was recommended to add two categories.

The first category that should be added is **'Mobility services'**. This product group concerns all kinds of services for mobility of public authorities' staff with vehicles that are (partly) driven by others, including different transport modes, as well as car sharing concessions. This includes for example taxi services but also broader mobility service packages as offered by some more advanced lease companies. Such packages can include access to cars or LCVs, but also 'L-category' vehicles (i.e. two-, three- and small four-wheeled vehicles), bicycles and cargo bikes, as well as access to car-sharing schemes, public transport cards or multi-modal transport cards, etc. One of the differences with the first category (purchase, lease or rental of cars, LCVs and L-category vehicles) is that this new category does not only include vehicles driven by public staff or elected representatives, but also driven by others, as for example taxi services. Another important difference is that the provision of mobility services involves the use of a service fleet.

For a better understanding of the mobility services or 'Mobility as a service' (MaaS) concept, the following definitions will be used in this report (Holmberg, et al., 2016):

- Simplified car ownership: it offers their customers to share the ownership of a car with other users.
- Peer transport services: it leverages the excess of capacity (empty seats during a trip) and shares it with users. The MaaS provider does not own the vehicles; it only provides the platform for the pairing. The main example is Uber.
- Car sharing: in this category, an organisation owns the vehicles and the platform. It is usually more standardised and reliable than the peer services, and some carmakers have an associated car sharing company.
- Extended multimodal planners: they combine all the available transport options with real time transport data in order to help users plan the most efficient route to their destination. Some services can go beyond just planning by allowing you to purchase the necessary tickets for the suggest route.
- Combined mobility services (CMS); services based on a new business model such as UbiGo and MaaS.fi that offer a wide range of combined mobility options and offer it to users based on subscription and unified invoicing, possibly also with the services offered as packages adapted to the customer's needs, for example, a package of the trips usually done along the week. CMS are supported by some form of digital interface for the customer (app, web based service etc.).
- Integrated public transport systems: they aim at designing public transport in a way that it can easily integrate other mobility offers (e.g. car sharing, bike sharing, taxis, etc.). In Austria, the SMILE-project 4 2014-2015, aimed to include public transport, urban mobility services and national railway in the same concept offering planning options and ability to book and obtain tickets in the same app without subscription or packaging.
- Mobility broker: this concept also offers mobility subscriptions but these services go one step further in that mobility is offered as part of the house rent. This demands that mobility services be included in the initial planning process of apartment complexes or city areas. The drive for such services is to enable densification of cities without the need of a personal car. The Vinnova financed project "Dencity" aims at delivering a working concept for a Mobility Broker in Frihamnen, Gothenburg.

The scope proposal would cover those services that could be purchased by a public procurer using a tendering procedure. This would rule out peer transport services, extended multimodal planners and integrated public transport systems. Therefore, the category would include taxi services, car sharing and combined mobility services.

The second category that should be added is **'post, courier and moving services'**. This was supported by those that responded to the stakeholder survey, while criteria for all of these services already exist in the Dutch GPP criteria. These services should also be defined with reference to the relevant CPV categories, i.e.:

- 'Post and courier services': Group 641 Post and courier services, with the exception of rail, airmail and mail transport over water, and 63100000-0 Cargo handling and storage services.
- 'Moving services': 79613000-4 Employee relocation services and 98392000-7 Relocation services.

In summary, the product groups covered by this report, in Sections 3 to 8, respectively, are:

- Purchase, lease or rental of cars, LCVs and L-category vehicles.
- Provision of mobility services.

- Purchase or lease of buses.
- Provision of public bus services.
- Purchase or lease of waste collection trucks.
- Provision of waste collection services.
- Provision of post, courier and moving services.

2.2 Market analysis

The size of the overall markets for the vehicles and services in the product groups covered by the revised EU GPP criteria, and the proportion of these markets that might be procured by the public sector, are summarised in Table 1. Of these figures, those for the size of the car and LCV market are most certain, as these are based on industry figures (ACEA, 2016), while the size of the post and courier market comes from a dedicated report. The other figures included in Table 1 are estimates for the EU, based on information for a small number of countries, or even a single EU Member State. For 'services' in particular, it was challenging to identify the scale of the EU market, and in many cases it was not possible to identify relevant information.

Table 1: The size of the respective markets and the role of the public sector in these

Vehicle/service	**Size of the EU market**	**Proportion of which is operated/purchased by the public sector (estimates)**
Passenger cars[1)]	15.6 million vehicles (new registrations 2017)	3.4% (530 000 vehicles)
Light commercial vehicles[1)]	2.1 million vehicles (new registrations 2017)	2.8% (59 000 vehicles)
Buses and coaches (> 3.5t) [1)]	36 000 (new registrations 2016)	75% (27 000 vehicles)
Waste collection trucks[2)]	4 500 (estimated new registrations, 2013)*	Nearly 100% (4 500 vehicles)
Post and courier services[3)]	€91 billion (2011)**	No more than 5% (postal) No more than 1% (courier)
Moving services[4)]	No data	No more than 2%

[1)] (ACEA, 2016)
[2)] Estimation based on data from (ACEA, 2014) and (KBA, 2014).
[3)] Estimation based on (ITA Consulting and WIK Consult, 2009) and (Ofcom, 2015)

[4)] Estimation based on (Eurostat, 2015c); (CCRE/CEMR, 2016)

Even with the partial estimates provided in Table 1, it might be concluded that the public sector is responsible for procuring around 620 000 vehicles a year and relevant services that might have a value in the order of billions of Euros, particularly when considering that no information was available for bus or waste collection services.

Where information was available, it was clear that the vehicle markets are still dominated by vehicles using diesel and petrol, rather than those using alternative fuels, while the fleets are dominated by vehicles that meet Euro emissions standards of Euro 4/IV or earlier. The proportion of Euro 5/V and Euro 6/VI vehicles in the car and LCV fleets is likely to increase at a faster rate than in the bus and waste collection vehicle fleets, as the former tend to have short lifespans.

2.3 Key environmental hotspots and improvement options

The analysis of the environmental hotspots showed that for all categories the main environmental impacts are related to the use phase of the vehicles. The main impacts during the use phase are the GHG emissions, air pollutant emissions and noise.

Closely related to the use phase are the environmental impacts related to the production of energy carriers (liquid or gaseous fuels or electricity). The main environmental issues of the supply chain of energy carriers are GHG emissions and air pollutant emissions.

Other environmental impacts occur during vehicle manufacturing, which is more relevant for electric vehicles where the battery manufacturing is the most impacting component. The reduction of the environmental impact of electric vehicles during the use phase, however, outweighs the negative environmental impacts of the additional emissions in the production phase in most cases (Bauer, et al., 2015).

3 Category 1: Purchase, Lease or Rental of Cars, LCVS and L-Category vehicles

3.1 Scope of the category

This category covers the purchase, lease or rental of:

- 'Cars and LCVs': M_1 and N_1 vehicles, as defined by Directive 2007/46;
- 'L-category' vehicles as defined by Regulation 168/2013.

Special purpose vehicles such as armoured vehicles are excluded from the scope.

3.2 Overview of the revision of the EU GPP criteria

The tables below show a summary of the revision proposal for the current EU GPP criteria of the category 'purchase and lease of cars and LCVs. The proposal is further described in the following sections. The common criteria for vehicle categories in Section 10 also apply.

Purchase/lease of cars and LCV (EU GPP criteria 2012)					
		Current criterion	**Core**	**Compr**	**Revision proposed in this report**
TECHNICAL SPECIFICATIONS	1	CO_2 emissions	X	X	Updated
	2	Exhaust gas emissions	X	X	Updated
	3	Eco-driving	X	X	Updated (see Section 10)
	4	Gear shift indicators (GSI)	---	X	Updated
	5	Tyre Pressure Monitoring Systems (TPMS)	---	X	Updated (see Section 10)
	6	Fuel consumption display	---	X	Updated
	7	Air conditioning gases	---	X	Discarded
	8	Lubricant oils	---	X	Discarded
	9	Vehicle tyres – noise	---	X	Updated (see Section 10)
	10	Vehicle tyres – rolling resistance	---	X	Updated (see Section 10)
	1	Use of alternative fuels	X	X	Updated
AWARD CRITERIA	2	Noise emission levels	X	X	Updated (see Section 10)
	3	Lower CO_2 emissions	X	X	Updated
	4	Vehicle materials	---	X	Discarded
	5	Start and stop	---	X	Discarded

Purchase/lease/rental of cars, LCV and L-category vehicles (EU GPP criteria proposal in this report)				
		Proposed criterion	**Core**	**Compr**
TECHNICAL SPECIFICATIONS	1	CO_2 emissions and energy efficiency	X	X
	2	Air pollutant emissions	X	X
	3	Gear shift indicators (GSI)	X	
	4	Energy consumption displays	X	X
	5	**Traffic information and route optimisation**		X
	6	**Minimum warranty of the battery**		X
AWARD CRITERIA	1	Lower CO_2 emissions	X	X
	2	**Energy efficiency**		X
	3	**Improved air pollutant emissions performance**	X	X
	4	**Zero tailpipe emission capability**	X	X
	5	**Speed limiter**		X
	6	**Extended warranty**		X

3.3 Criteria proposal

3.3.1 CO_2 emissions and energy efficiency

3.3.1.1 Proposed criteria

<table>
<tr><th>Core criteria</th><th>Comprehensive criteria</th></tr>
<tr><td colspan="2">Technical Specification</td></tr>
<tr><td>
TS1. Type-approval CO_2 value
Type-approval CO_2 emissions of vehicles must not exceed the following values:
<table>
<tr><th>Vehicle type[1)]</th><th>CO_2 g/km</th></tr>
<tr><td>Cars - Small (M1)</td><td>2018: 86 (NEDC)[2)]
2019: 103 (WLTP)[2)]
2020: 99 (WLTP)
2021: 95 (WLTP)</td></tr>
<tr><td>Cars - Mid-size (M1)</td><td>2018: 94 (NEDC)
2019: 104 (WLTP)
2020: 100 (WLTP)
2021: 97 (WLTP)</td></tr>
<tr><td>Cars - Large (M1)</td><td>2018: 107 (NEDC)
2019: 111 (WLTP)
2020: 106 (WLTP)
2021: 102 (WLTP)</td></tr>
<tr><td>LCV - Small (diesel, N1 class I)</td><td>2018: 93 (NEDC)
2019: 116 (WLTP)
2020: 113 (WLTP)</td></tr>
<tr><td>LCV - Small (petrol, N1 class I)</td><td>2018: 117 (NEDC)
2019: 135 (WLTP)
2020: 131 (WLTP)</td></tr>
<tr><td>LCV - Mid-size (N1 class II)</td><td>2018: 127 (NEDC)
2019:
- From 01/01 to 31/08/2019: 124 (NEDC)
- From 01/09/2019: 157 (WLTP)
2020: 153 (WLTP)</td></tr>
<tr><td colspan="2">LDV - Large (N1 class III)</td></tr>
<tr><td colspan="2">2018: 151+0.096*(M – 1766.35) (NEDC)
2019:
- From 01/01 to 31/08/2019: 147+0.096*(M — 1766.35) (NEDC)
- From 01/09/2019: 193 +0.096*(M — 1766.35) (WLTP)
2020: 188 +0.096*(M – 1766.35) (WLTP)
Where M is the mass of the vehicle</td></tr>
</table>
Verification:
The tenderer must provide the vehicle’s certificate of conformity.
</td><td>
TS1. Type-approval CO_2 value
Type-approval CO_2 emissions of vehicles must not exceed the following values:
<table>
<tr><th>Vehicle type</th><th>CO_2 g/km</th></tr>
<tr><td>All M1 and N1 vehicles</td><td>2018: 45 (NEDC)
2019: 40 (WLTP)
2020: 35 (WLTP)
2021: 25 (WLTP)</td></tr>
</table>
L-category vehicles must be battery electric.

Verification:
The tenderer must provide the vehicle’s certificate of conformity.
</td></tr>
</table>

Core criteria	Comprehensive criteria
Award criteria	
AC1. Lower CO_2 emissions *(same for core and comprehensive)* Points will be awarded to vehicles presenting lower type-approval CO_2 emissions than those required in TS1, in proportion to the reduction achieved. **Verification:** See above TS1	
	AC2 Energy efficiency *If the public authority is requiring battery electric vehicles:* Points will be awarded to those vehicles with higher energy efficiency expressed in kWh/100km according to the NEDC test procedure[3)] in 2018 and WLTP test procedure in 2019 and beyond. **Verification:** The tenderer must provide the vehicle's certificate of conformity.

[1)] *The definitions of the three vehicle types for cars are provided in the table below.*

Passenger car types used in GPP criteria	***Corresponding segments according to segmentation used by the European Commission (http://ec.europa.eu/competition/mergers/cases/decisions/m1406_en.pdf)***
Small	*A: mini cars* *B: small cars*
Mid-size	*C: medium cars*
Large	*D: large cars* *E: executive cars* *F: luxury cars* *S: sport coupés* *M: multi-purpose cars* *J: sport utility cars (including off-road vehicles)*

[2)] *Since September 2017, the new worldwide harmonised light vehicle test procedure (WLTP) is in place and type approval of all new vehicles will fully change to the new test by 2019. The Commission recommends that until the end of 2018 new European driving cycle (NEDC) type approval data be used for the purpose of communicating to consumers (Commission Recommendation (EU) 2017/948). According to the provisions of this recommendation, from beginning 2019 onward, only the CO2 type approval measured with WLTP From 2019, only the CO2 type approval measured with WLTP will be should be communicated to consumers for all cars and vans except. N1 Class II and Class III, for which the date of implementation is deferred to September 2019.*

[3)] *A reduction of 10 Wh/km in the energy efficiency of a battery electric vehicle travelling an*

average of 10 000 km/year can save from EUR 15 to EUR 20 per year, depending on the electricity price.

3.3.1.2 Rationale

Incentives for the most performing internal combustion engine vehicles (ICEVs) and alternative powertrains

The use phase has the largest share in the GHG emissions of cars and LCVs. There are various technical options for reducing these emissions, either by making ICEVs more fuel-efficient, through hybridisation, or by switching to alternative powertrains, such as plug-in hybrid vehicles, full electric or fuel-cell vehicles. For the electric vehicles, the GHG emissions related with vehicle production and electricity generation may partly offset the lower use-phase emissions. However, when taking account the full lifecycle, and using 2015 EU electricity mix, GHG emissions of electric vehicles are still lower than those of petrol or diesel cars (Bauer, et al., 2015). These GHG emissions will go down further in the next decades due to decarbonisation of the EU electricity mix (EEA, 2017).

Setting requirements for CO_2 type approval values in EU GPP criteria may incentivise the purchase of the following types of vehicles, depending on the CO_2 value:

- more fuel efficient ICEVs
- plug-in hybrid electric vehicles
- full electric and fuel cell electric vehicles

Costs of improved ICEVs and alternative powertrains

Increasing the fuel-efficiency of petrol and diesel cars (including hybrids) generally increases the purchase price, but will also lower fuel costs over the lifetime of the vehicle. The analysis of the total cost of ownership as included in Annex I Cost analysis of this study shows that the total energy cost savings over the entire lifetime exceed the additional vehicle purchase price for the top-10 non hybrid ICEVs in terms of lowest CO_2 values (except for large passenger cars with low annual mileages, e.g. 10 000 km/year)

For plug-in hybrid and full electric vehicles the higher purchase cost is currently not compensated by the fuel cost savings over the vehicle lifetime. Based on data for the Volkswagen Golf, the total cost of ownership (TCO) (excluding taxes) of a full electric car is estimated to be around €0.02 per vehicle-kilometre higher (assuming 17 000 km/year), compared to a petrol car of the same size . The number of full electric and plug-in cars on the market will increase in the coming years. A literature review carried out by ICCT (ICCT, 2016a) shows that the battery pack determines about 75% of the current cost increments of battery electric vehicles (BEV), with 24.9 kWh battery at €375 per kWh. ICCT report indicates that the costs associated with Li-ion batteries are expected to drop: they are expected to cost €205 per kWh for PHEVs and €160 per kWh for BEVs in 2030 in the optimistic scenario, or €250 and €200 per kWh in the midrange scenario. This cost reduction would be derived from the replacement of high-cost materials and economies of scale, improvements to the cell and electrode structure design, and high-volume production processes with reduced wastage. IEA (IEA, 2017) shows that some manufacturers have predicted even lower costs, up to €80 per kWh in 2022.

In the case of L-category vehicles (two and three wheelers and quadricycles), the criteria proposal is focused on powered two-wheelers (PTW) which cover mopeds (L1e) and motorcycles (L3e). Electric PTWs still account for only 0.3% of the market; however they experienced a 60% surge in purchases between 2009 and 2010, and a similar growth in 2011.

2020 targets

The CO_2 emissions of new cars and LCVs need to decrease further in view of the 2020/2021 targets under the CO_2 emission regulations (Regulations (EC) No 443/2009 and (EU) No 510/2011). The requirements of those regulations should be taken into account in the EU GPP criteria; otherwise those criteria will be either too stringent for the short term or be outdated very soon. Therefore, the CO_2 values proposed in the criteria set are set in different tiers from 2018 to 2021.

On average the NEDC type approval CO_2 value of new passenger cars needs to decrease by 21% between 2015 (119.5 g/km) and 2021 (95 g/km), meaning a reduction of around 3.8% yearly. For new vans, the NEDC type approval values need to decrease by 13% between 2015 (168.3 g/km) and 2020 (147 g/km), requiring a reduction of 2.7% yearly. Therefore, the CO_2 type approval tiers for the years 2018 – 2020/21 have been set according to these reductions rates (3.8% yearly for cars and 2.7% yearly for LCVs), as shown in Table 2:

Table 2: Different tiers for CO2 type approval of cars and vans

Fuel type	**Size category**	**Average NEDC CO_2 emission (2015)**	**Highest NEDC CO_2 emission in top-10 (or top 5 for LCVs) most fuel efficient vehicles 2016**	**CO_2 emissions in 2018-2020/21 assuming equal reduction rates for best in class and average sales**			
		In g/km	**In g/km**	**2018**	**2019**	**2020**	**2021**
CARS	Average	119.5					
Petrol	Small (segment A, B)	119	93	89	86	83	80
Petrol	Mid-size (segment C)	136	102	98	94	91	87
Petrol	Large (all other segments)	153	116	112	107	103	99
Diesel	Small (segment A, B)	102	88	85	81	78	75
Diesel	Mid-size (segment C)	110	89	86	82	79	76
Diesel	Large (all other segments)	130	99	95	92	88	85
LCVs	Average	168.3					
Diesel	Small (N1 class I)		96	93	91	88	
Petrol	Small (N1 class I)		120	117	114	111	
Diesel	Mid-size (N1 class II)		130	126	123	120	
Diesel	Large (N1 class III)		162	158	153	149	

The initial values on which the yearly reduction rates have been applied come from the top-10 (cars) and top-5 (vans) of the most fuel efficient ICEVs available on the market in 2016. For cars, the values proposed for each segment are based on the performance of the most efficient petrol vehicles available in the Netherlands (source: https://www.anwb.nl/auto/besparen/top-10-zuinige-autos). The values for vans are based on the performance of the most fuel efficient diesel vans available in the UK, where the most comprehensive data was available (source: http://vanfueldata.dft.gov.uk/vehicles.aspx). Choosing the threshold at the level of the top-10/top-5 ensures sufficient choice, as at least 10 car models (or 5 van models) meet the criterion proposal. For vans, the values were based on the top-5 vans in the UK

market, as there are far fewer van models than car models. There are even fewer petrol van models, which meant that data was only available to identify proposed limit values for small, class I petrol vans, but not for class II or III.

For the comprehensive criteria, the CO_2 values are set at the level that can be met by PHEVs (plug-in hybrid electric vehicles) and REEVs (range extended electric vehicles). The thresholds have been lowered compared to the first proposal to ensure that the electric drive range is large enough also in real world conditions. As the number of PHEV/REEV models on the market meeting tighter values is increasing and additional cost impacts are expected to be small, the threshold is lowered from 45 g/km in 2018 to 30 g/km in 2021. In the case of BEVs (battery electric vehicles) and fuel cell electric vehicles, tailpipe emissions are zero.

Worldwide harmonised Light vehicle Test Procedure (WLTP)

Until recently, the type approval values were determined by the New European Driving Cycle (NEDC) test cycle. The 2021 CO2 emission target for cars of 95 g/km and 2020 target for LCVs of 147 g/km are both defined in terms of NEDC emissions. Since September 2017, the new Worldwide harmonised Light vehicle Test Procedure (WLTP) has been in place and type approval of all new vehicles will fully change to the new test by 2019. The Commission has recommended that until the end of 2018 NEDC data be used for the purpose of communicating to consumers (Commission Recommendation (EU) 2017/948). From beginning 2019 onward, only the CO2 type approval measured with WLTP will be communicated to consumers, for all cars and vans except. N1 Class II and Class III, for which the date of implementation is deferred to September 2019. Only for the purpose of CO2 target compliance, these WLTP values will be translated into NEDC values by means of a simulation tool. Therefore, the thresholds proposed in the technical specification for 2019 and onwards, which are based on the current type approval in force (NEDC) have to be transformed into WLTP values. This translation has been based on the WLTP/NEDC ratios estimated by JRC (JRC, 2017). The ratios can be found in Tables E.1 and E.2 of the JRC report.

Tank-to-wheel (TTW) or Well-to-wheel (WTW)

The type approval CO_2 values only cover the tailpipe emissions during the use phase of the car (tank-to-wheel emissions, TTW). CO_2 criteria for cars and LCVs based on the WTW emissions would not significantly change the incentive to the market of conventional vehicles, as the WTW emissions for ICEVs are proportional to TTW emissions. The gap between ICEVs and BEVs would be smaller, but the latter would still have significantly lower emission values. The same is true with a complete lifecycle approach, i.e. when also considering the emissions from vehicle manufacturing and end-of-life processing. In that case and using the 2015 EU Electricity mix, the GHG emissions of BEVs would still be lower than of a petrol car (Bauer, et al., 2015).

Two options were proposed in the first version of the Technical report to be discussed with the stakeholders:

- Option 1: a technical specification based on NEDC CO_2 type approval, which would be equivalent to the most fuel efficient ICEV at the core level, and to semi and full electric vehicles at the comprehensive level. An additional award criterion based on energy efficiency would complement the comprehensive TS.
- Option 2: a technical specification based on CO_2 type approval translated into WTW GHG emissions. This option would require setting values for calculating well-to-wheel (WTW) emissions based on recognised references

Defining the GHG criteria in terms of WTW emissions would complicate the criteria: WTT emission values would then need to be set for each fuel/energy carrier at EU level.

Therefore, the application would become more complex, which has been confirmed by the public procurers that participated in the consultation. Option 1 is preferred by public procurers since it is much easier to implement in a call for tender, and it is based on metrics used by all manufacturers and well known by the consumers. This is also in line with overall CO_2 legislation in the EU for vehicles. Later on, in the discussion on the purchase of buses, public procurers agreed that the fuel is not part of the call for tender to purchase the vehicles. In case there are fuel contracts or infrastructure installations involved, these are usually settled prior to the purchase of the vehicles. Therefore, the choice of WTW factors might entail some issues, since in most cases it is not possible to know the pathway of the fuels consumed. Note that it is even more complicated with passenger cars and LCVs compared to buses, because passenger cars/LCVs are more often not linked to any infrastructure.

The limitation of a criterion based on a TTW metric is that it does not provide incentives for improving the energy efficiency of BEVs (which in turn may reduce GHG emissions caused by electricity generation). This could be solved by setting an award criterion for those offers with higher energy efficiencies.

Some stakeholders argued that the TTW option was not able to reflect the environmental benefits of the use of biomethane in natural gas vehicles. However, the WTW approach would not be a solution, since the refilling of the natural gas vehicles with biomethane depends on the type of fuel available at the stations, and therefore it cannot be ensured. The use of a dedicated supply is not common practice in cars and LCVs. Besides, any measure that could entail an increase of natural gas demand by the EU fleet of LDVs should be evaluated cautiously since LDVs are responsible for 15% of the EU's emissions of CO_2 and 75% of the CO_2 emitted by road transport. Final energy demand from cars and powered two-wheelers is responsible for more than half of total final energy demand in transport, including rail and aviation (EC, 2016). Biomethane for transport competes with other final uses of biomethane and biogas, such as space and water heating and cogeneration, so even if the transport demand could be met with biomethane, the side effect may be an increase of fossil share in those competing final uses. Therefore, the biomethane supply would need to demonstrate additionality to ensure that the increase of demand does not generate a shortage elsewhere. Some stakeholders argued that the first step needed is the purchase of NG vehicles, which will create the demand driving the additional supply of biomethane. However, according to the data about number of NG vehicles and biomethane available for transport, the number of NG vehicles does not seem to influence the ratio biomethane/fossil natural gas at national level. In 2013, Sweden had less than 1% of NG vehicles (44 319 vehicles), with a biomethane production for transport of 900 GWh/year supplied by 200 filling stations, while Italy doubled that share with a total of 846 000 vehicles, with a production of 15 GWh/year and 2 filling stations of biomethane (FC Gas Intelligence, 2014) (EBA, 2014).

Number of vehicle segments distinguished

In the current EU GPP criteria, the number of vehicle segments that is distinguished is larger than what seems to be really necessary from a procurement perspective. Distinguishing three size segments provides sufficient differentiation to cover the variation in CO_2 emissions and the main different vehicle segments. Therefore, in the proposed set, the number of vehicle segments has been reduced. The definitions of the three vehicle segments for cars are provided in Table 3, as suggested by the stakeholders.

Table 3: Passenger car vehicle categories proposed for the GPP criteria and corresponding segments

Passenger car types used in GPP criteria	**Corresponding segments according to segmentation used by the European Commission**
Small	A: mini cars B: small cars
Mid-size	C: medium cars
Large	D: large cars E: executive cars F: luxury cars S: sport coupés M: multi purpose cars J: sport utility cars (including off-road vehicles)

N1 Class III

N_1 Class III includes a wide range of vehicles of different sizes, purpose and weight, and this variety may be difficult to reflect by a single threshold. One limit value might restrict the choices of LCVs, and thus it might hinder the purchase of the most appropriate vehicle for the needs of the public procurer. One stakeholder indicated that the values proposed for N_1 vehicles in the first draft of the technical report were too lenient, and suggested stricter thresholds. Two options were proposed for discussion at the second AHWG:

- Option 1: the thresholds stick to the initial approach based on one single figure for all N_1 Class III vehicles.
- Option 2: the thresholds for N_1 Class III vehicles take account of the mass of the vehicle. For 2019 and 2020, the threshold is proposed to decrease 5% per year.

Option 2 – the mass-based approach – was considered to be the best option, as it addressed the variety of N_1 class III vehicles. The values have been revised and now come from the report Monitoring CO_2 emissions from new passenger cars and vans in 2015 (EEA, 2016). In 2015, the average of CO_2 emissions from vans was 168.3 g/km. Therefore, the average vans will need to reduce their emissions around 2.7% yearly to reach the 2020 target. In 2015 there were at least four OEMs whose average performance was just 10% above the 2020 target, or closer. The vans that in 2015 perform 10% above the target are expected to achieve the target a year earlier, if they follow the same reduction trend (2.7% yearly reduction). Therefore, the criterion proposal sets the tier for 2019 equal to the 2020 target for vans, for 2018 2.7% above the target and 2.7% below the target in 2020.

As an alternative, it was suggested that a loading-based approach might also be considered. The challenge with such an approach is the lack of availability of relevant data that is collated in a coherent manner. Data on the loading capacity of N_1 vehicles is not recorded as part of the LCV CO_2 Regulation or even on the Certificate of Conformity. Hence, in order to build a CO_2-based criterion on the loading capacity of an N_1 vehicle, an alternative dataset would need to be identified that covers all of the N_1 vehicles on the EU market. It is unlikely that such a dataset exists.

Verification

The Directive 2007/46/EC sets the legal framework for the type approval of the motor vehicles covered by the scope of the EU GPP criteria. According to this Directive, the manufacturers must issue a certificate of conformity which is a statement delivered by to the buyer in order to assure that the vehicle complies with the legislation in force in the European Union at the time it was produced. The certificate of conformity also enables the competent authorities of the Member States to register vehicles without having to require the applicant to supply additional technical documentation. The certificate of conformity includes among other data, the environmental performance of the vehicle (noise and air pollutant emissions, energy efficiency, CO_2 emissions, where applicable). This document is therefore proposed for the verification of criteria related to those environmental issues.

3.3.2 **Air pollutant emissions**

3.3.2.1 Proposed criteria

Core criteria	**Comprehensive criteria**
Technical Specification	
TS2. Air pollutant emissions *Note: this criterion applies to M1 and N1 vehicles with a reference mass1) not exceeding 2 610 kg. M1 and N1 vehicles with a reference mass exceeding 2 610 kg will have to comply with TS2 Air pollutant emissions of category 3 (Section 5.3.2.1).* From 1 September 2019, all new cars and LCVs must comply with a real driving emission (RDE) performance which is at most the Euro 6 limit values for NOx and PN (not including the applicable measurement margin[2)]). From 1 January 2021, all new cars and LCVs must comply with an RDE emission performance which is at most equal to 0.8 times the Euro 6 limit values for NOx and PN (not including the applicable measurement margin[2)]). *If purchasing vehicles to be used in areas with air quality issues[3)]:* Vehicles must have zero tailpipe emissions. *If there is no charging infrastructure available, or the expected use profile requires large ranges:* The vehicles may at the least be zero tailpipe emissions capable, meaning a car that can travel a minimum range without any tailpipe emissions. *The contracting authority will set the minimum zero tailpipe emissions range according to the expected use profiles in the call for tender (a proposed default range could be 40 km). From 2019, the range without emitting any tailpipe emissions will be the electric range over WLTP* **Verification:** The tenderer must provide the vehicle's certificate of conformity.	**TS2. Air pollutant emissions** *If purchasing vehicles to be used in areas with air quality issues:* Vehicles must have zero tailpipe emissions. *If there is no charging infrastructure available, or the expected use profile requires large ranges:* The vehicles may at the least be zero tailpipe emissions capable, meaning a car that can travel a minimum range without emitting any tailpipe emissions. *The contracting authority will set the minimum zero tailpipe emissions range according to the expected use profiles in the call for tender (a proposed default range could be 40 km). From 2019, the range without emitting any tailpipe emissions will be the electric range over WLTP.* **Verification:** The tenderer must provide the vehicle's certificate of conformity.
Award criteria	
AC3. Improved air pollutant emissions performance (*Same for core and comprehensive)* *Note: this criterion applies to M_1 and N_1 vehicles with a reference mass not exceeding 2 610 kg. M_1 and N_1 vehicles with a reference mass exceeding 2 610 kg will have to comply with AC3 Improved air pollutant emissions performance of category 3 (Section 5.3.2.1).* Points will be awarded proportionally to the air polluting emissions performance to	

vehicles that have an RDE performance better than Euro 6 limit values for NOx and PN (not including the applicable measurement margin).

Points will be awarded according to the following formula:

$$Points = \left(\frac{NOx_{high} - NOx}{NOx_{high} - NOx_{low}}\right) \times PNOx_{max} + \left(\frac{PN_{high} - PN}{PN_{high} - PN_{low}}\right) \times PPN_{max}$$

Where

- NOx_{high} and NOx_{low} is the highest and lowest NOx emissions in mg/km among the offers presented to the call for tender.
- PN_{high} and PN_{low} is the highest and the lowest PN emissions in #/km among the offers presented to the call for tender
- *NOx and PN* are the NOx and PN emissions of the offer evaluated
- $PNOx_{max}$ *and* PPN_{max} are the maximum points to be awarded for each air pollutant.

Verification:
The tenderer must provide the vehicle's certificate of conformity.

AC4. Zero tailpipe emission capability (*Same for core and comprehensive)*
Note: this criterion applies to M_1 and N_1 vehicles with a reference mass not exceeding 2 610 kg. M_1 and N_1 vehicles with a reference mass exceeding 2 610 kg will have to comply with AC3 Improved air pollutant emissions performance of category 3 (Section 5.3.2.1).

Points will be awarded to those vehicles that can demonstrate a minimum zero tailpipe emission capability, meaning the range the car can travel without any tailpipe emissions, in proportion to the capability of the vehicle. *The contracting authority will set the minimum zero tailpipe emissions range reference threshold according to the expected use profiles in the call for tender (a proposed default range could be 40 km).*

Verification:
The tenderer must provide the vehicle's certificate of conformity.

Explanatory notes
[1] 'Reference mass' means the mass of the vehicle in running order, as declared in the certificate of conformity, minus the uniform mass of the driver of 75 kg, plus a uniform mass of 100 kg;
[2] The RDE max values will be declared in the certificate of conformity as mg/km or particle number/km, as appropriate, and will not include the measurement margin which is only linked with the uncertainties of the measurement equipment. This is because the uncertainty margin of 0.5, currently set in legislation, is under review and thus bound to change. Therefore, if a manufacturer declared a value today with the applicable margin added (i.e. value+margin 2017), and the margin was subsequently lowered in 2018, that declaration would be at a disadvantage compared to a manufacturer who would declare in 2018 (i.e. value+margin 2018), although the two cars would have the same emissions.
The table below lists the RDE NOx max and PNmax limit values to qualify under the EU GPP criteria, which the values declared in the vehicle's certificate of conformity will have to comply with.

NOx max/ PNmax limit values to qualify for EU GPP (light-duty vehicles covered by RDE), not including the applicable measurement margin			
1 September 2019 to 31 December	M and N1 Class I	N1 class 2	N1 class III

2020						
	Diesel	Gasoline	Diesel	Gasoline	Diesel	Gasoline
NOx (mg/km)	80	60	105	75	125	82
PN (#/km)	6×10^{11}	6×10^{11}	6×10^{11}	6×10^{11}	6×10^{11}	6×10^{11}

From 1 January 2021	M and N1 Class I		N1 class 2		N1 class III	
	Diesel	Gasoline	Diesel	Gasoline	Diesel	Gasoline
NOx (mg/km)	64	48	84	60	100	66
PN (#/km)	5×10^{11}	5×10^{11}	5×10^{11}	5×10^{11}	5×10^{11}	5×10^{11}

[3)]Areas with air quality issues are those areas where traffic restriction measures are put in place to comply with the air pollutant emissions limits set by the Air Quality Directive (Directive 2008/50/EC)

3.3.2.2 Rationale

All newly registered cars and LCVs have to comply with the Euro 6 emissions standard. Therefore, the EU GPP criteria for cars and LCVs should go beyond these mandatory requirements, and there are two ways for this purpose:

- Improving the air pollutant emissions performance by the implementation of Euro 6d stage.
- Requiring zero tailpipe emission or zero tailpipe emission capability.

Performance on the RDE test

For passenger cars and LCVs, the Real-Driving Emission (RDE) testing procedures will be introduced in 2017. The European Parliament agreed on requiring real 'Real Driving Emissions' (RDE) tests for all new models by September 2017, and for all new vehicles by September 2019 (stage Euro 6d), with a not-to-exceed value of 2.1 times higher than the Euro 6 limit value. In a next step the not-to-exceed value will be the Euro 6 limit value, with the taking into account of measurement margins of error, by January 2020 for all new models (and by January 2021 for all new cars). The EU GPP criteria should go beyond the mandatory limits which are applicable for all new vehicles and properly account for vehicles which offer further reductions in air pollutant emissions compared to the mandatory limits. Therefore, the criterion proposal brings forward the tier that new models will have to comply with by January 2020 to September 2019. By January 2021, a stricter tier is proposed, so the vehicle must meet 80% of the air pollutant emissions of emission limits. The latest experiences show that the measurement margin will decrease over time. This means that if a manufacturer declared a value in 2017, adding the applicable margin (i.e. value+margin 2017) and the margin was subsequently lowered in 2018, that declaration would be at a disadvantage compared to a manufacturer who would declare in 2018 (i.e. value+margin 2018) although the two cars would have the same emissions. Therefore in order to be able to compare vehicles in a fair manner, the measurement margin will not be written on the Certificate of Conformity, since the margin is only linked with the uncertainties of the measurement equipment, and not to the vehicle performance.

Some stakeholders suggested not distinguishing between diesel and gasoline vehicles, and setting one only threshold to be met. In their view, this formulation would be a way to remove the advantage that the Euro standards give to diesel vehicles due to higher limit values. However, this approach would be a contradictory signal within the current European regulations, and would add complexity to the criteria. Manufacturers work on

their vehicles towards the limits set by Euro standards, which make that differentiation between diesel and gasoline, and any improvement on the technologies will be achieved within this legal framework. Since the EU GPP criteria are aimed at selecting the technologies going beyond the mandatory limits, they need to converge with the Euro standards that rule the automotive industry and that are the main drivers currently pushing the market towards those better technologies. Nevertheless the award criterion should compare the performance of the vehicle in absolute terms on a competitive basis. Therefore, the formula to calculate the points is based on the performance of the vehicle in terms of emissions per km, and no points would be allocated to the vehicle with the highest air pollutant emissions.

Regarding gasoline engines, the gasoline direct-injection (GDI) technology generates more particles than traditional gasoline engines. Euro 6c requires all vehicles to meet uniform particle number (PN) standards, including those with spark-ignition GDI engines. According to ICCT (ICCT, 2015), it is expected that GDI vehicles will meet PN standards with relatively low-cost gasoline particulate filters. However, the criterion has been reworded to be based on conformity factors, which will be set also for PN by the third RDE package. This prevents the criterion from having to require a specific technology.

Once the Euro 6c becomes mandatory for all new vehicles from September 2019 onwards, the emission performance of new vehicles will be stated on the certificate of conformity. Hence, this document is the most suitable proof of compliance with this criterion proposal.

Zero tailpipe emission capability

Air quality in urban areas is one of the main impacts derived from the exhaust gases from vehicles, thus, a criterion is proposed to promote those technologies that can prove zero tailpipe emission capability. This concept can be expressed as the range (or the distance) that the vehicle is able to travel without emitting any air pollutant. This definition would include plug in-hybrid, pure electric and hydrogen vehicles, but would exclude hybrid technology. These technologies are the ones selected by the comprehensive technical specification on type approval CO_2 emissions, which are also linked to the electric range of the vehicle. Therefore, the award criterion on zero tailpipe emission capability will add the electric range as another parameter to evaluate the performance of the vehicles that are qualified at comprehensive level.

Zero tailpipe emissions in urban areas with poor air quality

Several European cities have problems with bad air quality that trigger traffic-calming measures. Some of them have set up low emission zones where the circulation of vehicles is restricted. In order to align the criteria with those measures, the technical specification proposal requests the public authorities to purchase zero tailpipe emission vehicles, if they are to be used in urban areas with poor air quality. In case of low availability of charging infrastructures or the need of large ranges, zero tailpipe emission capable vehicles would be allowed, which provides sufficient leeway to fit the different situations and driving needs of the public authority.

3.3.3 **Technical options to reduce GHG emissions**

3.3.3.1 Proposed criteria

<table>
<tr><th>Core criteria</th><th>Comprehensive criteria</th></tr>
<tr><td colspan="2">Technical Specification</td></tr>
<tr><td>TS3. Gear shift indicators (GSI)
Note: this criterion does not apply to automatic vehicles. The criterion is not relevant for electric and plug–in hybrid vehicles, so it is not part of the comprehensive criterion.
LCVs must be equipped with a gear shift indicator, meaning a visible indicator recommending that the driver shift gear.
Verification:
The tenderer must provide the technical sheet of the vehicle where this information is stated.</td><td></td></tr>
<tr><td colspan="2">TS4. Energy consumption display (Same for core and comprehensive)
The vehicles must be equipped with a mechanism to display to the driver fuel consumption figures.
Verification:
The tenderer must provide the technical sheet of the vehicle where this information is stated.</td></tr>
<tr><td></td><td>TS5. Traffic information and route optimisation
Note: This criterion may be requested by contracting authorities if the vehicle is to be used in urban areas with congestion issues, or to be driven to places that the drivers are not familiar with and no other information system (e.g. smartphones) is available.
Note: This criterion will not apply to vehicles used for special purposes that require a high level of floating car data protection, e.g. security forces fleets, official vehicles used by members of the government, etc.
Vehicles must be equipped with traffic information and route optimisation systems meant to interact with the driver providing pre-trip information services to help avoid congestion and make other journey choices to optimise the trip route. The system must be an embedded system, meaning a complete communication module, consisting of a modem and a subscriber identity module (SIM), permanently integrated into the car
Verification:
The tenderer must provide the technical sheet of the vehicle where this information is stated.</td></tr>
<tr><td colspan="2">Award criteria</td></tr>
<tr><td></td><td>AC5. Speed limiter</td></tr>
</table>

	Points will be awarded to those vehicles equipped with a speed limiting device, meaning an on-board device that automatically limits a vehicle's speed to a certain maximum speed as set in the device. **Verification:** The tenderer must present the technical sheet of the vehicle where this information is stated.

3.3.3.2 Rationale

Energy consumed in the use phase of passenger cars also depends on other factors than technology, such as driving behaviour, vehicle-pavement interactions, congestion, etc. This implies that measures that help drivers to improve these conditions should be incentivised.

Some stakeholders argued that the core criteria set should be kept as simple as possible, in order to facilitate their use by public procurers. The multiple and different technical options could become too burdensome and discourage the uptake of the GPP criteria. To this end, the technical measures described in this section have been assessed according to their cost-effectiveness, their market penetration and their means of verification: those options that are clearly cost-effective, available in the market but not in all the models, and easy to verify will be proposed for the core level.

Gear shift indicators (GSI)

Gear shift indicators (GSI) are monitoring tools that help a driver to adjust their behaviour and can reduce fuel consumption according to Regulation (EC) No 661/2009. Gear shift indicators (GSI) are mandatory for new passenger cars, but not for LCVs. Investment costs of gear shift indicators are very low (€0-15) and the cost-effectiveness is estimated to be negative, meaning that the fuel saving compensates the additional cost..

Because GSI are commercially available and cost-effective technologies, GSI should be included as core criteria for LCVs.

Energy consumption displays

Energy consumption displays (or eco-driving displays) help car drivers to see whether their driving style adjustments have a positive impact on energy consumption and can reduce energy consumption between 0.3 and 1.1% for €0-20 installation cost (EC, 2014d). These displays are not mandatory yet. They are very common in large passenger cars, but not so much in small cars. Because these displays are also relevant for electric vehicles, the more broad term energy consumption display seems to be more appropriate than the current used term 'fuel consumption displays'.

Traffic information and route optimisation

The literature reviewed showed that congestion in roads can lead to a surge of emissions: the increase in emissions at 45 km/h (a typical average speed on urban roads) due to congestion is approximately 40% compared to a road with stable free-flow traffic (Garbarino, et al., 2016). Traffic information and route optimisation systems are already available in many models (connected cars) (Everis, 2015) but would entail additional costs, according to the OEMs websites. . The saving potentials will depend on each specific situation, and on the availability of intelligent traffic systems to provide the needed traffic data. Therefore it is proposed as technical specification at comprehensive level which the contracting authority may require only in those urban areas with congestion issues, or if the drivers of the vehicles have to travel to places that they are

unfamiliar with. An exemption is added for vehicles that require a high level of floating car data protection, e.g. security forces.

Speed limiters

Speed limiters are on-board devices that automatically limit the speed of a vehicle to a certain maximum speed as set in the device. Two systems of speed limiters are offered: separate speed limiters and cruise control with speed limiters. The separate speed limiter is installed by the manufacturer and generally cannot be adjusted by the driver. For the cruise control with speed limiter, however, the speed limiter is a functionality of the cruise control system which can be adjusted by the driver. These 'open' speed limiters are common on-board devices; however, they are not usually standard factory-equipped equipment for small models. The 'closed' ones are not so frequent but they bring similar CO_2 reductions than the open ones. Since the most common ones are the open devices that rely on the user behaviour, it is proposed that these devices are part of the comprehensive level as award criterion.

Criteria withdrawn

Start and stop systems

Start and stop systems are applied in more than 50% of all new sold cars and LCVs and can therefore be seen as a commonly available technology able to reduce fuel consumption by a few percent. However, start and stop systems are already promoted through the criteria on type approval CO_2 emissions. Therefore, the new proposed criteria do not longer include start and stop systems as a criterion.

Air conditioning gases

From 2017 onwards the GWP of air conditioning gases applied in mobile air conditioning systems should be below 150. This implies that the exceptions allowed under the current criterion will no longer be valid. Because the limit will become mandatory, the criterion will not provide an incentive for more environmentally-friendly refrigerant unless the criterion is changed into a more ambitious criterion. Alternative refrigerant options include CO_2 and the HFO refrigerant called R1234yf, which has been introduced in certain car models recently. These refrigerants have a GWP of 1 and 4, have a high energy efficiency, bring no or acceptable additional cost and are commercially available.

Given that the only currently available alternatives to meet the legal limit already have a very low GWP, an award criterion for lower GWP beyond that limit would be easily complied by all the vehicles and would not bring any added value. Therefore it is proposed to be deleted.

3.3.4 **Durability of the battery**

3.3.4.1 Proposed criterion

Core criteria	**Comprehensive criteria**
Technical specification	
TS6 Minimum warranty (*Same for core and comprehensive)* *If the contracting authority is requiring battery electric vehicles:* The tenderer must provide a minimum warranty of the battery of 150 000 km or 8 years against capacity loss below 70% of its original value at delivery according to EN 62660. **Verification:** The tenderers must present a declaration with the warranty terms.	
Award criteria	
AC6 Extended warranty (*Same for core and comprehensive)* *If the contracting authority is requiring battery electric vehicles:* Points will be awarded to those tenders offering an extension of the minimum warranty set by the TS in proportion to the value of the extension. **Verification:** Same as TS7	
Note *The technology of electric vehicles is evolving very quickly towards more durable and reliable batteries. For that reason, the thresholds proposed in this criterion should be cross-checked with the options available in the market at the moment of the call for tenders.*	

3.3.4.2 Rationale

The manufacture of the battery is the major contributor to the environmental impacts of battery electric vehicles. Most LCA literature uses lifetimes in the range of 100 000 and 150 000 km, and highlight that longer lifetimes of the batteries will obviously entail a reduction of the life cycle impacts of the vehicle.

Longer lifetimes of the battery can be promoted by means of criteria on time/distance and capacity warranties. Table 4 gathers the warranties offered by the some OEMs in July 2017 (information from OEMs websites).

Table 4: Battery warranties offered by OEMs

OEM	**warranty time (years)**	**warranty distance (km)**	**Capacity covered by the warranty**	**Source**
BMW	8	100 000	70%	https://www.bmw.co.uk/bmw-ownership/servicing-and-repairs/bmw-warranties/bmw-iperformance-warranty-guidelines
Citroen	8	100 000	Not found	http://www.citroen.es/electricos/tienes-dudas.html

OEM	warranty time (years)	warranty distance (km)	Capacity covered by the warranty	Source
Ford	8	160 000	"Loss of battery capacity due to or resulting from gradual capacity loss is NOT covered"	https://www.ford.com/resources/ford/general/pdf/brochures/2016-hybrid-car-electric-warranty-version-2_frdwa_en-us_08_2015.pdf
Hyundai	8	200 000	Not found	http://www.hyundai.com/wcm/idc/groups/sgvehiclecontent/@hmc/documents/sitecontent/mdaw/mte0/~edisp/ioniq_hev_brochure_20p_final.pdf
Mercedes	06-Aug	100 000	70%	http://tools.mercedes-benz.co.uk/current/passenger-cars/pdfs/owners-area/HV-Battery-Warranty.pdf
Nissan	5	100 000	70%	http://newsroom.nissan-europe.com/eu/en-gb/media/pressreleases/105380
Opel	8	160 000	Not found	http://www.opel.at/content/dam/Opel/Europe/master/hq/en/01_Vehicles/01_PassengerCars/Ampera/PDF/Ampera_15.0_Long-Master.pdf
Peugeot	8	100 000	70%	http://www.peugeot.es/gama/selector-de-coches/nuevo-partner-tepee-electric.html
Renault	8	160 000	66%	http://www.renault.es/gama-renault/gama-vehiculos-electricos/zoe/renault-zoe/prefieres-comprar-bateria.jsp
Tesla	8	Unlimited except for original 60 kWh battery, 200 000 km	"Loss of Battery energy or power over time or due to or resulting from battery usage is NOT covered"	https://www.tesla.com/support/vehicle-warranty

OEM	warranty time (years)	warranty distance (km)	Capacity covered by the warranty	Source
Volkswagen	8	160 000	"Gradual reduction in battery capacity over time is integral to the nature of the component, and does not represent a defect under the terms of this guarantee, as long as the reduction in capacity is not in excess of the value specified for this vehicle in the owner's manual" (no further information found)	http://www.volkswagen.co.uk/owners/warranty/new-car/terms-and-conditions

Therefore, a criterion on warranty of the battery is proposed in order to reward those manufacturers that improve the lifetime of batteries. The capacity loss covered by the warranty has been set at 70% in line with the information received in the stakeholder consultation and the specific conditions of the warranties currently offered by OEMs (Table 4).

Since the technology of BEV is developing very fast towards more durable and reliable batteries, some stakeholders recommended updating the benchmark set by this criterion as often as possible. This recommendation has been added by means of an explanatory note.

3.4 Criteria proposals withdrawn

3.4.1 Vehicle manufacturing

The use phase dominates the environmental impact of the life cycle of vehicles; however the manufacturing phase is also relevant. In case of vehicles whose use phase emissions are strongly reduced, the manufacture can become the most relevant stage.

The stakeholder consultation has confirmed the complexity that the criteria on the manufacturing process might raise, mainly related to barriers to verification by the public procurer. Recycled materials go through a complex supply chain which hinders the traceability and the verification on the final product. For this reason, this criterion is withdrawn from the current criteria proposal for all categories.

3.4.2 Waste disposal

The requirements on waste fractions and tyres and on wash bays are quite relevant, but they are already mandatory. It is therefore proposed to withdraw these criteria since they would not bring any added value to the minimum legal requirements. This applies to all categories.

3.4.3 Reuse of the battery

On the disposal of the battery, some studies pointed out that batteries still retain some capacity at the end-of-life and thus can be reused on other applications, such as stationary energy storage, where the requirements are more flexible. This suggests that a part of the manufacturing emissions should be ascribed to the second-life application, which consequently lowers overall GHG emissions of an EV. However, this is evolving naturally towards a market for second hand batteries, and therefore, rewarding suppliers for offering take-back systems is not necessary. For this reason, the award criterion on reuse of batteries is proposed to be dropped. This applies to all categories.

4 Category 2: Mobility Services

4.1 Scope of the category

This category covers the purchase of special-purpose bus services, non-scheduled bus services, hire of buses and coaches with driver services, taxi services, car sharing services and combined mobility services that are purchased by the contracting authority as final users of the services, using the following vehicles:

- 'Cars and LCVs': M_1 and N_1 vehicles, as defined by Directive 2007/46
- 'Buses': M_2 and M_3 vehicles as defined by Directive 2007/46, and having a maximum mass exceeding 5 tonnes.
- 'L-category' vehicles as defined by Regulation 168/2013.
- 'Cycles': Bicycles, cycle trailers, electrically power assisted cycles,
- 'Light electric vehicles and self-balancing vehicles' whose specific definitions are under development by CEN/TC 354 /WG 4.

4.2 Overview of the new EU GPP criteria

In the case of purchasing mobility services, various types of measures exist for improving the environmental performance. First of all, the whole criteria set proposed for Category 1 as presented in the previous section could be potentially requested when purchasing services. However, an approach based on fleet performance is needed to make these criteria feasible and workable for services. In addition, several other criteria would only apply to services. These are discussed below. The common criteria for service categories in Section 11 also apply.

	Mobility services (EU GPP criteria proposal in this report)			
		Proposed criterion	**Core**	**Compr**
TS	1	Air pollutant emissions	**X**	**X**
AWARD CRITERIA	1	CO_2 emissions	**X**	**X**
	2	Air pollutant emissions	**X**	**X**

4.3 Criteria proposal

4.3.1 GHG emissions

4.3.1.1 Proposed criteria

Core criteria	**Comprehensive criteria**
Award criteria	
AC1. CO_2 emissions (*Same for core and comprehensive)* *Note: the contracting authority will set in the call for tender what types of vehicles are required to provide the service.* ***For cars and LCVs*** Points will be awarded to those tenders offering a service fleet whose average CO_2 type approval is equal or below the core TS1 CO_2 emissions of category 1 (Section 3.3.1.1), proportionally to the average CO_2 type approval of the fleet. ***For buses*** Points will be awarded to those tenders offering a service fleet composed of *[the contracting authority may set a percentage, all the vehicles of the fleet, specific vehicle categories or sub-categories or the vehicles to be used in specific routes, see explanatory note]* vehicles equipped with one of the eligible technologies set by the core TS1 of category 3 (Section 5.3.1.1). **Verification:** the tenderer must present, in a spreadsheet, the list of vehicles of the service fleet, their CO_2 emissions type approval (supported by the respective certificates of conformity) and the calculation of their average, for cars and vans, or the technical sheet of the vehicle where these technologies are stated, for buses.	

4.3.1.2 Rationale

In terms of alternative fuels Eurostat statistics show that the share of alternative fuels in cars is still very limited (5%), and the market is dominated by diesel and petrol engines. For LCV, the share is even lower (1%) and the most of the fleet is composed by diesel engines.

In the case of L- vehicles, the criteria proposal is focused on powered two-wheelers (PTW) which cover mopeds (L1e) and motorcycles (L3e). Electric PTWs still account for only 0.3% of the market; however they experienced a 60% surge in purchases between 2009 and 2010, and a similar growth in 2011.

For buses, the rationale is explained in Sections 5.3.1 and 6.3.1.

The average age of fleet has been increasing the last year to reach 40% of cars above 10 years and 10% below 2 years. However, these figures cover both private and professional fleets, and the vehicles used in the category of mobility services tend to be younger, due to larger annual mileage and consequent higher replacement rates, and to meet their clients' demands as well. Besides, some companies are specialised in specific models: premium, hybrid, electric, etc. In Brussels, the car sharing company Zen Car offers 20 electric cars and 40 pick-up/drop-off points (BBL Belgium; et al, 2011).

In Germany, the average age of vehicles used in car sharing is also much lower than that of private cars. For instance, total CO_2 emissions of German Car-Sharing cars are about 16% below those of all newly-registered German cars. According to their website,

Cambio's fleet is no older than 4 years (Cambio carsharing, 2016)). Figure 1 shows these data for different car sharing companies (BBL Belgium; et al, 2011):

Figure 1: Comparison of specific CO_2 emissions of car-sharing fleets with personal cars by country (BBL Belgium; et al, 2011)

C-S provider or country	Specific CO_2 emissions of C-S fleet	Number of vehicles in C-S fleet	specific CO_2 emissions of the national vehicle fleet	...% lower consumption	Comparison year	Source
Mobility, Switzerland	151 g/km	2,200	183 g/km (new cars only)	17.5% (total 1,510 t in year)	2008	Mobility 2009
various, Germany	148 g/km	1,042 (included in the study)	176 g/km (new cars only)	16%	2003	Knie, Canzler 2005
cambio, Germany	129 g/km	575	165 g/km (new cars only)	21.2%	2009	cambio Journal 19/2009; German Federal Bureau of Statistics 2009
cambio Belgium, Belgium	117 g/km (Flanders) 120 g/km (Brussels) 122 g/km Wallonia	248	155 g/km (new cars only)	21.3% - 24.5%	2008	Information by e-mail, Taxistop
4 providers, Italy	127 g/km	236			2008	momo survey
various, Great Britain	110 g/km		171 g/km (assuming the replacement of personal cars after 6 years)	36%	2007 (2001 in some cases)	Carplus 2007

It is therefore apparent that mobility services tend to use better performing cars than the average fleets. Some of them even offer the top models, for example, in Germany one of latest model of cambio cars in 2010 (Ford Fiesta ECOnetic) emitted only 98 g of CO_2/km (BBL Belgium; et al, 2011).

The first version of the criteria proposal set 12% of the fleet compliant with the core TS1 for category 1 at core level, and 25% at comprehensive level. Stakeholders agreed that the substitution of vehicle purchases by mobility services entailed an environmental benefit itself, and therefore it should be encouraged over the purchase or lease. Too strict criteria would create a barrier for the development of these services, and the same would be true for too complex requirements. Thus, the criteria proposal was reformulated as an award criterion that gives points to those service fleets whose average CO_2 type approval complies with the core TS1 for category 1 (see Section 3.3.1.1), or that are equipped with the technologies required by TS1 of category 3, in case of buses (see Section 5.3.1.1).. The criterion based on an average is more representative of the performance of the fleet as a whole, instead of setting percentages on the fleet compositions which would only ensure the performance of a share.

4.3.2 **Air pollutant emissions**

4.3.2.1 Proposed criteria

Core criteria	**Comprehensive criteria**
Technical Specification	
TS1. Air pollutant emissions *Note: the contracting authority will set in the call for tender what types of vehicles are required to provide the service.* All buses used in carrying out the service must meet at least Euro V. 2018: 40% of buses must meet Euro VI. 2019: 48% of buses must meet Euro VI. 2020: 56% of buses must meet Euro VI. 2021: 64% of buses must meet Euro VI. Where vehicles are not certified as meeting Euro V or higher, but technical after-treatment has achieved the same standard, this should be documented in the tender. All LDV used in carrying out the service must meet at least Euro 5. 2018: 40% of LDV must meet Euro 6. 2019: 50% of LDV must meet Euro 6. 2020: 60% of LDV must meet Euro 6. 2021: 70% of LDV must meet Euro 6. All L-category vehicles used in carrying out the service must meet at least Euro 3. 2018: 40% of L-category vehicles must meet Euro 4. 2019: 50% of L-category vehicles must meet Euro 4. 2020: 60% of L-category vehicles must meet Euro 4. 2021: 70% of L-category vehicles must meet Euro 4. The tier applicable will correspond to the year that the call for tender is launched. **Verification:** The tenderer must provide the technical sheets of the vehicles where emission standards are defined. For those vehicles having achieved the standard mentioned above following a technical upgrade the measures must be documented and included in the tender, and this must have been verified by an independent third party.	**TS1. Air pollutant emissions** *Note: the contracting authority will set in the call for tender what types of vehicles are required to provide the service.* TS1.1. All buses used in carrying out the service must meet at least Euro V. 2018: 60% of buses must meet Euro VI. 2019: 68% of buses must meet Euro VI. 2020: 76% of buses must meet Euro VI. 2021: 84% of buses must meet Euro VI. Where vehicles are not certified as meeting Euro V or higher, but technical after-treatment has achieved the same standard, this should be documented in the tender. All LDV used in carrying out the service must meet at least Euro 5. 2018: 60% of LDV must meet Euro 6. 2019: 70% of LDV must meet Euro 6. 2020: 80% of LDV must meet Euro 6. 2021: 90% of LDV must meet Euro 6. All L-category vehicles used in carrying out the service must meet at least Euro 3. 2018: 60% of L-category vehicles must meet Euro 4. 2019: 70% of L-category vehicles must meet Euro 4. 2020: 80% of L-category vehicles must meet Euro 4. 2021: 90% of L-category vehicles must meet Euro 4. The tier applicable will correspond to the year that the call for tender is launched. TS1.2. *In the case of mobility services to be used in areas with air quality issues:* *[the contracting authority may set a percentage, all the vehicles of the fleet, specific vehicle categories or sub-categories or the vehicles to be used in specific routes, see explanatory note]* cars, LCVs and L-category vehicles must have zero tailpipe emissions. *If there is no charging infrastructure available, or the expected use profile requires large ranges:* the vehicles may at the least be zero tailpipe emissions capable, meaning they can travel the minimum range of 40 km without emitting any tailpipe emissions.

	Verification: the tenderer must present the list of vehicles of the service fleet and their certificates of conformity.
Award Criteria	
AC2. Air pollutant emissions (*Same for core and comprehensive, not applicable if zero tailpipe emissions required for all vehicles in the technical specification TS1.2.)* Points will be awarded to those tenders offering either: (a). A higher percentage than the one set by the TS1, or (b). cars and vans and L-category vehicles that have an emission performance better than Euro 6/4, or (c). natural gas buses and zero-emission capable vehicles, meaning with a minimum range of 40 km without emitting any tailpipe emissions for cars and LCVs, and plug in hybrid electric vehicles (PHEV), battery electric vehicles (BEV) for buses and L-category vehicles, and fuel cell electric vehicles (FCEV) for buses. *(to be detailed to which extent points will be attributed to higher percentages, better performance and zero tailpipe vehicles. Zero tailpipe emissions vehicles must be given more points than vehicles with better performance than Euro 6/4 and natural gas buses)*. **Verification:** See above TS1	

4.3.2.2 Rationale

For cars and LCV, the share of the total fleet in 2015 of Euro 6 was 15%, and around 55% lower than Euro 5, which means 30% Euro 5 (TML, 2012)

For buses, the rationale is explained in Sections 5.3.2 and 6.3.2

A JRC study (Clairotte, et al., 2015) in the framework of the Regulation 168/2013 includes representative data of products placed on the EU market between September 2014 and June 2015. According to this study, less than 1% of mopeds and motorcycles complied with Euro 5, and 63% of mopeds and 8% of motorcycles complied with Euro 4. Note that the enforcement timing of Euro standards for L-category vehicles according to Regulation 168/2013 is the following:

	L-vehicle	**New types of vehicles**	**Existing types of vehicles**
Euro 4	L1e, L2e, L6e	1 January 2017	1 January 2018
	L3e, L4e, L5e, L7e	1 January 2016	1 January 2017
Euro 5	L1e-L7e	1 January 2020	1 January 2021

Setting a minimum proportion of Euro 6 and Euro 5 might entail an increase of the replacement rate, and therefore a larger investment. Only 10% of the fleet is below 2 years. However, and as said before, the average age of professional fleets are usually lower than the private ones.

Based on these facts, and given the market induced replacement of cars, a minimum percentage of 40% is proposed for core and 60% for comprehensive level. The replacement of vehicles will naturally increase the penetration of Euro 6/VI in the fleets, and therefore these percentages need to rise yearly according to the typical replacement

rates to maintain the same ambition level. For these reason, the criteria proposal includes yearly increments of 10% for LDVs and L-category vehicles and 8% for buses.

The first version of the criteria proposal set percentages of the fleet compliant with Euro 6 and Euro 6d-TEMP standard. In order to simplify the criteria set, the requirements on Euro 6d-TEMP have been withdrawn. However, the comprehensive level integrates some of the aspects of the air pollutants criteria of category 1. The technical specification also includes a provision to request zero tailpipe emission vehicles in urban areas with poor air quality. The business model of mobility services is considered a promising market driver to increase the uptake of electric vehicles. The service company assumes the initial purchase price, and the "range anxiety" that hinders the purchase by private users is mitigated (Amsterdam Roundtable Foundation and McKinsey & Company, 2014). As explained in Section 4.3.1, there are companies specialised in electric vehicles, and therefore, the mobility services can also help improve the air quality of urban areas where needed.

4.3.3 **Combined mobility services**

4.3.3.1 Proposed criteria

Explanatory note
Combined mobility services *Combined mobility services (CMS) offer a wide range of combined mobility options which usually include public transport and renting bicycles. A key feature of CMS is the capacity to meet the travel demands of customers using the most appropriate and efficient transport mode, or combination of modes. The mobility solutions are optimised to reduce the ratio energy consumed per distance and passenger (energy/[km.passenger]); this is achieved by prioritising the non-motorised vehicles and public transport modes. Therefore, the level of multi and intermodality is a crucial element in meeting the travel need in the most efficient way. The level of multi and intermodality of the mobility service could be defined as the different types of transport modes that the service is able to offer, and its combinations in one trip. Transport modes are understood to mean: private cars, L-category vehicles, electric bikes, bikes, public transport, ride sharing, etc. The combined mobility services are still at a very early stage of development. However, the potential of this type of service to stimulate the modal shift towards non-motorised and public transport services is very significant, and it is recommended that public procurers explore the possibility of procuring combined mobility services instead of other mobility services that do not offer intermodality, if there are operators available.*

4.3.3.2 Rationale

The combined mobility services (CMS) offer a wide range of combined mobility options which might include public transport and bikes renting. This could be used as a way to promote the modal shift towards non-motorised and public means of transport.

These mobility solutions are optimised to reduce the ratio energy consumed per distance and travel, and this is the result of prioritising the non-motorised vehicles and public transport modes. Therefore, the level of multi and intermodality is a crucial element to meet the travel demand in the most efficient way. Besides, Holmberg et al. (Holmberg, et al., 2016) highlight that the environmental improvement that might be derived from the mobility services relies on the assumption that the primary customer group is the car-user, and not the public transport everyday user. This will result in a modal shift towards public transport, and not the other way around. The intermodality, referring to the seamless use of several different modes in one trip chain, is therefore a key element to ensure the environmental improvement from mobility services. The level of multi and intermodality of the mobility service could be defined as the different types of transport modes that the service is able to offer, and its combinations in one travel. By transport modes is meant: private cars, L-category vehicles, electric bikes, bikes, public transport, ride sharing, etc. The tenderer may need to create a partnership with other suppliers, public transport operators and other fleet operators, as shown in Figure 2.

Figure 2: Summary of Integrated Mobility Services around the World (Kamargianni, et al., 2015)

Name	Place	Integrator	Integration level**						Modes included
			1	2	3	4	5	6	
Communauto + BIXI + Public transport + local Taxi	Canada	Communauto (car sharing)	X						
SBB + Mobilty +Publibike/Quickbike	Switzerland	SBB (rail)	X						
STIB+Cambio	Brussels, Belgium	Cambio (car sharing)	X	X					
Hannovermobil	Hannover, Germany	Üstra (public transport)	X	X	X*	X			
EMMA	Montpellier, France	TAM (public transport)	X*	X	X	X	X*		
Smile	Vienna, Austria			X	X	X			
Moovel	Germany	Moovel (application)		X	X*	X			
SHIFT	Los Angeles, USA	SHIFT (all modes)		X	X	X	X	X	 + Valet
UbiGo	Gothenburg, Sweden	CLOSER, Lindholmen Science Park AB (research)		X	X	X		X	
Helsinki Model	Helsinki, Finland			X	X	X		X	 + on demand transport

* Partial integration
**1:Cooperation only in terms of providing discounts for combined subscriptions
2: Ticketing integration
3: Payment integration
4: ICT integration
5: Institutional integration
6: Mobility packages

The combined mobility services are still at a very early stage of development to come up with workable criteria for public procurement. In the Nordic countries, Ubigo was the pioneer project developed in Goteborg during 2014, offering a range of mobility options to users based on subscription and unified invoicing (Kamargianni, et al., 2015), (Holmberg, et al., 2016). The potential of this type of services to stimulate the modal shift is very relevant, and an explanatory note recommends that public procurers explore the possibility of procuring combined mobility services, instead of other mobility services that do not offer intermodality.

5 Category 3: Purchase or lease of buses

5.1 Scope of the category

This category covers the purchase or lease of city buses and coaches defined as M_2 and M_3 vehicles by Directive 2007/46.

- Category M_2: Vehicles designed and constructed for the carriage of passengers, comprising more than eight seats in addition to the driver's seat, and having a maximum mass not exceeding 5 tonnes.
- Category M_3: Vehicles designed and constructed for the carriage of passengers, comprising more than eight seats in addition to the driver's seat, and having a maximum mass exceeding 5 tonnes

5.2 Overview of the revision of the EU GPP criteria

The tables below show a summary of the revision proposal for the current EU GPP criteria of the category 'purchase and lease of buses'. The proposal is further described in the following sections. The common criteria for vehicle categories in Section 10 also apply.

Purchase/lease of buses					
		Criterion	**Core**	**Compr**	**revision**
TECHNICAL SPECIFICATIONS	1	Exhaust gas emissions	X	X	Updated
	2	Exhaust pipes (location)	---	X	Updated
	3	Lubricant oils	---	X	Discarded
	4	Tyres	---	X	Updated (see Section 10)
AWARD CRITERIA	1	Use of alternative fuels	X	X	Updated
	2	Noise emission levels	X	X	Updated (see Section 10)
	3	Exhaust gas emissions	X	---	Updated
	3	Tyre Pressure Monitoring Systems (TPMS)	---	X	Updated (see Section 10)
	4	Air conditioning gases	---	X	Updated
	5	Vehicle materials	---	X	Discarded
	6	Start and stop	---	X	Discarded

Purchase/lease of buses				
		Criterion	**Core**	**Compr**
TECHNICAL SPECIFICATIONS	1	**Technological options to reduce GHG emissions**	X	X
	2	**Air pollutant emissions**	X	X
	3	Exhaust pipes	X	X
AWARD CRITERIA	1	**Technological options to reduce GHG emissions**	X	X
	2	Air conditioning gases		X
	3	**Improved air pollutant emissions performance**	X	

5.3 Criteria proposal

5.3.1 GHG emissions

5.3.1.1 Proposed criteria

<table>
<tr><th>Core criteria</th><th>Comprehensive criteria</th></tr>
<tr><td colspan="2">Technical Specifications</td></tr>
<tr><td></td><td></td></tr>
<tr><td>
TS1 Technological improvement options to reduce GHG emissions
<u>City buses</u>
The vehicle must be equipped with one of the technologies classified as A or B in the Table 5

Table 5: List of eligible technologies for city buses – core level
<table>
<tr><th>Technology</th><th>Class</th></tr>
<tr><td>Mild hybrid</td><td>B</td></tr>
<tr><td>Flywheel hybrid</td><td>B</td></tr>
<tr><td>Full Series hybrid</td><td>B</td></tr>
<tr><td>Full Parallel hybrid</td><td>B</td></tr>
<tr><td>Full electric and plug-in vehicle</td><td>A</td></tr>
<tr><td>High pressure direct injection natural gas vehicles</td><td>B by default, A under the conditions set in the note below</td></tr>
<tr><td>OEM dual-fuel natural gas vehicle with a gas energy ratio over the hot part of the WHTC test-cycle of at least 50% *)</td><td>B or A under the conditions set in the note below</td></tr>
<tr><td>Hydrogen fuel cell vehicle *)</td><td>B or A under the conditions set in the note below</td></tr>
<tr><td>Dedicated natural gas vehicles *)</td><td>B or A under the conditions set in the note below</td></tr>
</table>
*) Hydrogen and natural gas vehicles require a minimum percentage of renewable fuel supply to be classified B (see note below)

<u>Coaches and inter-urban buses</u>
The vehicle must be equipped with one of the technologies in the Table 6
</td><td>
TS1 Technological improvement options to reduce GHG emissions
<u>City buses</u>
The vehicles must be equipped with one of the technologies classified A in the Table 5

Table 7: List of eligible technologies for city buses – comprehensive level
<table>
<tr><th>Technology</th><th>Class</th></tr>
<tr><td>Full electric and plug-in vehicle</td><td>A</td></tr>
<tr><td>Hydrogen fuel cell vehicle *)</td><td>A under the conditions set in the note below</td></tr>
<tr><td>OEM dual-fuel natural gas vehicle with a gas energy ratio over the hot part of the WHTC test-cycle of at least 50% *)</td><td>A under the conditions set in the note below</td></tr>
<tr><td>High pressure direct injection natural gas vehicles *)</td><td>A under the conditions set in the note below</td></tr>
<tr><td>Dedicated natural gas vehicles *)</td><td>A under the conditions set in the note below</td></tr>
</table>
*) Hydrogen and natural gas vehicles require a minimum percentage of renewable fuel supply to be classified A (see note below)

<u>Coaches and inter-urban buses</u>
The vehicle must be equipped with one of the technologies classified A in Table 6

Table 8: List of eligible technologies for coaches and inter-city buses – comprehensive level
<table>
<tr><th>Technology</th><th>Class</th></tr>
<tr><td>Hydrogen fuel cell vehicle *)</td><td>A under the conditions set in the note below</td></tr>
<tr><td>OEM dual-fuel natural gas vehicle with a gas energy ratio over the hot part of the WHTC</td><td>A under the conditions set in the note below</td></tr>
</table>
</td></tr>
</table>

Table 6: List of eligible technologies for coaches and inter-city buses – core level

Technology	Class
Active flow control	C
Boat tails/ extension panels	C
Mild hybrid (only for inter-city buses)	C
Flywheel hybrid (only for inter-city buses)	C
Full Series hybrid (only for inter-city buses)	C
Full Parallel hybrid (only for inter-city buses)	C
OEM dual-fuel natural gas vehicle with gas energy ratio over the hot part of the WHTC test-cycle of at least 50%.	C by default, B or A under the conditions set in the note below
High pressure direct injection natural gas vehicles	B by default, A under the conditions set in the note below
Hydrogen fuel cell vehicle	C by default, B or A under the conditions set in the note below
Dedicated natural gas vehicles*)	C, B or A under the conditions set in the note below
Full electric and plug-in vehicle*[*)]	A

**) Dedicated natural gas vehicles require a percentage of renewable methane supply to be qualified as eligible (see note below)*

***) Currently, plug-in hybrid technology is not being used for inter-city buses and coaches, and although its future use cannot be discarded, there is not a clear usage pattern visible at the moment*

Verification:

The tenderer must present the technical sheet of the vehicle where these technologies are stated.

test-cycle of at least 50% *)	
High pressure direct injection natural gas vehicles *)	A under the conditions set in the note below
Dedicated natural gas vehicles *)	A under the conditions set in the note below
Full electric and plug-in vehicle*[*)]	A

**) Hydrogen and natural gas vehicles require a minimum percentage of renewable fuel supply to be classified A (see note below)*

***) Currently, plug-in hybrid technology is not being used for inter-city buses and coaches, and although its future use cannot be discarded, there is not a clear usage pattern visible at the moment*

Verification:

The tenderer must present the technical sheet of the vehicle where these technologies are stated.

Award criteria

AC1 Technological improvement options to reduce GHG emissions Points will be awarded to those vehicles equipped with one of the technologies classified A, in the Table 5 for city buses, and A or B within Table 6 for coaches. This technology does not have to be additional to the technology compliant with the TS1 **Verification:** same as TS1.	
	AC2. Air conditioning gases Points will be awarded to those vehicles equipped with an air conditioning system that uses a refrigerant with a global warming potential (GWP), related to CO_2 and a time horizon of 100 years, below 150. **Verification**: The tenderer must provide the name, formula and GWP of the refrigerating gas used in the air conditioning system. If a mixture of gases is used (n number of gases), the GWP will be calculated as follows: GWP= Σ(Substance X1 % x GWP(X1)) + (Substance X2 % x GWP(X2)) + … (Substance Xn % x GWP(Xn)) where % is the contribution by weight with a weight tolerance of +/- 1 %. GWP of gases can be found in Annexes I and II of the Regulation (EU) No 517/2014 (http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2014.150.01.0195.01.ENG)

Notes

Upgrading and qualification of technologies

The contracting authorities may classify fuel cell electric vehicles as class B, if they have a supply of hydrogen produced with renewable sources generated on-site, meeting at least 5%, or A, if they have a supply of hydrogen produced with renewable sources generated on-site, meeting at least 15% of their demand.

The contracting authorities may classify an OEM dual-fuel natural gas vehicle as class B or A, if they have a supply of renewable methane meeting at least 15% or 35% of their demand, respectively

The contracting authorities may classify high pressure direct injection natural gas vehicles as class A, if they have a supply of renewable methane meeting at least 10% of their demand, respectively.

The contracting authorities may qualify dedicated natural gas vehicles as class C, B or A, if they have a supply of renewable methane meeting at least 10%, 15% or 25% of their demand, respectively.

Renewable methane means biomethane and synthetic methane produced with a surplus of renewable electricity, meaning the renewable electricity production that exceeds the demand during certain periods and creates a surplus production of electricity (power-to-gas).

Description of some technologies

Mild hybrid: System uses an electric motor mounted to the crankshaft to operate stop / start and recover braking energy; recovered energy is used to boost acceleration and for electrified

ancillaries

Flywheel hybrid: An additional high speed flywheel that stores and releases energy from/to the vehicle driveline. The flywheel stores energy, while braking, releasing it to supplement or temporarily replace the engine output. Flywheel technology does not include stop start functionality.

Full parallel hybrid: Electric/diesel hybrid where electrical power is routed to/from the wheels in parallel to the mechanical drive from the engine. Direct drive via a relatively conventional transmission remains between the engine and wheels.

Full series hybrid: Electric/diesel hybrid without conventional transmission, engine generates electricity that is stored in a battery and used to power a separate traction motor. Electrical machines and battery are higher power than in equivalent parallel.

Active flow controls: Active flow control is a system that actively pressurizes the lower pressure-vortex or vacuum that develops behind the vehicle.

Boat tail / extension panels: Panels at the rear of the vehicle that assist in the pressure equilibrium between the front and the rear of the vehicle facilitating the air flow and reducing the air drag.

5.3.1.2 Rationale

The first stakeholder consultation suggested that a technology-neutral approach based on GHG emissions could be explored as an option to revise the criterion on alternative fuels. Other views recommended the removal of the criterion arguing that the use of alternative fuels was not a consideration made in the course of purchasing, but part of a public transport authority's wider strategy. However, the EU GPP criteria would still be valid in those cases, as a way to assist the decision-making of the public procurers.

In the case of buses, there is currently a lack of data that hinders an EU-harmonised approach to formulate a CO_2 emissions criterion. The European Commission has already developed a simulation tool called VECTO (Vehicle Energy Consumption calculation Tool), which is aimed to support the certification, monitoring and reporting of CO_2 emissions from heavy duty vehicles. Five different driving cycles (mission profiles) have been developed and introduced into VECTO for buses and coaches. The regulation on monitoring and reporting of CO_2 emissions using VECTO is expected to be in force within the next years.

The UITP (International Association of Public Transport) has also developed their Standardised on-road tests which are especially designed for buses and are used by some public procurers. Apart from that, there are other national and local cycles as the new LowCVP UK Bus test cycle, used by the initiative Low Emission Buses of DfT's Office of Low Emission Vehicles (OLEV). This initiative sets up a subsidies scheme to help reduce GHG emissions from UK bus fleets and to improve air quality. The scheme defines a Low Emission Bus (LEB) as the one producing 15% less WTW emissions compared with an equivalent Euro V diesel bus, based on a methodology developed by the LowCVP (LowCVP, 2016)

This situation leads to a lack of comparable data on CO_2 emissions of buses per km, in contrast to the CO_2 labelling scheme for cars and LCVs. The possibility to set thresholds as proposed for cars and LCVs had to be ruled out, and alternative solutions needed to be explored.

Therefore, two options were presented for discussion in the first version of the technical report:

- Option 1 technology-neutral approach: the criterion would be based on a reduction of WTW GHG emissions compared to a reference vehicle, using default WTT factors for the different fuels and energy carriers.
- Option 2 technology-specific approach: the criterion would select directly the technologies that have been identified as improvement options.

Both options were discussed at the first Ad Hoc Working group meeting held on 23 November 2016 and at an interactive webinar on 16 March 2017.

It was agreed that in terms of fairness and level playing field, Option 1 is the preferable one; however its implementation is hindered by several limitations that cannot be overcome for the time being. The definition of the reference vehicle is identified as the main obstacle. It would need enough data on consumption from VECTO to come up with distributions and averages to support the definition of the reference vehicles. Besides, the reference vehicles must be set for different types of buses (12 m rigid, double-decker, articulated, etc.) and for different duty cycles: urban city, interurban, coaches, etc.

There was strong support to set just one test method, instead of letting the public procurer to choose it. One of the reasons is that the percentage of GHG emissions reduction might significantly vary as a function of test method used. Besides, it was argued that the manufacturers should not be challenged to test their vehicles with different test methods. VECTO is the most recommended option since there is a lot of work invested on the development of this tool by the different parties involved, and it will be the way to implement the future regulation on monitoring and reporting of CO_2.

The stakeholders agreed on Option 2 as interim solution, and developing Option 1 once VECTO is fully implemented and data available. Option 2 should distinguish at least between city buses and coaches, and if possible inter-city. However, no literature has been found about specific technologies suitable for inter-urban buses, so it is proposed to apply the list of technologies for coaches also to inter-city buses. During the consultation period, a stakeholder indicated that this duty cycle is representative of those networks that link several municipalities close to each other, and they are quite common in some countries. The eligible technologies would be in between inter-city buses and coaches, meaning that hybrid vehicles would be within the list of inter-city buses.

Option 2: technology-specific approach

Identification of technologies

The EU GPP criteria aim at incentivising the purchase of the best technologies currently in the market. The following technologies were initially identified as potential options to reduce GHG emissions compared to a conventional diesel bus:

- Natural gas vehicle
- Hybrid vehicle
- Full Electric Vehicle and Plug-in Hybrid Electric Vehicle
- Fuel Cell Electric Vehicle

Other sources of information have been analysed to come up with the lists of technologies for city buses and coaches. These have demonstrated at least 5% GHG emissions reduction compared to a conventional diesel vehicle. Table 9 gathers the information from the literature reviewed (Zacharof & Fontaras, 2016), (Ricardo, 2013), (ICCT, 2017), including the type of technology, whether it is appropriate for city buses or coaches, or both, and a rough estimation of the GHG reduction. In the second version of the technical report, '*engine software management optimisation*' was also included, but it was withdrawn since the information was based on rigid trucks and stakeholders indicated it was very uncommon and difficult to verify.

Table 9. List of technologies for city buses and coaches (Ricardo, 2013), (Zacharof & Fontaras, 2016)

Type of technology	**Technology**	**City bus**	**Coach**	**Approx. GHG reduction (WTW) %**
Smart ancillaries, parasitic loss reduction	Smart / clutched compressor	yes	yes	6
Smart ancillaries, parasitic loss reduction	Smart alternator / improved alternator	yes	yes	5
Hybridisation	Stop/start battery systems	yes	no due to constant speed operation	9
Hybridisation	Mild hybrid	yes	no due to constant speed operation	13
Hybridisation	Flywheel hybrid	yes	no due to constant speed operation	15
Hybridisation	Full Series hybrid	yes	no due to constant speed operation	15 - 40
Hybridisation	Full Parallel hybrid	yes	no due to constant speed operation	15 - 35
Alternative fuels	Full electric and plug-in vehicle	yes	no	30 - 100
Alternative fuels	Fuel cell vehicle	yes	yes	10 - 100
Aerodynamics	Active flow control	no due to low speed operation	yes	1 - 12
Aerodynamics	Boat tails/ extension panels	no due to low speed operation	yes	4 - 5

The consultation of the second draft of the technical report showed a split view on the performance of natural gas vehicles. From one side, some stakeholders argued that natural gas vehicles were capable to achieve GHG emissions reduction of 10%. On the opposite side, some stakeholders indicated that the energy efficiency of natural gas vehicles is much lower than the literature review suggests (up to 30% efficiency loss), so the increase in GHG emissions may be underrated. A more in-depth look into this technology provided the following insights:

First of all, there are two different engines used in natural gas vehicles that determine their performance: compression-ignition engines used in dual-fuel vehicles and spark-ignition engines used in dedicated vehicles. According to basic thermodynamics, compression-ignition engines are, in general, more efficient than spark-ignition since they work at higher compression ratios. The efficiency losses of dedicated vehicles due to this reason vary between 20 and 45% (LowCVP, 2017). LowCVP report also indicates that dedicated natural gas vehicles will be optimised in the coming years; however, the improvement is expected to be marginal.

Dual-fuel engines run on both diesel and natural gas, with gas energy ratios (meaning the percentage of diesel fuel replaced by gas in dual-fuel mode) from 24 to 47%. Efficiency losses of dual-fuel vehicles compared to conventional diesel are small, but most dual-fuel vehicles are aftermarket conversions and they show high levels of methane slips. These emissions of methane, with a GWP of 25, cancel the potential

benefits of the lower carbon intensity of natural gas (IEA, 2017), (LowCVP, 2017). New OEM dual-fuel vehicles still represent a very small share of the market, but the number is growing (Ricardo-AEA, 2015). Since they are new vehicles in the market, they must be compliant with Euro VI limit for methane, which is expected to entail a significant decreasing of methane slip (LowCVP, 2017), (ICCT, 2016a). According to Ricardo-AEA, methane slip could be abated to 1% of the total GHG emissions of the vehicle. However none of the test programmes consulted (Ricardo-AEA, 2015), (Cenex and Atkins, 2016), (LowCVP, 2017) measured the methane slips of OEM dual-fuel vehicles. Substitution rates will also improve in OEM dual-fuel vehicles, up to 50%. Manufacturers are also developing high pressure direct ignition (HPDI) engines that use diesel fuel as a pilot in a compression ignition engine. This technology is expected to achieve gas energy ratios above 95% with no loss of engine efficiency. This engine was developed by Westport, and Volvo has recently implemented it in trucks (Ricardo, 2013), (Cenex and Atkins, 2016).

With all this data, it is feasible to estimate the theoretical relative performance of a natural gas vehicle compared to an equivalent diesel vehicle, assuming both are identical in engine size and transmission, which might not be reproducible in real practice. The natural gas vehicles are also assumed to be compliant with Euro VI methane limit. The results are shown in Table 10:

Table 10: Theoretical relative performance of natural gas vehicles compared to diesel vehicle

	Efficiency loss	Gas energy ratios	% WTW reduction
OEM Dual-fuel	4%	45 - 50%	5.2 - 6.4
Dedicated	20 - 45%	100%	5.2 – (-15.0)
High pressure diesel/gas injection	0%	95%	14.3

WTW factors (JEC - Joint Research Centre-EUCAR-CONCAWE collaboration, 2014)
Diesel = 88.6 gCO_{2eq}/MJ
CNG = 69.3 gCO_{2eq}/MJ
LNG = 74.5 gCO_{2eq}/MJ

This analysis is based on a literature review of the performance of natural gas trucks, in particular a report from LowCVP, *Emissions Testing of Gas-Powered Commercial Vehicles* (LowCVP, 2017) that gathers the results of a test programme carried out on dedicated and dual-fuel natural gas trucks, and the Low Carbon Truck Trial (LCTT) (Cenex and Atkins, 2016) that consists of 12 consortia projects with 35 participating companies which tested a sample of 371 vehicles under different duty cycles. No similar test programmes for buses have been found. This is a limitation of the analysis since some results might not be equivalent for buses, or the technology might not be available. However, the estimations of the relative performance in Table 10 are in line with the overall performance of natural gas buses reported by other sources (TNO (CIVITAS WIKI), 2016), (Clean Fleets, 2014), (Ricardo, 2013).

Based on this information, OEM dual-fuel natural gas vehicles that can demonstrate a gas energy ratio of at least 50% are included in the criterion proposal as eligible technologies. Vehicles equipped with HPDI are also eligible, though it is not clear whether this technology is currently available for buses.

Technologies grading based on the GHG emissions reduction potential

As shown above, there are technology types suitable for each duty cycle: hybridisation for city buses and aerodynamics for coaches. Within the city bus list, different levels of GHG emissions reduction are apparent: some technologies show modest reductions, as smart ancillaries, others range from 10 to 20%, as mild hybridisation technologies, and

there are some of them that can reach up to 40%. These different performance levels enable the classification of technologies that is necessary to formulate a combination of technical specification and award criterion. Table 9 shows the classification for the proposed criterion, where technologies that can reach 10% would be class C, up to 20% would be B, and more than 20% A.

Table 11. List of technologies for city buses and classification

Technology type	**Technology**	**Class according to GHG reduction**
Smart ancillaries, parasitic loss reduction	smart / clutched compressor	C
Smart ancillaries, parasitic loss reduction	smart alternator / improved alternator	C
Hybridisation	Stop/start battery systems	C
Alternative fuels	Fuel cell vehicle	C
Hybridisation	Mild hybrid	B
Hybridisation	Flywheel hybrid	B
Hybridisation	Full Series hybrid	B
Hybridisation	Full Parallel hybrid	B
Alternative fuels	Full electric and plug-in vehicle	A
Alternative fuels	OEM dual-fuel natural gas vehicle with a gas energy ratio over the hot part of the WHTC test-cycle of at least 50%.	C
Alternative fuels	High pressure direct injection natural gas vehicles	B

There are not the same variations of GHG emissions reduction in the technologies for coaches, which range 3 – 15%. A stakeholder proposed to include hybridisation also for coaches; however, no data specific for coaches has been found to support this recommendation. The report *Fuel Efficiency Technology in European Heavy-Duty Vehicles: Baseline and Potential for the 2020–2030 Time Frame* (ICCT, 2017) analysed the potential of CO_2 reduction of several technologies for tractor-trailers and rigid trucks, under three duty cycles: urban, regional and long haul. The reduction of hybridisation of rigid trucks resulted in 6.1% for regional delivery and 2.3% for long haul. Based on this data, hybridisation is proposed to be part of the eligible technologies for inter-city buses only. Currently, electric and plug-in hybrid technologies are not being used for inter-city buses and coaches, albeit their future use cannot be discarded. The list of technologies for coaches and inter-city buses is gathered in Table 12.

Table 12: List of technologies for coaches and inter-city buses and classification

Technology type	Technology	Class according to GHG reduction
Alternative fuels	Fuel cell vehicle	C
Alternative fuels	OEM dual-fuel natural gas vehicle with substitution ratios of at least 50%.	C
Alternative fuels	High pressure direct injection natural gas vehicles	B
Alternative fuels	Full electric and plug-in vehicle	A
Aerodynamics	Active flow control	C
Aerodynamics	Boat tails/ extension panels	C
Hybridisation (only for inter-city buses)	Stop/start battery systems	C
Hybridisation (only for inter-city buses)	Mild hybrid	C
Hybridisation (only for inter-city buses)	Flywheel hybrid	C
Hybridisation (only for inter-city buses)	Full Series hybrid	C
Hybridisation (only for inter-city buses)	Full Parallel hybrid	C

Ambition levels for core and comprehensive criteria

The technology classes required for city buses have been set to B at core level, and A at comprehensive level. This ambition level is aimed at aligning the comprehensive level with the definition of clean buses set by the Proposal for a Directive amending Directive 2009/33/EU on the promotion of clean and energy-efficient road transport (COM(2017) 653 Annex Table 5). This definition encompasses hydrogen vehicles, full electric and plug-in hybrid vehicles and natural gas vehicles. In accordance with the proposal, Member States must ensure that, by 2025, a minimum percentage of the publicly procured vehicles fall under the proposal's definition of clean vehicles. By that time, the EU GPP core criteria for transport, which currently also include hybridisation and aerodynamics, are planned to be revised accordingly; pending the adoption and entry into force of the amendment to the Clean Vehicles Directive, it is considered appropriate to still include these technologies in the core criteria.

Although hydrogen fuel cell vehicles and OEM dual-fuel natural gas vehicles are classified as C, these technologies are kept within the lists since they can be upgraded to B or A provided they run on fuels produced under specific pathways. Dedicated natural gas vehicles are also part of the list for similar reasons. This is further explained below.

In the case of coaches and inter-city buses, the minimum class is kept as C, at core level. This is to prevent that the eligible technologies at core level are restricted to the same ones required at the comprehensive level, which would excessively narrow the choices for contracting authorities.

Technologies classification according to fuels pathway

The relation between vehicles and fuels has been discussed during the stakeholder consultation, and many public procurers agreed that the fuels are not part of the call for tender to purchase the vehicles. The contracts with the fuels suppliers or the

infrastructure installation are settled prior to the purchase of the vehicle. Therefore, the WTT part is evaluated and sorted out separately from the call for tender for the purchase of the vehicle. This means that the criteria for the purchase of vehicles cannot include requirements on the fuels, but the pathways of the fuels supplied clearly influence the GHG reduction potential of certain technologies, and therefore their classification.

In the case of fuel cell electric buses, the WTW GHG saving potential heavily depends on the pathway to produce the hydrogen. If it is from electrolysis using 100% renewable energy, the savings are ensured. On the contrary, the production of hydrogen by means of natural gas steam reforming raises some doubts: one report (TNO (CIVITAS WIKI), 2013) does not include results that prove a better performance but just indicates it is a very promising technology, while another report (Roland Berger, 2015) suggests a saving potential of 10%. Given that this technology is still on the learning curve and further development is needed, it is proposed that fuel cell electric buses are included as class C. However, the contracting authority may classify them as B or A if there is a supply of hydrogen produced with renewable sources generated on-site.

This is also the case of dedicated natural gas buses. If they run on fossil natural gas, the GHG emissions reduction compared to a diesel reference vehicle is very narrow (3 - 4%) (TNO (CIVITAS WIKI), 2013) (TNO (CIVITAS WIKI), 2016), or could even result in an increment of GHG emissions due to efficiency losses derived from replacing compression-ignition diesel engines by spark-ignition dedicated gas engines (Ricardo, 2013), (LowCVP, 2017). However, the use of biomethane turns the natural gas bus into one of the best options. It is therefore proposed that the contracting authority is enabled to qualify dedicated natural gas buses as an eligible technology if there is a supply of renewable methane meeting at least 10% of their demand. The additional 5% is a buffer aimed at offsetting a possible increase of GHG emissions of the vehicle when running on fossil natural gas. The supply of biomethane would also entail the classification of OEM dual-fuel vehicles as B or A, and HPDI vehicles as A. Dual-fuel vehicles require higher percentages since natural gas only shares 50% of their total energy consumption.

Air conditioning

Air conditioning gases are also relevant for buses, because a large share of the bus fleet is equipped with air-conditioning systems (MAC). Buses and coaches are excluded from the MAC Directive (2006/40/EC) which provides a gradual phase-out of refrigerant HFC-134a from mobile air conditioners in passenger cars and light commercial vehicles, although refrigerant R134a is the main refrigerant for buses (some buses use R407C). However, the HFCs used in these systems are affected by the phase-down put in place by the F-gas Regulation (Regulation (EU) No 517/2014), which will exert a strong pressure on prices of these gases as the supply will become more restricted. Therefore, there is a strong regulatory driver in place that favours the use of low GWP or even non-HFC (e.g. CO_2) technologies in this sector.

5.3.2 **Air pollutant emissions**

5.3.2.1 Criterion proposal

<table>
<tr><th>Core criteria</th><th>Comprehensive criteria</th></tr>
<tr><td colspan="2">Technical specification</td></tr>
<tr><td colspan="2">TS2. Air pollutant emissions performance (Same for core and comprehensive)
M_3 vehicles and M_2 vehicles with a reference mass[1)] exceeding 2 610 kg must meet Euro VI.
M_2 vehicles with a reference mass[1)] not exceeding 2 610 kg must comply with the TS2 Air pollutant emission performance of category 1 (Section 3.3.2.1).

Verification:
The tenderer must present the certificate of conformity of the vehicle. For those vehicles having achieved the standard mentioned above following a technical upgrade the measures must be documented and included in the tender, and this must be must be verified by an independent third party.</td></tr>
<tr><td colspan="2">Award criteria</td></tr>
<tr><td>AC3. Improved air pollutant emissions performance
M_3 vehicles and M_2 vehicles with a reference mass exceeding 2 610 kg: Points will be awarded to the following technologies:
natural gas
plug in hybrid electric vehicles (PHEV)[2)]
battery electric vehicles (BEV) and
hydrogen fuel cell electric vehicles (FCEV).
(to be detailed to which extent more points will be attributed to zero tailpipe capable vehicles, i.e. plug in hybrid electric vehicles (PHEV), battery electric vehicles (BEV), and fuel cell electric vehicles (FCEV). Zero tailpipe emissions capable vehicles must be given more points than natural gas buses).

M_2 vehicles with a reference mass not exceeding[1)] 2 610 kg: the formula of the AC3 Improved air pollutant emissions performance and AC4 Zero tailpipe emission capability of category 1 (Section 3.3.2.1) will be applied.

Verification:
The tenderer must provide the vehicle's certificate of conformity. For those vehicles having achieved the abovementioned standard following a technical upgrade the measures must be documented and included in the tender, and this must be verified by an independent third party.</td><td></td></tr>
<tr><td colspan="2">Notes:
1) 'Reference mass' means the mass of the vehicle in running order, as declared in the certificate of conformity, minus the uniform mass of the driver of 75 kg, plus a uniform mass of 100 kg;
2) In the case of plug-in hybrid electric vehicles, the total daily hours that a city bus is operated</td></tr>
</table>

in full electric depends on the specific duty cycle and the charging strategy. Therefore, the contracting authorities need to ensure that the plug-in hybrid buses will be able to maximise their daily hours of operation in full electric mode along their daily cycles using the charging infrastructure available.

5.3.2.2 Rationale

All new buses placed on the market must comply with Euro VI, which sets quite strict limits on air pollutants. Euro VI reduces the PM emission limits by 67% compared to Euro IV and V, and includes a PN (particle number) limit. It also decreases the NOx emission limit by 77% compared to Euro V. The standard also replaces the European Stationary Cycle and Transient Cycle used for testing by the World harmonized Transient cycle, which covers cold and hot start, and in general stricter testing conditions (load, idle time). Euro VI introduces in-service conformity testing using Portable Emission Measurement Systems, the first one to be carried out within 18 months of the approval and then every 2 years. Other changes are a new limit for ammonia emissions--due to the selective catalytic reduction systems using urea--and stricter limits for methane on CNG and LNG vehicles (ICCT, 2015).

The lifetime of buses is quite long, with an average of 12 years (UITP, 2015). The figures of stocks of buses and coaches in EU show that about half of the buses and coaches are older than 10 years. The other half is distributed evenly with age. For this reason, there is a market for used buses that must be taken into account. That leads to a technical specification requesting the compliance with Euro VI, if needed by means of retrofitting exhaust after treatment technology to existing buses.

Tests carried out by LowCVP (LowCVP, 2017) in heavy good vehicles showed that Euro VI had been effective in cutting overall NOx emissions by over 98% when compared to Euro V vehicles. Euro VI dedicated natural gas vehicles increase that reduction in NOx emissions to 99%. According to this report, NOx emissions of dedicated natural gas trucks were 140 mg/km in average, while diesel vehicles emitted 300 mg/km. In the case of buses, TNO report (TNO (CIVITAS WIKI), 2016) estimated that NOx emissions of natural gas buses were below 1 g/km, while Euro VI diesel buses range from 0.5 to 1.1 g/km. PM emissions of natural gas vehicles were below 0.01 g/km and Euro VI diesel bus 0.015 g/km. Only electric and hydrogen buses can reduce the emissions further, to zero tailpipe air pollutants emissions. Therefore, it is proposed to set award criteria to promote those vehicles able to emit below Euro VI limits. However, the compliance of HDVs with Euro VI is measured as mg per kWh delivered by the engine, and therefore, those results are only valid to evaluate compliance and not to compare different vehicles. For this reason, the criterion must set the technologies able to outperform Euro VI, i.e. natural gas, plug-in hybrid, electric and hydrogen vehicles. This set of technologies is equivalent to those included in the definition of clean vehicles within the proposal of revision of the CVD. They are also the same technologies requested by the TS1 Technological improvement options to reduce GHG emissions at comprehensive level (see Section 5.3.1). Therefore, the award criterion is only necessary at core level.

The award criterion gives preference to those vehicles capable to run without emitting any air pollutant, i.e. zero tailpipe emission capable. This definition would include plug-in hybrid, pure electric and hydrogen buses. Given that there is not a harmonised test method to measure the zero tailpipe emissions capability of buses expressed in distance, the criterion is proposed to directly select the technologies. In the case of plug-in hybrid vehicles, the buses may have little capacity to operate full electric, and there is not a harmonised way to compare their performances. According to the to *ZeEUS eBus Report An updated overview of electric buses in Europe* (ZeEUS project, 2017), the total daily hours that a city bus is operated in full electric depends on the specific duty cycle and the charging strategy. The share of full electric hours ranges from 33% of the VECTIA

buses that operate in Valladolid, to 74% of Volvo buses in Stockholm, reaching even 100% in the case of Volvo buses in Gothenburg and the Scania bus in Södertälje (ZeEUS project, 2017). Although it is not possible to set a requirement as a minimum percentage of operation time in full electric, the contracting authorities should be warned about this issue so they are able to make the correct decisions taking into account the charging infrastructure and the specific bus cycles.

The scope of the criterion has been clarified, since some M_2 vehicles are subject to Euro 6 standards, not Euro VI, so the criteria on air pollutant emissions of category 1 should apply to those M_2 vehicles.

5.3.3 **Exhaust pipe location**

5.3.3.1 Proposed criteria

Core criteria	**Comprehensive criteria**
Technical Specification	
TS3. Exhaust pipes (location) (*Same for core and comprehensive)* Vehicles' exhaust pipes must be located on the opposite side of the passenger door at the rear of the vehicle. **Verification:** The tenderer must provide the technical sheet of the vehicle.	

5.3.3.2 Rationale

The stakeholder consultation showed that there is enough support to keep this criterion. The only update proposed is including this requirement as both a core criterion and comprehensive criterion.

5.3.4 **Durability of the battery for battery electric vehicles**

5.3.4.1 Information to set the warranty terms of the batteries for battery electric vehicles.

Explanatory notes
Information to set the warranty terms of the batteries for battery electric vehicles *(If the contracting authority is requiring battery electric vehicles)* According to the ZeEUS eBus report '*An updated overview of electric buses in Europe'* (ZeEUS project, 2017)*, the suppliers of LiFePO4 batteries usually offer warranty periods ranging from 2 to 5 years, 4-5 years being the most frequent period. There is less data on lithium nickel manganese cobalt oxide (LiNiMnCoO2 or NMC) batteries, which range from 2 to 6 years. Lithium titanate batteries show higher warranty periods, up to 15 years, and graphene ultracapacitors from 8 to 11 years. Other suppliers offer tailored warranties depending on the leasing contract, which may include performance monitoring over an agreed timeframe.* *Further details can be found in the ZeEUS eBus report 'An overview of electric buses in Europe':* *http://zeeus.eu/uploads/publications/documents/zeeus-ebus-report-internet.pdf* *The technology of electric vehicles is evolving very quickly towards more durable and reliable batteries. For that reason, the public authority should look at the latest available information on what the market can deliver when formulating the call for tenders.* *Public authorities could also reward longer warranty periods via an award criterion.*

5.3.4.2 Rationale

The report *ZeEUS eBus Report An overview of electric buses in Europe* (ZeEUS project, 2017) gathers the specifications of numerous models of electric buses, including warranty periods. According to this report, the suppliers of $LiFePO_4$ batteries usually offer warranty periods ranging from 2 to 5 years, being 4-5 years the most frequent period. There is less data of Lithium Nickel Manganese Cobalt Oxide ($LiNiMnCoO_2$ or NMC) batteries, which range from 2 to 6 years. Lithium titanate batteries show higher warranty periods, up to 15 years, and graphene ultracapacitors from 8 to 11 years. Other suppliers offer tailored warranties depending on the leasing contract, and which may include performance monitoring over an agreed timeframe.

The ZeEUS report displays very clearly the current EU market of electric buses: the uptake of electric buses has increased in the last years, but the context is still transitional and the transport providers are on a learning curve. A minimum warranty criterion expressed in too rigid terms could jeopardise the development of new technologies and materials in a not yet mature market. However, a stakeholder disagreed with the withdrawal of the battery criteria, since they are a crucial element in the total cost of ownership of the electric vehicles. It was highlighted that all contracts require a minimum warranty of the batteries. Given that it is not possible to set specific criteria that represent all types of buses, technologies and duty cycles, the information provided by the ZeEUS report is included as information to set the terms of the warranties.

6 Category 4: Public Bus Services

6.1 Scope of the category

This category covers the purchase of public bus services using M2 and M3 vehicles by Directive 2007/46.

6.2 Overview of the revision of the EU GPP criteria

In the case of bus services, various types of measures exist for improving the environmental performance. First of all, the whole criteria set proposed for Category 3 as presented in the previous section could be potentially requested when purchasing services. However, an approach based on fleet performance is needed to make these criteria feasible and workable for services, since service providers will usually rely on an existing fleet. In addition, several other criteria would only apply to services. These are discussed below. The common criteria for service categories in Section 11 also apply.

Bus services (EU GPP criteria 2012)					
		Current criterion	**Core**	**Compr**	**Revision**
TECHNICAL SPECIFICATIONS	1	Exhaust gas emissions	X	X	Updated
	2	Noise emissions	X	X	Updated
	3	Lubricant oils	---	X	Updated (see Section 11)
	4	Tyres	---	X	Updated
AWARD CRITERIA	1	Exhaust gas emissions	X	X	Updated
	2	Use of alternative fuels	X	X	Updated
	3	Tyre Pressure Monitoring Systems (TPMS)	---	X	Updated
	4	Air conditioning gases	---	X	Discarded
	5	Vehicle materials	---	X	Discarded
	6	Start and stop	---	X	Discarded
CONBTRACT PERFORMANCE CLAUSES	1	New vehicles	X	X	Updated
	2	Fuel consumption data	X	X	Updated (see Section 11)
	3	Training of drivers	X	X	Updated (see Section 11)
	4	Disposal of lubricant oils and tyres	X	X	Discarded
	5	Wash bays	---	X	Discarded

	Bus services (EU GPP criteria proposal in this report)			
		Proposed criterion	**Core**	**Compr**
TECHNICAL SPECIFICATIONS	1	**Technological options to reduce GHG emissions**	X	X
	2	Tyres - rolling resistance	X	X
	3	Tyre Pressure Monitoring Systems (TPMS)	X	X
	4	**Fuels**	X	X
	5	Air pollutant emissions	X	X
AWARD CRITERIA	1	Technological options to reduce GHG emissions	X	X
	2	Air pollutant emissions	X	X
	3	Noise emissions		X
CPC	1	New vehicles	X	X

6.3 Criteria proposal

6.3.1 GHG emissions

6.3.1.1 Proposed criteria

Core criteria	Comprehensive criteria
Technical Specification *(These criteria apply only if the operators own or lease the service fleet)*	
TS1. Technological options to reduce GHG emissions **Option 1** The bus route/s *[the CA will insert the identification of the route/s]* must be operated using vehicles *[the CA will choose one of the following]:* (a). Equipped with one of the eligible technologies listed among the core TS1 Technological improvement options to reduce GHG emissions of category 3 (Section 5.3.1.1). (b). Equipped with the technology X *[the contracting authority will select the technology among the eligible technologies listed as one of the core TS1 Technological improvement options to reduce GHG emissions of category 3 (Section 5.3.1.1)]* **Option 2:** The fleet must be composed of the following shares of vehicles equipped with one of the eligible technologies listed among the core TS1 Technological improvement options to reduce GHG emissions of category 3 (Section 5.3.1.1).: 2018: 12% 2019: 20% 2020: 28% 2021: 36% The tier applicable will correspond to the year that the call for tender is launched. **Verification:** Same as TS1 Technological improvement options to reduce GHG emissions of category 3 (Section 5.3.1.1) together with the list and technical sheets of the whole fleet.	**TS1. Technological options to reduce GHG emissions** **Option 1** The bus route/s *[the CA will insert the identification of the route/s]* must be operated using vehicles *[the CA will choose one of the following]:* (a). Equipped with one of the eligible technologies listed among the core TS1 Technological improvement options to reduce GHG emissions of category 3 (Section 5.3.1.1). (b). Equipped with the technology X *[the contracting authority will select the technology among the eligible technologies listed as one of the core TS1 Technological improvement options to reduce GHG emissions of category 3 (Section 5.3.1.1)]* **Option 2:** The fleet must be composed of the following shares of vehicles equipped with one of the eligible technologies listed among the core TS1 Technological improvement options to reduce GHG emissions of category 3 (Section 5.3.1.1).: 2018: 24% 2019: 32% 2020: 40% 2021: 48% The tier applicable will correspond to the year that the call for tender is launched. **Verification:** Same as TS1 Technological improvement options to reduce GHG emissions of category 3 (Section 5.3.1.1) together with the list and technical sheets of the whole fleet.

TS2. Tyre Pressure Monitoring Systems (TPMS) (*Same for core and comprehensive)*

All the vehicles must be equipped with systems compliant with TS1 on TPMS as defined in Section 10.1.1 of Common criteria for vehicle categories

Verification:

Same as TS1 on TPMS in Section 10.1.1 of Common criteria for vehicle categories together with the list and technical sheets of the whole fleet.

TS3. Vehicle tyres – rolling resistance (*Same for core and comprehensive)*

All the vehicles must be equipped with tyres compliant with TS2 on vehicle tyres as defined in the Section 10.1.1of Common criteria for vehicle categories

Verification:

Same as TS2 on vehicle tyres in Section 10.1.1of Common criteria for vehicle categories together with the list and technical sheets of the whole fleet.

TS4. Fuels (*Same for core and comprehensive)*

Note: this criterion is applicable only if the contracting authority qualifies or upgrades a technology according to the note of the TS1 Technological improvement options to reduce GHG emissions of category 3 (Section 5.3.1.1) and the tenderer offers that technology to comply with TS1. The contracting authority may set higher percentages of renewable fuel supply according to the available supply in their national or regional market.

The share of renewable fuel supply must comply with the percentages set in the note of the TS1 Technological improvement options to reduce GHG emissions of category 3 (Section 5.3.1.1).

Verification:

The tenderer must provide a copy of the contract(s) that has (have) been signed with the supplier(s) and the description and technical specifications of the production and the dedicated fuel supply system.

Award Criteria *(These criteria apply only if the operators own or lease the service fleet)*

AC1. Technological options to reduce GHG emissions (*Same for core and comprehensive)*

Points will be awarded to tenders offering:

Option 1: more routes than the ones set by the TS1 (see above) to be operated with vehicles compliant with core TS1 of category 3 (Section 5.3.1.1).

Option 2: fleet to be used under the contract with the proportion of vehicles (%) larger than TS1 (see above), in proportion to the excess over the TS1 (see above).

If the fleet is composed of technologies of different classes, triple points than class C will be granted to class A, and double points to class B.

Verification:

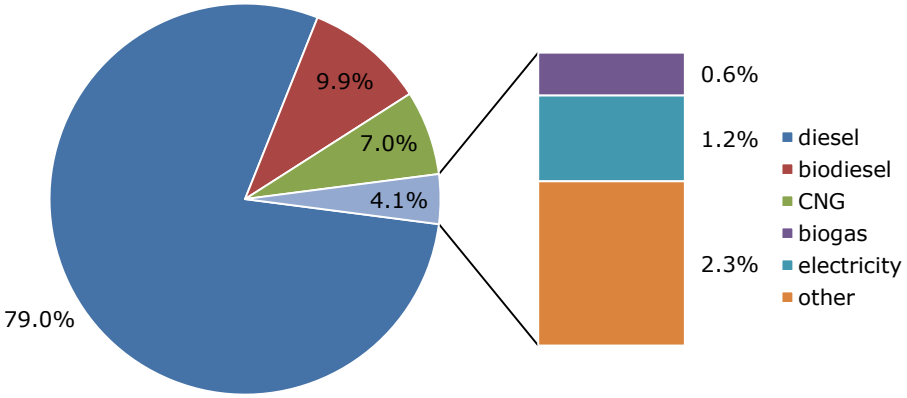
See above TS1

6.3.1.2 Rationale

According to the literature, hybrid technologies are commercially available and should be seen as a first stage of electrification of the EU fleet, with payback times up to 1.5 years (Ricardo, 2013)). Some alternative fuels powertrains are more costly, but could lead to larger GHG emissions savings. The technologies based on aerodynamics are also available but their market penetration is also limited (3 – 10%) (Zacharof & Fontaras, 2016).

The current fleet composition is represented in Figure 3:

Figure 3: Shares of fuel type in current public transport bus fleet in the European Union (3iBS, 2013)



The market penetration of the technologies is expected to grow in the next years driven by the Proposal for a Directive amending Directive 2009/33/EU on the promotion of clean and energy-efficient road transport. The proposal sets minimum procurement targets for the EU countries, for 2025 and 2030, ranging from 29 to 50% in 2025 and from 42 to 75% in 2030. For this reason, the criterion proposal includes different tiers for 2018 to 2020 that reflect that market evolution. Each year the percentage is increased 8%, which would be the replacement rate for vehicles with an average lifetime of 12 years.

Another option would be that the contracting authorities set which routes are to be operated with vehicles equipped with the eligible technologies. This option would be suitable for vehicles that require special infrastructure and also facilitate the verification of the criterion.

For public transport services, it is common that the fleet is owned by the contract authority and just the operation is outsourced. It has been also clarified that the criteria proposal would only apply in those cases where the operator owns or leases the service fleet.

Some stakeholders requested higher percentages (up to 50%) of renewable methane to qualify natural gas vehicles as eligible. The percentages proposed in this report are based on the GHG emissions reduction levels required for all technologies, meaning that higher percentages would break that correlation. In any case, it would need to reflect the current penetration of biomethane which largely varies across Europe. In some countries biogas upgrading is a well-established practice, in others, it is marginal. In 2013, almost 90% of the biogas upgrading capacity was concentrated in Germany, Sweden, and Netherlands (European Biogas Association, 2014). For these reasons, the criterion keeps the percentages set for the vehicle category as minimum, but includes a provision to allow contracting authorities to increase the percentages according to the available supply.

6.3.2 **Air pollutant emissions**

6.3.2.1 Proposed criteria

Core criteria	**Comprehensive criteria**
Technical Specification *(These criteria apply only if the operators own or lease the service fleet)*	
TS5. Air pollutant emissions All buses used in carrying out the service must meet at least Euro V. 2018: 40% of buses must meet Euro VI. 2019: 48% of buses must meet Euro VI. 2020: 56% of buses must meet Euro VI. 2021: 64% of buses must meet Euro VI. The tier applicable will correspond to the year that the call for tender is launched. Where vehicles are not certified as meeting Euro V or higher, but technical after-treatment has achieved the same standard, this should be documented in the tender. **Verification:** The tenderer must present the list of the vehicles of the service fleet and their certificates of conformity. For those vehicles having achieved the standard mentioned above following a technical upgrade the measures must be documented and included in the tender, and this must be verified by an independent third party.	**TS5. Air pollutant emissions** All buses used in carrying out the service must meet at least Euro V. 2018: 60% of buses must meet Euro VI. 2019: 68% of buses must meet Euro VI. 2020: 76% of buses must meet Euro VI. 2021: 84% of buses must meet Euro VI. The tier applicable will correspond to the year that the call for tender is launched. Where vehicles are not certified as meeting Euro V or higher, but technical after-treatment has achieved the same standard, this should be documented in the tender. **Verification:** The tenderer must present the list of the vehicles of the service fleet and their certificates of conformity. For those vehicles having achieved the standard mentioned above following a technical upgrade the measures must be documented and included in the tender, and this must be must be verified by an independent third party.
Core criteria	**Comprehensive criteria**
Award Criteria *(These criteria apply only if the operators own or lease the service fleet)*	
AC2. Air pollutant emissions *(same for core and comprehensive)* Points will be awarded to the fleet to be used under the contract with the proportion of vehicles used in carrying out the service (%) larger than TS6, in proportion to the excess over the TS5, or if the vehicles comply with the AC3 Improved air pollutant emissions performance of Category 3 *(to be detailed to which extent points will be attributed to higher percentages, improved performance and zero tailpipe vehicles. Zero tailpipe emissions capable vehicles must be given more points than natural gas buses)* **Verification:** See above TS5	

6.3.2.2 Rationale

Similarly to the GHG emission criteria, the criteria on air pollutant emissions and EURO compliance should be set as a proportion of the fleet. The average share of Euro VI heavy duty vehicles in the current fleets is 8% (data from ICCT, ACEA and OICA, EU-28 and EFTA average). More than 60% of the heavy duty vehicles using diesel is still equipped with Euro III (implemented in 2000), 11% with Euro IV (in 2005) and 15% complies with Euro V. The average age of the bus fleet has been increasing the last year to reach 55% of buses above 10 years and less than 10% below 2 years (Eurostat, 2015e)

).

It is proposed that all vehicles comply with Euro V at core level, in order to prevent the use of low performance vehicles. A minimum percentage of 40% of Euro VI is proposed for core and 60% for comprehensive level. The replacement of vehicles will naturally increase the penetration of Euro VI in the fleets, and therefore these percentages need to raise yearly according to the typical replacement rates to maintain the same ambition level. For these reason, the criteria proposal includes yearly increments of 8%. This will stimulate the acceleration of the replacement rate to increase the share of Euro VI buses. These technical specifications are complemented with award criteria to promote a better performance of the fleet in line with the criteria of category 3.

6.3.3 **Noise emissions**

6.3.3.1 Proposed criteria

Core criteria	**Comprehensive criteria**
Award Criteria *(These criteria apply only if the operators own or lease the service fleet)*	
	AC3. Noise emissions Points will be awarded to those tenders offering a service fleet totally composed of vehicles compliant with the AC1 on vehicle noise emissions set in the Section 10.2.1 of the common criteria for vehicle categories. **Verification:** The tenderer must present the list of the vehicles of the service fleet and their certificates of conformity.

6.3.3.2 Rationale

Vehicle noise can have significant negative impacts on the health of residents, especially in case of traffic in or nearby residential areas. This is particularly relevant for buses used in urban public transport.

An award criterion is proposed to promote the use of low noise vehicles by the service providers, at comprehensive level to keep the simplicity of the core criteria set.

6.3.4 **New vehicles**

6.3.4.1 Proposed criteria

Core criteria	**Comprehensive criteria**
Contract Performance Clauses *(These criteria apply only if the operators own or lease the service fleet)*	
CPC1. New vehicles (*Same for core and comprehensive)* If a vehicle of the service fleet is replaced, the new vehicle must help in keeping or improving the service fleet features (composition and technologies) in terms of GHG emissions and air pollutant emissions as offered in the tender. The contractor will keep records which must be made available to the contracting authority for verification purposes. The contracting authority may set rules for penalties for non-compliance.	

6.3.4.2 Rationale

A fleet can change over the duration of the contract. In order to maintain the level of environmental performance of the fleet or even to continuously improve it over time, a CPC can lay down the requirements for replacements.

6.4 Criteria proposals withdrawn

6.4.1 **Durability of the battery**

The contracts of public transport service usually include provisions on service quality performance such as reliability, minimum frequencies, etc. In the case of battery electric vehicles, these quality requirements can trigger the adoption of warranty contracts between the contractor and the battery supplier. As explained in Section 5.3.4 the uptake of electric buses has increased in the last years, but the context is still transitional and the transport providers are on a learning curve. For this reason, it is proposed that no criteria on battery warranty are within the service categories.

7 Category 5: Purchase or lease of waste collection vehicles

7.1 Scope of the category

This category covers the purchase or lease of N_2 and N_3 vehicles, as defined by Directive 2007/46, that are designed to provide waste collection services and waste transport services.

7.2 Overview of the revision of the EU GPP criteria

The tables below show a summary of the revision proposal for the current EU GPP criteria of the category 'purchase and lease of waste collection trucks'. The proposal is further described in the following sections. The common criteria for vehicle categories in Section 10 also apply.

Purchase/lease of waste collection trucks (EU GPP criteria 2012)					
		Current criterion	**Core**	**Compr**	**Revision**
TECHNICAL SPECIFICATIONS	1	Exhaust gas emissions	X	X	Updated
	2	Noise emission levels	X	X	Updated (see Section 10)
	3	Pollutant emissions	---	X	Updated
	4	Lubricant oils	---	X	Discarded
	5	Tyres	---	X	Updated (see Section 10)
AWARD CRITERIA	1	Exhaust gas emissions	X	---	updated
	2	Tyre Pressure Monitoring Systems (TPMS)	---	X	Updated (see Section 10)
	3	Vehicle materials	---	X	Discarded

Purchase/lease of waste collection vehicles (EU GPP criteria proposal in this report)				
		Criterion	**Core**	**Compr**
TECHNICAL SPECIFICATIONS	1	**Technological options to reduce GHG emissions**	X	X
	2	Auxiliary units	X	X
	3	Air pollutants	X	X
AWARD CRITERIA	1	**Air conditioning**		X
	2	**Electrification of auxiliary units**		X
	3	**Improved air pollutant emissions performance**	X	X

7.3 Criteria proposal

7.3.1 GHG emissions

7.3.1.1 Proposed criteria

Core criteria	Comprehensive criteria
Technical Specifications	
TS1. Technological options to reduce GHG emissions The vehicle must be equipped with one of the following technologies: • Hybrid vehicles, both diesel and natural gas • Vehicles equipped with energy accumulation/recovery systems • Vehicles equipped with load-sensing hydraulic systems • Vehicles equipped with electric bin lifts • Plug-in hybrid: Vehicle equipped with a battery pack which can be charged from the grid and provides the energy for the electrical drive of the body and lifter • OEM dual-fuel natural gas vehicle with a gas energy ratio over the hot part of the WHTC test-cycle of at least 50%. • High pressure direct injection natural gas vehicles • Full electric vehicles • Hydrogen fuel cell electric vehicles. • Dedicated natural gas vehicles under the conditions set in the note below. *Note: The contracting authorities may include dedicated natural gas vehicles if they have a supply of renewable methane meeting at least 15% of their demand.* **Verification:** The tenderer must present the technical sheet of the vehicle where these technology specifications are stated.	**TS1. Technological options to reduce GHG emissions** The vehicle must be equipped with one of the following technologies: • Plug-in hybrid: Vehicle equipped with a battery pack which can be charged from the grid and provides the energy for the electrical drive of the body and lifter • OEM dual-fuel natural gas vehicle with a gas energy ratio over the hot part of the WHTC test-cycle of at least 50%. • High pressure direct injection natural gas vehicles • Full electric vehicles • Hydrogen fuel cell electric vehicles. • Dedicated natural gas vehicles under the conditions set in the note below. *Note: The contracting authorities may include dedicated natural gas vehicles if they have a supply of renewable methane meeting at least 15% of their demand.* **Verification:** The tenderer must present the technical sheet of the vehicle where these technology specifications are stated.
Award criteria	

	AC1. Air conditioning gases Points will be awarded to those vehicles equipped with an air conditioning system that use a refrigerant with a global warming potential (GWP), related to CO_2 and a time horizon of 100 years, < 150. **Verification**: The tenderer must provide the name, formula and GWP of the refrigerating gas used in the air conditioning system. If a mixture of gases is used (n number of gases), the GWP will be calculated as follows: GWP= Σ(Substance X1 % x GWP(X1)) + (Substance X2 % x GWP(X2)) + … (Substance Xn % x GWP(Xn)) where % is the contribution by weight with a weight tolerance of +/- 1 %. GWP of gases can be found in Annexes I and II of Regulation (EU) No 517/2014 (http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2014.150.01.0195.01.ENG)

7.3.1.2 Rationale

The stakeholder consultation suggests that a technology-neutral approach based on GHG emissions could be explored as an option to revise the criterion on alternative fuels in waste collection trucks. Most comments were very similar to the ones on buses, and the rationale for the criterion proposed on GHG emissions (see Section 5.3.1) is almost fully applicable to waste collection trucks.

There is the same lack of robust and comparable data on energy consumption of waste collection trucks, but with additional hindrances. The VECTO tool is aimed at measuring and reporting CO_2 emissions from heavy vehicles, but it will not include waste collection duty cycles in the mid-term.

For these reasons, the only possible option is Option 2 technology-specific approach: the criterion is proposed to promote directly the technologies that have been identified as improvement options.

Option 2: technology-specific approach

The EU GPP criteria should promote the best technologies currently in the market. The report *Opportunities to overcome the barriers to uptake of low emission technologies for each commercial vehicle duty cycle* (Ricardo AEA, 2012) identified hybrid vehicles and natural gas vehicles as potential options to reduce GHG emissions compared a to conventional diesel vehicle.

The results for hybrid vehicles are confirmed by other references (Zacharof & Fontaras, 2016), (ICCT, 2017). For natural gas vehicles, the same rationale as for buses (see Section 5.3.1.2) would apply.

Specific technologies for waste collection vehicles have been identified by the European Association of Municipal Equipment Manufacturers (EUnited Municipal Equipment, 2014). They include both drivetrain and compaction and lifting technologies. Apart from hybrid vehicles, the following technical improvements are identified in this report:

- Energy accumulation/recovery system with hydraulic accumulators: a group of hydraulic accumulators transforms into potential hydraulic energy the kinetic energy of the vehicle during the braking phase and the stationary phase when the

vehicle is idling. The stored energy can be used during operational phases like bin emptying and compaction.

- Electric bin lift range; this electric drive technology eliminates the need for increased engine rev during operation; it can even operate while the engine is off.
- Plug-in vehicles: the vehicle is equipped with a battery pack which can be charged overnight at low power consumption times provides the energy for the electrical drive of the body and lifter. The vehicle is still driven by the truck's diesel engine.
- Load-sensing-hydraulic system: the flow-capacity of the pump will be regulated through the load-sensing-pressure.

Unfortunately, the information available is very scarce, and there is not enough data of CO_2 reductions that enable the classification of technologies which is necessary to formulate a combination of technical specification and award criterion. The comprehensive level has been differentiated from the core level in order to align it to the definition of clean HDV of the Proposal for a Directive amending Directive 2009/33/EU on the promotion of clean and energy-efficient road transport (COM(2017) 653 Annex Table 5). This definition encompasses hydrogen vehicles, full electric and plug-in hybrid vehicles and natural gas vehicles

Air conditioning

The rationale would be the same as for buses (see Section 5.3.1)

7.3.2 **Auxiliary units**

7.3.2.1 Proposed criteria

Core criteria	**Comprehensive criteria**
Technical Specification	
TS2. Auxiliary units (*Same for core and comprehensive)* The vehicle's emissions from the separate engines for auxiliary units (e.g. compactor, lifter, etc. to be defined by the contracting authority) must meet the exhaust emission limits according to Regulation (EU) No 2016/1628, Stage V. **Verification:** The tenderer must present either a type approval certificate, or a test report from an independent laboratory according to the Regulation (EU) No 2016/1628.	
Award criteria	
	AC2. Electrification of auxiliary engines Points will be awarded to those vehicles equipped with electric auxiliary units. **Verification:** The tenderer must present the technical sheet of the vehicle where this information is stated.

7.3.2.2 Rationale

The current EU GPP criteria are extracted from the Blue Angel standard RAL-UZ 59 'Low-Noise and Low-Pollutant Municipal Vehicles and Buses'. This document has been updated in April 2014. The requirements within the RAL-UZ 59 are based on compliance with the Directive 97/68/EEC (Stage IIIa), which was replaced by Regulation (EU) No 2016/1628 of the requirements related to gaseous and particulate pollutant emission limits and type-approval for internal combustion engines for non-road mobile machinery (NRMM). The NRMM Regulation defines emission limits for NRMM engines for different power ranges and applications. It also lays down the procedures engine manufacturers have to follow in order to obtain type-approval of their engines. The Stage V limits came into effect on 1 January 2018 for approval of new engine types, and in 2019 for all engines placed in the market. Therefore it is proposed as technical specification at core and comprehensive levels.

An award criterion is added for the electrification of the auxiliary engines. Electrification of the stationary phases of operation could significantly reduce the need to turn on the internal combustion engines and thus reduce both air pollutant and noise emissions.

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7.3.3 **Air pollutant emissions**

7.3.3.1 Criterion proposal

<table>
<tr><th>Core criteria</th><th>Comprehensive criteria</th></tr>
<tr><td colspan="2">Technical specification</td></tr>
<tr><td colspan="2">TS3. Air pollutant emissions performance (Same for core and comprehensive)
N_3 vehicles and N_2 vehicles with a reference mass[1)] exceeding 2 610 kg must meet Euro VI.
N_2 vehicles with a reference mass[1)] not exceeding 2 610 kg must comply with the TS2 Air pollutant emission performance of category 1 (Section 3.3.2.1).

Verification:
The tenderer must present the certificate of conformity of the vehicle. For those vehicles having achieved the standard mentioned above following a technical upgrade the measures must be documented and included in the tender, and this must be must be verified by an independent third party.
.</td></tr>
<tr><td colspan="2">Award criteria</td></tr>
<tr><td>AC3. Improved air pollutant emissions performance
N_3 vehicles and N_2 vehicles with a reference mass exceeding 2 610 kg: Points will be awarded to the following technologies:
natural gas
plug-in hybrid electric vehicles (PHEV)[2)]
battery electric vehicles (BEV) and
hydrogen fuel cell electric vehicles (FCEV).
(to be detailed to which extent more points will be attributed to zero tailpipe capable vehicles, i.e. plug in hybrid electric vehicles (PHEV), battery electric vehicles (BEV), and fuel cell electric vehicles (FCEV) Zero tailpipe emissions capable vehicles must be given more points than natural gas vehicles)

N_2 vehicles with a reference mass not exceeding[1)] 2 610 kg: the formula of the AC3 Improved air pollutant emissions performance and AC4 Zero tailpipe emission capability of category 1 (Section 3.3.2.1) will be applied.

Verification:
The tenderer must provide the vehicle’s certificate of conformity. For those vehicles having achieved the abovementioned standard following a technical upgrade the measures must be documented and included in the tender, and this must be verified by an independent third party.</td><td></td></tr>
<tr><td colspan="2">Notes:
1) 'Reference mass' means the mass of the vehicle in running order, as declared in the certificate of conformity, less the uniform mass of the driver of 75 kg and increased by a uniform mass of</td></tr>
</table>

100 kg;
[2)] In the case of plug-in hybrid electric vehicles, the total daily hours that a truck is operated in full electric depends on the specific duty cycle and the charging strategy. Therefore, the contracting authorities need to ensure that the plug-in hybrid trucks will be able to maximise their daily hours of operation in full electric mode along their daily cycles using the charging infrastructure available.

7.3.3.2 Rationale

The rationale is the same as for buses.

8 Category 6: Waste collection services

8.1 Scope of the category

This category covers the purchase of waste collection services.

8.2 Overview of the revision of the EU GPP criteria

In the case of waste collection services, various types of measures exist for improving the environmental performance. First of all, the whole criteria set proposed for Category 5 as presented in the previous section could be potentially requested when purchasing services. However, an approach based on fleet performance is needed to make these criteria feasible and workable for services. In addition, several other criteria would only apply to services. These are discussed below. The common criteria for service categories in Section 11 also apply.

Waste collection services (EU GPP criteria 2012)					
		Current criterion	**Core**	**Compr**	**revision**
TECHNICAL SPECIFICATIONS	1	Exhaust gas emissions	X	X	updated
	2	Noise emissions	X	X	updated
	3	Pollutant emissions	---	X	updated
	4	Lubricant oils	---	X	Updated (see Section 11)
	5	Tyres	---	X	Updated
AWARD CRITERIA	1	Exhaust gas emissions	X	X	updated
	2	Use of alternative fuels	X	X	updated
	3	Tyre Pressure Monitoring Systems (TPMS)	---	X	updated
	4	Vehicle materials	---	X	discarded
CONBTRACT PERFORMANCE CLAUSES	1	New vehicles	X	X	updated
	2	Fuel consumption data	X	X	Updated (see Section 11)
	3	Training of drivers	X	X	Updated (see Section 11)
	4	Disposal of lubricant oils and tyres	X	X	discarded
	5	Wash bays	---	X	discarded

	Waste collection services (EU GPP criteria proposal in this report)			
		Proposed criterion	**Core**	**Compr**
TECHNICAL SPECIFICATIONS	1	**Technological options to reduce GHG emissions**	X	X
	2	Tyres - rolling resistance	X	X
	3	Tyre Pressure Monitoring Systems (TPMS)	X	X
	4	Air pollutant emissions	X	X
AWARD CRITERIA	1	**Technological options to reduce GHG emissions**	X	X
	2	Air pollutant emissions	X	X
	3	Auxiliary units	X	X
	4	Noise emissions		X
CPC	1	New vehicles	X	X

8.3 Criteria proposal

8.3.1 **GHG emissions**

8.3.1.1 Proposed criteria

Core criteria	**Comprehensive criteria**
Technical Specification *(These criteria apply only if the operators owns or leases the service fleet)*	
TS1. Technological options to reduce GHG emissions **Option 1** The waste collection route/s *[the CA will insert the identification of the route/s]* must be operated using vehicles *[the CA will choose one of the following]:* (a). Equipped with one of the eligible technologies listed among the core TS1 Technological options to reduce GHG emissions of category 5 (Section 7.3.1.1). (b). Equipped with the technology X *[the contracting authority will select the technology among the eligible technologies listed as one of the core TS1 Technological options to reduce GHG emissions of category 5 (Section 7.3.1.1)]* **Option 2:** The fleet must be composed of the following shares of vehicles equipped with one of the eligible technologies listed among the core TS1 Technological options to reduce GHG emissions of category 5 (Section 7.3.1.1): 2018: 12% 2019: 20% 2020: 28% 2021: 36% The tier applicable will correspond to the year that the call for tender is launched. **Verification:** same as the core TS1 Technological options to reduce GHG emissions of category 5 (Section 7.3.1.1) together with the list and technical sheets of the whole fleet.	**TS1. Technological options to reduce GHG emissions** **Option 1** The waste collection route/s *[the CA will insert the identification of the route/s]* must be operated using vehicles *[the CA will choose one of the following]:* (a). Equipped with one of the eligible technologies listed among the core TS1 Technological options to reduce GHG emissions of category 5 (Section 7.3.1.1).. (b). Equipped with the technology X *[the contracting authority will select the technology among the eligible technologies listed as one of the core TS1 Technological options to reduce GHG emissions of category 5 (Section 7.3.1.1)]* **Option 2:** The fleet must be composed of the following shares of vehicles equipped with one of the eligible technologies listed among the core TS1 Technological options to reduce GHG emissions of category 5 (Section 7.3.1.1): 2018: 24% 2019: 32% 2020: 40% 2021: 48% The tier applicable will correspond to the year that the call for tender is launched. **Verification:** same as the TS1 Technological options to reduce GHG emissions of category 5 (Section 7.3.1.1) together with the list and technical sheets of the whole fleet.

TS2. Tyre Pressure Monitoring Systems (TPMS) (*Same for core and comprehensive)* All the vehicles must be equipped with systems compliant with TS1 on TPMS as defined in Section 10.1 of Common criteria for vehicle categories **Verification:** Same as TS1 on TPMS in Section 10.1.1 of Common criteria for vehicle categories together with the list and technical sheets of the whole fleet.
TS3. Vehicle tyres – rolling resistance (*Same for core and comprehensive)* All the vehicles must be equipped with tyres compliant with TS2 on vehicle tyres as defined in the Section 10.1.1of Common criteria for vehicle categories **Verification:** Same as TS2 on vehicle tyres in Section 10.1.1of Common criteria for vehicle categories together with the list and technical sheets of the whole fleet.
TS4. Fuels (*Same for core and comprehensive)* *Note: this criterion is applicable only if the contracting authority qualifies dedicated natural gas vehicles as eligible technology and the tenderer offers dedicated natural gas vehicles to comply with TS1 (see above). The contracting authority may set higher percentages of renewable fuel supply according to the available supply in their national or regional market.* At least 15% of the methane supply must be renewable methane. **Verification:** The tenderer must provide a copy of the contract(s) that has (have) been signed with the supplier(s) and the description and technical specifications of the production and the dedicated fuel supply system.
Award Criteria *(These criteria apply only if the operators owns or leases the service fleet)*
AC1. Technological options to reduce GHG emissions (*Same for core and comprehensive)* Points will be awarded to tenders offering: Option 1: more routes than the ones set by the TS1 (see above) to be operated with vehicles compliant with core TS1 of category 3 (Section 7.3.1.1) Option 2: fleet to be used under the contract with the proportion of vehicles (%) larger than the TS1, in proportion to the excess over the TS1 (see above). **Verification:** See TS1 above

8.3.1.2 Rationale

Similar to public road transport services, waste collection services are usually contracted to provide a public service to citizens within a network over a contract period. Therefore, it would be feasible to request a fleet composition since all the vehicles are to be providing the service contracted.

In terms of alternative fuels Eurostat statistics show that the share of electrical energy in trucks is still very limited (<1%) and the biggest growth is happening for natural gas vehicles with a load capacity <1500 kg. Natural gas vehicles >1500 kg are also limited (Eurostat, 2015g)

The market penetration of the technologies is expected to grow in the next years driven by the Proposal for a Directive amending Directive 2009/33/EU on the promotion of clean and energy-efficient road transport. The proposal sets minimum procurement targets for the EU countries, for 2025 and 2030. For this reason, the criterion proposal includes different tiers for 2018 to 2020 that reflect that market evolution.

Another option would be that the contracting authorities set which routes are to be operated with vehicles equipped with the eligible technologies. This option would be suitable for vehicles that require special infrastructure and also facilitate the verification of the criterion.

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8.3.2 **Air pollutant emissions**

8.3.2.1 Proposed criteria

Core criteria	**Comprehensive criteria**
Technical Specification *(These criteria apply only if the operators owns or leases the service fleet)*	
TS5. Air pollutant emissions All HDVs used in carrying out the service must meet at least Euro V. 2018: 40% of HDVs must meet Euro VI. 2019: 48% of HDVs must meet Euro VI. 2020: 56% of HDVs must meet Euro VI. 2021: 64% of HDVs must meet Euro VI The tier applicable will correspond to the year that the call for tender is launched. Where vehicles are not certified as meeting Euro V or higher, but technical after-treatment has achieved the same standard, this should be documented in the tender. **Verification:** The tenderer must present the list of the vehicles of the service fleet and their certificates of conformity. For those vehicles having achieved the standard mentioned above following a technical upgrade the measures must be documented and included in the tender, and this must be verified by an independent third party.	**TS5. Air pollutant emissions** All HDVs used in carrying out the service must meet at least Euro V. 2018: 60% of HDVs must meet Euro VI. 2019: 68% of HDVs must meet Euro VI. 2020: 76% of HDVs must meet Euro VI. 2021: 84% of HDVs must meet Euro VI The tier applicable will correspond to the year that the call for tender is launched. Where vehicles are not certified as meeting Euro V or higher, but technical after-treatment has achieved the same standard, this should be documented in the tender. **Verification:** The tenderer must present the list of the vehicles of the service fleet and their certificates of conformity. For those vehicles having achieved the standard mentioned above following a technical upgrade the measures must be documented and included in the tender, and this must be verified by an independent third party.
Award Criteria *(These criteria apply only if the operators owns or leases the service fleet)*	
AC2. Air pollutant emissions (*Same for core and comprehensive)* Points will be awarded to the fleet to be used under the contract with the proportion of vehicles used in carrying out the service (%) larger than TS5, in proportion to the excess over the TS5 (see above), or if the vehicles comply with the AC3 Improved air pollutant emissions performance of category 5 (Section 7.3.3.1) *(to be detailed to which extent points will be attributed to higher percentages, improved performance and zero tailpipe vehicles. Zero tailpipe emissions capable vehicles must be given more points than natural gas vehicles)* **Verification:** See above TS5	
AC3. Auxiliary units (*Same for core and comprehensive)* Points will be awarded based on the proportion of vehicles that comply with the TS2 Auxiliary units of category 5 (Section 7.3.2) **Verification:** See TS2 of category 5 (Section 7.3.2).	

8.3.2.2 Rationale

The rationale is the same as for buses used in public transport services. An award criterion for auxiliary units compliant with the criteria of category 5 is also proposed.

8.3.3 **Noise emissions**

8.3.3.1 Proposed criteria

Core criteria	**Comprehensive criteria**
Award Criteria *(These criteria apply only if the operators owns or leases the service fleet)*	
	AC4. Noise emissions Points will be awarded to those tenders offering a service fleet totally composed of vehicles compliant with the AC1 on vehicle noise emissions set in the section 10.2.1 Common criteria for vehicle categories. **Verification:** The tenderer must present the list of vehicles of the service fleet and their certificates of conformity

8.3.3.2 Rationale

Tyre noise

The same Regulations as for passenger cars/LCVs are relevant for trucks as well, although buses use C2 or C3 tyres, while passenger/cars/ LCVs use C1 tyres. This makes the same rationale can be followed as for these light duty vehicles: allowing only the top class of the Tyre Labelling Directive of 3 dB less than prescribed by Regulation 661/2009.

The criterion is proposed to be a TS at comprehensive level and a core award criterion at core level.

Vehicle noise

The current EU GPP criteria are based on the Blue Angel standard 'Low-Noise and Low-Pollutant Municipal Vehicles and Buses'. This document has been updated in April 2014 and set a limit of 98 dB for operating noise.

Regulation (EU) No 540/2014 sets noise limits for N3 vehicles between 79 and 82 dB(A) for phase 1 and being applicable for new vehicles types from 1 July 2016. . Phase 2 (range 77 – 81 dB(A)) will be applicable for new vehicle type from 1 July 2020 and for first registration from 1 July 2022, and phase 3 (range 76 – 79 dB(A)) will be applicable for new vehicle type from 1 July 2024 and for first registration from 1 July 2026. The regulation does not include any provision to exclude waste collection trucks, or vehicles for special purposes, in general. According to a report from TNO (TNO, 2012), there was technology commercially available for shielding and encapsulation for trucks in 2010, and there were models that fulfilled phase 3 limits available in the market. Therefore, the award criterion at comprehensive level is proposed to promote phase 3 compliant vehicles in line with the other categories.

8.3.4 **Route optimisation**

8.3.4.1 Proposed explanatory notes

Explanatory note
Route optimisation There are route optimisation systems incorporating computerised vehicle routing and scheduling (CVRS) technology that are able to reduce fuel consumption by 5 % to 15 %. These systems may use: (a). models that predict the level of filling of bins, based on data from Pay-as-you–throw systems or by means of weight systems installed in the trucks (b). sensors set inside the bins that monitor real time data of the level of filling of bins. Both technologies are currently mature and available on the market. Therefore, it is recommended that the contracting authority explore the possibilities of implementing these route optimisation systems within their waste collection systems.

8.3.4.2 Rationale

There are commercially available software tools incorporating Computerised Vehicle Routing and Scheduling (CVRS) technology that could improve the modelling and optimisation of collection operations (Zeschmar-Lahl, et al., 2016). Zeschmar-Lahl et al also describe some examples of collection optimisation, where CVRS were able to reduce the fuel consumption from 5% to 15%. These models could be fed with data from Pay-as-you–throw systems or by means of weight systems installed in the trucks. There are also systems providing real time data of the bin fill level. A case study resulted in a reduction of the collection and hauling distances by 17%, the number of stops to collect containers is decreased by 14% and the operational cost (fuel consumption) reduced by 15% (Johansson, 2016). However, the implementation of these systems seem to be decided at strategic level by the contracting authorities in charge of waste collection services, so tenderers would not offer them as a bonus over their competitors' offers. For this reason, only an explanatory note informing about the benefits of the route optimisation systems is proposed.

8.3.5 **New vehicles**

8.3.5.1 Proposed criteria

Core criteria	**Comprehensive criteria**
Contract Performance Clauses *(These criteria apply only if the operators owns or leases the service fleet)*	
CPC1. New vehicles (*Same for core and comprehensive)* If a vehicle of the service fleet is replaced, the new vehicle must help in keeping or improving the service fleet features (composition and technologies) in terms of GHG emissions and air pollutant emissions as it was offered in the tender. The contractor will keep records which must be made available to the contracting authority for verification purposes. The contracting authority may set rules for penalties for non-compliance.	

8.3.5.2 Rationale

The same rationale as for buses applies for this category.

9 Category 7: Post, courier and moving services

9.1 Scope of the category

This category covers the procurement of post, courier and moving services, which comprise:

- Group 641 Post and courier services, with the exception of rail, airmail and mail transport over water
- 79613000-4 Employee relocation services
- 63100000-0 Cargo handling and storage services
- 98392000-7 Relocation services

9.2 Overview of the new EU GPP criteria

The table below show a summary of the proposal for the EU GPP criteria of the new category 'post, courier and moving services'. The proposal is further described in the following sections. As for another services, an approach based on fleet performance is needed to make the criteria feasible and workable. The common criteria for service categories in Section 11 also apply.

	Post, courier and moving services (EU GPP criteria proposal in this report)			
		Proposed criterion	**Core**	**Compr**
TS	1	Cyclelogistics		X
	2	Air pollutant emissions	X	X
AWARD CRITERIA	1	CO_2 emissions	X	X
	2	Air pollutant emissions	X	X

9.3 Criteria proposal

9.3.1 GHG emissions

9.3.1.1 Proposed criteria

Core criteria	**Comprehensive criteria**
Technical specification	
TS1. Cyclelogistics (*Same for core and comprehensive)* *Note: this TS will apply to vehicles used in post and courier urban deliveries. Public authorities could also prescribe for what kind of deliveries cyclelogistics have to be used.* (*in cities where the urban infrastructure is suitable, and there are sufficient cyclelogistics operators*). The tenderer must offer a service fleet that includes cycles and cycle trailers, which may be electrically power assisted cycles. The cycles and cycle trailers will be aimed at minimising the use of motorised vehicles and addressing last mile issues, according to the emissions reduction plan set by the TS1 Environmental management practices within the common criteria for service categories. This criterion may be fulfilled by means of a partnership with an urban consolidation centre whose fleet is composed by bikes and cargo bikes. **Verification:** The tenderer will present the specifications of the service fleet, and where applicable the partnership agreement with the urban consolidation centre	
Award criteria	
AC1. CO_2 emissions (only applicable to LCVs and L-category vehicles) (*Same for core and comprehensive)* Points will be awarded to those tenders offering a service fleet where: - For LCVs: the average CO_2 type approval must comply with core TS1 of Category 1, tier corresponding to the year of the call for tender. Points will be awarded proportionally to the average CO_2 type approval of the fleet. - For L-category vehicles: all the L-category vehicles used in the service must be electric. **Verification:** the tenderer must present, in a spreadsheet, the list of the vehicles of the service fleet, their CO_2 emissions type approval (supported by the respective certificates of conformity) and their average calculation.	

9.3.1.2 Rationale

The rational for this criterion proposal can be extracted from the different sections addressing LCV and L-category vehicles, together with a fleet performance approach. The first version of the technical report proposed a criterion based on fleet composition. However, setting requirements on a share of the fleet does not ensure the performance of the group of vehicles actually providing the service, especially if they are part of a large fleet, or if the service consists of a limited number of individual deliveries. Therefore, the criteria proposal has been reformulated as an award criterion that gives points to those service fleets whose average CO_2 type approval comply with the core TS1 for category 1. This approach will give the companies enough flexibility to plan the fleet replacements. Another option would be requiring all vehicles to meet a threshold, but it would be too strict and unrealistic according to the common fleet management practices.

The criterion based on an average is more representative of the performance of the fleet as a whole, instead of setting percentages on the fleet compositions which would only ensure the performance of a share. As described in Sections 5.3.1 and 7.3.1, there is not a comparable monitoring and reporting system for CO_2 emissions of heavy duty vehicles yet in force, so these criteria apply only to LCVs.

Cyclelogistics has demonstrated its capability to operate in urban deliveries. According to CIVITAS 42% of all motorized trips in urban areas could be shifted to logistics by bicycle (this corresponds to 25% of all trips) (EPOMM, 2012). Also a deliverable within the project Cyclelogistics ahead (Chiffi & Galli, 2014a) indicates a high potential for municipal document delivery, like small documents, internal mail and consultation documents to residents, to shift to cargo bikes. It is proposed as technical specification, requiring that the fleet contains cycles and cycle trailers, aimed at helping operators to address last mile issues, within the framework of the emissions reduction plan set by the TS1 Environmental management practices.

9.3.2 **Air pollutant emissions**

9.3.2.1 Proposed criteria

Core criteria	**Comprehensive criteria**
Technical Specification	
TS2. Air pollutant emissions All HDV used in carrying out the service must meet at least Euro V. 2018: 40% of HDV must meet Euro VI. 2019: 48% of HDV must meet Euro VI. 2020: 56% of HDV must meet Euro VI. 2021: 64% of HDV must meet Euro VI. Where vehicles are not certified as meeting Euro V or higher, but technical after-treatment has achieved the same standard, this should be documented in the tender. All LDV used in carrying out the service must meet at least Euro 5. 2018: 40% of LDV must meet Euro 6. 2019: 50% of LDV must meet Euro 6. 2020: 60% of LDV must meet Euro 6. 2021: 70% of LDV must meet Euro 6. All L-category vehicles used in carrying out the service must meet at least Euro 3. 2018: 40% of L-category vehicles must meet Euro 4. 2019: 50% of L-category vehicles must meet Euro 4. 2020: 60% of L-category vehicles must meet Euro 4. 2021: 70% of L-category vehicles must meet Euro 4. The tier applicable will correspond to the year that the call for tender is launched. **Verification:** The tenderer must provide the technical sheets of the vehicles where emission standards are defined. For those vehicles having achieved the standard mentioned above following a technical upgrade the measures must be documented and included in the tender, and this must be verified by an independent third party.	**TS2. Air pollutant emissions** TS2.1. All HDV used in carrying out the service must meet at least Euro V. 2018: 60% of HDV must meet Euro VI. 2019: 68% of HDV must meet Euro VI. 2020: 76% of HDV must meet Euro VI. 2021: 84% of HDV must meet Euro VI. Where vehicles are not certified as meeting Euro V or higher, but technical after-treatment has achieved the same standard, this should be documented in the tender. All LDV used in carrying out the service must meet at least Euro 5. 2018: 60% of LDV must meet Euro 6. 2019: 70% of LDV must meet Euro 6. 2020: 80% of LDV must meet Euro 6. 2021: 90% of LDV must meet Euro 6. 2018: 10% of LDV must meet the Euro 6d-TEMP or Euro 6d standard. 2019: 15% of LDV must meet the Euro 6d-TEMP or Euro 6d standard. 2020: 20% of LDV must meet the Euro 6d-TEMP or Euro 6d standard. 2021: 25% of LDV must meet the Euro 6d-TEMP or Euro 6d standard. All L-category vehicles used in carrying out the service must meet at least Euro 3. 2018: 60% of L-category vehicles must meet Euro 4. 2019: 70% of L-category vehicles must meet Euro 4. 2020: 80% of L-category vehicles must meet Euro 4. 2021: 90% of L-category vehicles must meet Euro 4. The tier applicable will correspond to the year that the call for tender is launched. TS2.2. *In case of post and courier deliveries in urban areas with air quality issues:* LDVs and L-category vehicles must have zero tailpipe emissions If there is no charging infrastructure available, or the expected use profile requires large ranges: The vehicles may at the least be zero tailpipe emissions capable, meaning a LCV that

	can travel the minimum range of 40 km without emitting any tailpipe emissions. **Verification:** The tenderer must provide the technical sheets of the vehicles where emission standards are defined, and where applicable the partnership agreement with the urban consolidation centre. For those vehicles having achieved the standard mentioned above following a technical upgrade the measures must be documented and included in the tender, and this must be verified by an independent third party.
Award Criteria	
AC2. Air pollutant emissions (*Same for core and comprehensive, not applicable if zero tailpipe emissions required for all vehicles in the technical specification TS2.2)* Points will be awarded to those tenders offering either: (a). A higher percentage than the one set by the TS2 (see above), or (b). Cars and LCVs and L-category vehicles that have an emission performance better than Euro 6/4 that have an emission performance better than Euro 6/4 OR (c). Natural gas HDVs and zero-emission capable vehicles, meaning with a minimum range of 40 km without emitting any tailpipe emissions for cars and LCVs, and plug in hybrid electric vehicles (PHEV), battery electric vehicles (BEV), and fuel cell electric vehicles (FCEV) for buses *(to be detailed to what extent points will be attributed to higher percentages, better performance and zero tailpipe vehicles. Zero tailpipe emission capable vehicles must be given more points than vehicles with better performance than Euro 6/4 and natural gas HDVs)*. **Verification:** See TS2 above	

9.3.2.2 Rationale

The rational for this criterion proposal can be extracted from the different sections addressing LCV, HDV and L-category vehicles, and the same as for mobility services (see Section 4.3.2). However, mobility services are able to provide an environmental benefit just for replacing the purchase of a vehicle, while this is not the case for post, courier and moving services. Hence, there is no need of simplified criteria that encourage the choice of these services over other ones, and that brings enough room at core level for more criteria, and more complexity at comprehensive level. This is why the criteria comprise a percentage of vehicles complying with Euro 6d-TEMP or Euro 6d standard at comprehensive level, to incentivise the penetration of the Euro 6d stage

10 Common criteria for vehicle categories 1, 3 and 5

10.1 Technical options to reduce GHG emissions

10.1.1 Proposed criteria

Core criteria	Comprehensive criteria
Technical Specification	
TS1. Tyre Pressure Monitoring Systems (TPMS) (*Same for core and comprehensive)* LCVs and heavy duty vehicles must be equipped with tyre pressure monitoring systems, meaning a system fitted on a vehicle which can evaluate the pressure of the tyres or the variation of pressure over time and transmit corresponding information to the user while the vehicle is running, or, in the case of buses and waste collection trucks, with systems that transmit corresponding information to the operator site. **Verification:** The tenderer must provide the technical sheet of the vehicle where this information is stated.	
TS2. Vehicle tyres – rolling resistance (*Same for core and comprehensive)* *(not to be used if, for safety reasons, tyres with the highest wet grip class, snow tyres or ice tyres are needed)* The vehicles must be equipped with a) Tyres that comply with the highest fuel energy efficiency class for rolling resistance expressed in kg/tonne, as defined by Regulation (EC) No 1222/2009 of the European Parliament and of the Council of 25 November 2009 on the labelling of tyres with respect to fuel efficiency and other essential parameters. OR b) Retreaded tyres *Note: Regulation (EC) No 1222/2009 is currently under revision, and as part of this process, the European Commission has put forward proposal COM(2018) 296. This criterion will need to be updated according to the new legislation, once it is in force.* **Verification:** The tenderer must provide the label of the tyre according to Regulation (EC) No 1222/2009 for tyres under case a, or the Notice of approval according to Annex 1 of UNECE Regulation 109 for retreaded tyres (case b).	
TS3. Vehicle specific eco-driving information (*Same for core and comprehensive)* Vehicles must be equipped with information/ instructions on eco driving. In the case of ICEV, the user manual of the vehicle must include guidelines on early shifting, maintaining a steady speed at low revolutions per minute (RPM) and anticipating traffic flows. In case of hybrid and electric vehicles, the information must include information on the use of the regenerative braking to save energy. For plug-in hybrid electric vehicles and range extender electric vehicles, the instructions must include specific instructions to maximise the kilometres driven electrically. This information / instructions may be provided in the form of training sessions (if the public authority choses this option, it needs to prescribe a minimum amount of hours of training to be provided). **Verification:** The tenderer must provide the technical sheet of the vehicle where this information is stated or description and the contents of the training sessions.	

10.1.2 **Rationale**

Tyre pressure monitoring systems (TPMS)

Tyre pressure monitoring systems are monitoring tools that help a driver to adjust their behaviour and achieve an average fuel consumption reduction of 1% (Mustafic, et al., 2014) at relative low cost (€220 without shipping and installation). TPMS have a cost-effectiveness of -€39 and -€64/tCO_2). TPMS are mandatory for new passenger cars, but not for LCVs and heavy duty vehicles.

Vehicle tyres/rolling resistance

Low rolling resistance tyres can reduce fuel consumption by a few percent. The best performing tyres according to the Tyre Labelling Directive are widely available, but often not chosen by consumers due to low awareness. In addition to this, the Energy Efficiency Directive 2012/27/EU states:

'Central governments that purchase products, services or buildings, insofar as this is consistent with cost-effectiveness, economical feasibility, wider sustainability, technical suitability, as well as sufficient competition, must: …

..- purchase only tyres that comply with the criterion of having the highest fuel energy efficiency class, as defined by Regulation (EC) No 1222/2009 of the European Parliament and of the Council of 25 November 2009 on the labelling of tyres with respect to fuel efficiency and other essential parameters. This requirement must not prevent public bodies from purchasing tyres with the highest wet grip class or external rolling noise class where justified by safety or public health reasons'

Given the market availability, it seems to be justified to also require public procurers to purchase vehicles equipped with new tyres of the highest fuel energy efficiency class, as part of the EU GPP criteria. Therefore it is included as a technical specification for core and comprehensive.

The Regulation (EC) No 1222/2009 does not apply to retreaded tyres, which must comply with the provisions of UNECE Regulation 109 as a compulsory condition to be placed on the market. The use of retreaded tyres instead of new tyres brings environmental benefits due to the reduction of raw materials consumption and waste generation. Therefore, the technical specification can be complied with both low rolling resistance tyres and retreaded tyres. The Regulation (EC) No 1222/2009 is currently under revision and hence this criterion will need to be updated accordingly.

Vehicle specific eco-driving information

Most estimates available in literature indicate that eco-driving techniques may result in an average emission reduction and fuel consumption of 10 to 15% (CE Delft, 2012), and the cost of implementation is very low. However, according to the CE Delft report, this reduction potential will decrease in the long term, since future vehicles will become more energy efficient, and will incorporate technologies which automate eco-driving. The report estimated that this reduction potential would be 10% in 2020, 7% by 2030 and 2% by 2050.

The criteria proposed are more specified for vehicles with an electric drivetrain (including hybrids) including specific guidance for the use of the regenerative braking in order to save energy. For Plug-in Hybrid Electric Vehicles and Range Extender Electric Vehicles specific instructions to maximize the kilometres driven electrically are included in the criteria.

The stakeholders suggested that this criterion is also necessary for buses and waste collection vehicles, particularly hybrid and plug-in hybrid vehicles. It was also indicated that manufacturers sometimes provide training sessions to ensure that the vehicles is driven in a safe and efficient way.

10.2 Noise emissions

10.2.1 Proposed criteria

Core criteria	Comprehensive criteria
Technical Specifications	
	TS4. Tyre noise *(not to be used if, for safety reasons, tyres with the highest wet grip class, snow tyres or ice tyres are needed)* The vehicles must be equipped with a) tyres whose external rolling noise emission levels are 3dB below the maximum established in Annex II, Part C of Regulation (EC) No 661/2009. This is equivalent to the top category (of the three available) of the EU tyre label external rolling noise class. OR b) retreaded tyres *Note: Regulation (EC) No 1222/2009 is currently under revision, and as part of this process, the European Commission has put forward proposal COM(2018) 296. This criterion will need to be updated according to the new legislation, once it is in force.* **Verification:** The tenderer must provide the label of the tyre according to Regulation (EC) No 1222/2009 for tyres under case a) or the Notice of approval according to Annex 1 of UNECE Regulation 109 for retreaded tyres (case b)
Award criteria	
	AC1. Vehicle noise Points will be awarded to vehicles whose noise emissions are compliant with the Phase 3 limits of Regulation (EU) No 540/2014. The noise emissions will be tested according to Annex II of Regulation (EU) No 540/2014. **Verification:** The tenderer must provide the vehicle's certificate of conformity.

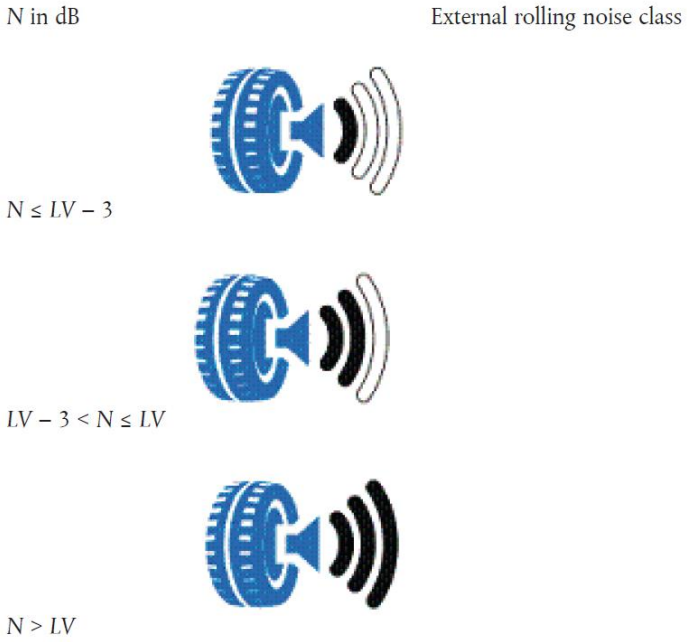
10.2.2 Rationale

Vehicle noise can have significant negative impacts on the health of residents, especially in case of traffic in or nearby residential areas. Public authorities should therefore gradually reduce the noise levels of both the tyres and vehicle of their fleet.

Tyre noise

Vehicle tyre noise is regulated by Regulation (EC) No 661/2009 and the labelling Regulation (EC) No 1222/2009, which obliges the tyre manufacturer to inform the customer about the external rolling noise class as follows:

Figure 4: External rolling noise classes (LV = Limit Values)



The Regulation (EC) No 1222/2009 does not apply to retreaded tyres, which must comply with the provisions of UNECE Regulation 109 as a compulsory condition to be placed on the market. Similar to the rolling resistance criterion, it is proposed that this criterion can be complied with both low noise tyres and retreaded tyres.

Since currently all tyres have to meet the limits set by Regulation (EC) No 661/2009, only the top category of the labelling Regulation (N≤ LV -3) can provide an additional benefit. In Table 13 the limit values for C1 tyres according to Regulation (EC) No 611/2009 are listed. The proposed limits that are 3 dB below the limit values are presented in the last column. Compliance with these limits will mean the tyres fall within the best performing class of labelling Regulation (EC) No 1222/2009. The Regulation (EC) No 1222/2009 is currently under revision and hence this criterion will need to be updated accordingly.

Table 13: Limit values for C1 tyres according to Regulation 611/2009 and proposed limits

Tyre class	Nominal section width (mm)	Limit values (dB(A))	Proposed limit (dB(A))
C1A	≤185	70	67
C1B	>185 ≤215	71	68
C1C	>215 ≤245	71	68
C1D	>245 ≤275	72	69
C1E	>275	74	71

The criterion is proposed to be a technical specification only at comprehensive level, for the sake of simplifying the core level which focuses on GHG and air pollutant emissions.

Vehicle noise

The Directive 2007/46/EC has been amended by Regulation (EU) No 540/2014, which will introduce stricter emissions limits for vehicle noise in three phases:

- Phase 1 applicable for new vehicle types from 1 July 2016;
- Phase 2 applicable for new vehicle type from 1 July 2020 and for first registration from 1 July 2022;
- Phase 3 applicable for new vehicle type from 1 July 2024 and for first registration from 1 July 2026.

So Phase 1 is already in force, but only for new vehicle types and not for all new sold vehicles. However, Phase 1 is already achieved by 90% of the cars and LCVs on the market.

In the case of heavy duty vehicles, Regulation (EU) No 540/2014 sets noise limits for N3 vehicles between 79 and 82 dB(A) for phase 1 and being applicable for new vehicles types from 1 July 2016. . Phase 2 (range 77 – 81 dB(A)) will be applicable for new vehicle type from 1 July 2020 and for first registration from 1 July 2022, and phase 3 (range 76 – 79 dB(A)) will be applicable for new vehicle type from 1 July 2024 and for first registration from 1 July 2026. The regulation does not include any provision to exclude waste collection trucks, or vehicles for special purposes, in general. According to a report from TNO (TNO, 2012) there was technology commercially available for shielding and encapsulation for trucks in 2010, and there were models that fulfilled phase 3 limits available in the market.

Therefore, the award criterion at comprehensive level is proposed to promote phase 3 compliant vehicles.

11 Common criteria for service categories

11.1 Competence of tenderer and staff training

11.1.1 Proposed criteria

Core criteria	Comprehensive criteria
Selection criteria	
SC1. Competences of the tenderer (*Same for core and comprehensive)* The tenderer must have relevant experience in each of the following areas: - identifying, evaluating and implementing the available technologies and measures to reduce the well-to-wheel GHG emissions and air pollutants emissions - monitoring and reporting procedures of the GHG emissions **Verification:** Evidence in the form of information and references related to relevant contracts (possibly of a similar size) carried out in the previous 5 years which included the above elements.	
Contract performance clause	
CPC1. Drivers training (*Same for core and comprehensive)* *Note: This contract performance clause will only apply if the service includes a driver and where drivers are not requested to have the driver certificate of professional competence (driver CPC) according to Directive 2003/59/EC* All drivers involved in carrying out the service for the duration of the contract period must be trained in a recognised institution on environmentally-conscious driving on a regular basis to increase fuel efficiency. Adequate training, with a minimum duration of 16 hours, must be provided to all new staff working under the contract within 4 weeks of starting employment, and an update on the above points, with a minimum duration of 4 hours, must be provided for all other staff at least once a year. The service provider must document and report yearly the amount (hours) and subject of training provided to each member of staff working on the contract to the contracting authority. All drivers involved in carrying out the service for the duration of the contract period must regularly receive information on their fuel efficiency performance (at least once per month). The yearly staff training records must be made available to the contracting authority for verification purposes. The contracting authority may set rules for penalties for non-compliance.	

11.1.2 Rationale

Fleet management is a crucial element to optimise the vehicle use, increase the technical performance of the fleet and take up best available technologies. The selection criteria proposal sets a minimum experience on identifying, evaluating and implementing technologies and measures to reduce GHG and air pollutant emissions. This selection criterion is aimed at ensuring the competences of the tenderer to manage their fleet according to environmental performance.

This is complemented with a staff training contract performance clause, which requires the drivers to be trained in eco-driving measures, which include proper feedback to drivers to reduce fuel consumption. In this specific service category, this would only apply to those services that include a driver, i.e. taxi services and post, courier and moving services.

The number of hours proposed for the update training in the first version of the technical report has been halved to 4 hours. This training duration results in a cost-effective measure while the cost of 8 hours training per year would exceed the benefits gained by this measure (see section 12.4.3)

For bus and waste collection services, there is a mandatory training for drivers set by Directive 2003/59/EC, which lays down the provisions for the initial qualification and periodic training of drivers of certain road vehicles for the carriage of goods or passengers. The topic 'advanced training in rational driving to optimise fuel consumption' is within the obligatory content of the training according to the Directive. As one of the stakeholders indicated, this mandatory qualification fits the requirements of the criteria proposed in the first version of the technical report, so that proposal is dropped to avoid a duplication of the training.

11.2 Environmental management measures

11.2.1 Proposed criteria

Technical specification
TS1. Environmental management measures (*Same for core and comprehensive)* The tenderers must have written procedures to: 1. monitor and record the GHG and air pollutant emissions of the service. The indicators used must be emissions and energy consumption of the service both in total per year and per passenger/tonne/unit transported-kilometre or another unit that reflects the performance of the service. 2. implement an emissions reduction plan with measures aimed at reducing the GHG emissions and air pollutants emissions. 3. evaluate the deployment of the emission reduction plan by tracking any changes in the indicators and the implementation of the measures of the plan in real practice. 4. implement the necessary actions to correct any deviations from the plan or any increase of the indicators, and if possible prevent them in the future. **Verification:** The tenderer must provide: 1. the procedure for monitoring and recording the indicators listed in Section 1) 2. the emissions reduction plan. 3. the evaluation procedure to ensure implementation of the emissions reduction plan 4. the correction procedure to correct the deviations found in the evaluation, and if possible prevent them in the future. Environmental management systems certified against ISO 14001 or EMAS will be deemed to comply if they cover the environmental objective of reducing GHG and air pollutant emissions of the service fleet. The tenderer must provide the environmental policy showing the commitment to achieve this objective, together with the certificate issued by the certification body *Note: the contracting authority may award points to those tenders offering significant improvements in their environmental management measures.*
Contract performance clause
CPC2. Environmental management measures (*Same for core and comprehensive)* The service provider must document and report, over the contract duration. - the results of the monitoring of indicators and - the results of the evaluation and the correction and prevention actions, where applicable, according to the written procedures provided for verifying the TS1 Environmental management measures. These reports must be made available to the contracting authority for verification purposes. The contracting authority may set rules for penalties for non-compliance and bonuses for exceeding the objectives set by the emissions reduction plan.

11.2.2 Rationale

Fleet management measures need to be supported by monitoring and planning, aimed at ensuring a proper implementation and guaranteeing continuous improvement. An environmental management system (EMS) is a systematic way to minimise the environmental issues of an organisation. It is particularly helpful to ensure the environmental performance of services, where an important part of the criteria must rely on best practices, staff training and other operational requirements. Some national GPP criteria require the company to have a certified environmental management system.

Although EMS is a very useful tool to develop systematic improvement processes, the leeway offered by the ISO standards may hinder their application in practice. Their requirements are so general that their interpretation may be difficult for the non-expert users. In addition, ISO certified EMS might be particularly difficult to be achieved by SMEs which may lead to their exclusion of the tender process. It is therefore proposed a technical specification inspired on the plan-do-check-act (PDCA) principles which constitute the basis of the management systems, and structured as follows:

- Monitoring the environmental issues by means of environmental indicators: in this case, the environmental issues are energy consumption, GHG and air pollutant emissions.
- Implementation of the operational procedures to minimise the environmental aspects: this would mean an emissions reduction plan that covers the service provided over contract period
- Evaluation of the implementation of the procedures and correction of the deviations found: there must be a systematic way to ensure the proper implementation of the emissions reduction plan and the minimisation of indicators. For this purpose, it is necessary to carry out a regular evaluation of both indicators and plan, and to set corrective and preventive actions where needed. This is proposed to be done by tracking the evolution of the indicators over the contract duration, and checking how the emissions reduction plan is deployed real practice.

The technical specification is complemented with a contract performance clause to ensure the implementation of the environmental management measures. It also works as a tool for the contracting authority to reward those contractors that achieve more ambitious targets, by means of bonuses. Besides, the technical specification indicates that the contracting authority may award points to environmental management measures that entail a significant improvement compared to the conventional practices. These provisions are in line with the comments suggesting a more dynamic and positive approach that can stimulate the continuous improvement of the service performance.

11.3 Maintenance of the fleet

11.3.1 Proposed criteria

<table>
<tr><th>Core criteria</th><th>Comprehensive criteria</th></tr>
<tr><td colspan="2">Contract performance clause</td></tr>
<tr><td colspan="2">CPC3. Low viscosity lubricant oils (Same for core and comprehensive)
Unless the manufacturer of the vehicle recommends another type of lubricant, the contractor must replace the lubricants of the vehicles providing the service with low viscosity engine lubricant oils (LVL). LVL are those corresponding to SAE grade number 0W30 or 5W30 or equivalent.
The contractor will keep records which must be made available to the contracting authority.</td></tr>
<tr><td colspan="2">CPC4. Vehicle tyres – rolling resistance (Same for core and comprehensive)
(not to be used if, for safety reasons, tyres with the highest wet grip class, snow tyres or ice tyres are needed)
The contractor must replace the worn tyres of vehicles providing the service with
a) new tyres that comply with the highest fuel energy efficiency class for rolling resistance expressed in kg/tonne, as defined by Regulation (EC) No 1222/2009 of the European Parliament and of the Council of 25 November 2009 on the labelling of tyres with respect to fuel efficiency and other essential parameters.
OR
b) retreaded tyres
The contractor will keep records which must be made available to the contracting authority.
Note: Regulation (EC) No 1222/2009 is currently under revision, and as part of this process, the European Commission has put forward proposal COM(2018) 296. This criterion will need to be updated according to the new legislation, once it is in force.</td></tr>
<tr><td></td><td>CPC5. Tyre noise
(not to be used if, for safety reasons, tyres with the highest wet grip class, snow tyres or ice tyres are needed)
The contractor must replace the worn tyres of vehicles providing the service with
a) new tyres whose external rolling noise emission levels are 3dB below the maximum established in Annex II, Part C of Regulation (EC) No 661/2009. This is equivalent to the top category (of the three available) of the EU tyre label external rolling noise class
OR
b) retreaded tyres
Note: Regulation (EC) No 1222/2009 is currently under revision, and as part of this process, the European Commission has put forward proposal COM(2018) 296. This criterion will need to be updated according to the new legislation, once it is in force.
The external rolling noise emissions of the tyre model must have been tested according to the Annex I of Regulation (EC) No 1222/2009.</td></tr>
</table>

	The contractor will keep records which must be made available to the contracting authority. *Note: The Regulation (EC) No 1222/2009 is currently under revision and the contracting authority may need to update this criterion accordingly once the new legislation is in force.*
Award criteria	
	AC1 Lubricant oils, hydraulic fluids and grease Points will be awarded to those tenders including the use of the following for the maintenance of the service vehicles: - Re-refined lubricant oils, meaning oils derived from used oils that underwent a process that returns the oil to a quality suitable for its original use. - Hydraulic fluids and greases that have no health or environmental hazard statement or R-phrase at the time of application (Lowest classification limit in Regulation (EC) No 1272/2008 or Council Directive 99/45/EC). The cumulative mass percentage of substances present in the hydraulic fluids and greases that are both nonbiodegradable and bioaccumulative must not be more than 0.1 % (w/w). **Verification:** The tenderer must provide the technical sheets of lubricants and hydraulic fluids and greases. Hydraulic fluids and greases that are compliant with the EU Ecolabel or equivalent type 1 ecolabel that includes the requirements set by AC1 will be deemed to comply.
Note on the purchase of maintenance services *The contracting authority may include these criteria within the call for tenders of vehicle maintenance services. However, these criteria only cover a small part of the maintenance activities and cannot be considered as EU GPP criteria for vehicle maintenance services.* *The contracting authority may set rules for penalties for non-compliance with the different contract performance clauses.* ***Note on requirements for Central Government procurement on the purchase of tyres*** *Article 6 and Annex III of the Energy Efficiency Directive (2012/27/EU), which had to be transposed into national law by June 2014, set out specific obligations for public authorities to procure certain energy efficient equipment. This includes the obligation to purchase only those tyres that:* 'comply with the criterion of having the highest fuel energy efficiency class, as defined by Regulation (EC) No 1222/2009 of the European Parliament and of the Council of 25 November 2009 on the labelling of tyres with respect to fuel efficiency and other essential parameters. This requirement must not prevent public bodies from purchasing tyres with the highest wet grip class or external rolling noise class where justified by safety or public health reasons' *This obligation is limited to central government and for purchases above the thresholds set out in the procurement directives. Moreover, the requirements have to be consistent with cost-effectiveness, economic feasibility, wider sustainability, technical suitability and sufficient competition. These factors can differ between public authorities and markets. For more guidance on the interpretation of this aspect of Article 6 and Annex III of the EED regarding procurement*	

of energy-efficient products, services and buildings by central government authorities, see the Commission guidance document COM/2013/0762 final, Communication from the Commission to the European Parliament and the Council, Implementing the Energy Efficiency Directive – Commission Guidance[1)].

Regulation (EC) No 1222/2009 is currently under revision, and as part of this process, the European Commission has put forward proposal COM(2018) 296. This CPC will need to be updated according to the new legislation, once it is in force.

[1)] *http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex:52013DC0762*

11.3.2**Rationale**

Sections 10.1 and 10.2 describe the requirements on rolling resistance and noise proposed for tyres used in new purchased vehicles. Tyres are replaced along the lifetime of the vehicle, and therefore the same requirements should apply in maintenance activities. For this purpose, contract performance clauses are proposed requiring the contractor to comply with the tyres criteria over the service contract. In the case of rolling resistance of tyres, it is proposed to be part of both core and comprehensive levels to be fully harmonised with the provisions of the Energy Efficiency Directive on the purchase of tyres by governments (see Section 10.1).

The use of low viscosity lubricants (LVL) is relevant to improve the engine performance, and it is a cost-effective option (WIP; Q1, 2008). Since lubricants are degraded and replaced regularly along the lifetime of the vehicle, LVL should be required as part of the maintenance criteria of the service categories.

The current criteria set also includes some requirements on lubricants related to other life cycle stages of the lubricant itself. The current criterion is partially based on the current EU Ecolabel of Lubricants (Commission Decision 2011/381/EU), which is being revised and new criteria are expected to be published by the end of 2018.

The current EU Ecolabel for lubricants covers different categories of products, and it focuses on the ones that are totally released into the environment during their use phase, or that are highly likely to be emitted to water and soil (so call loss and high risk lubricants). With this approach, the scope does not cover four-stroke oils, but two-stroke oils, which are mixed with the fuel, and therefore, emitted in the exhaust gases. According to the Preliminary report for the revision of EU Ecolabel for lubricants (JRC, 2016), 20-30% of the fuel and the added oil used two-stroke engines of boats was emitted unburned directly into the environment. Two-stroke engines are no longer used in vehicles in the EU and US markets, due to the air emissions standards. The scope of the EU Ecolabel for lubricants also includes hydraulic fluids and greases, which are very relevant for the product categories within the scope of EU GPP. Table 14 shows the requirements on the current EU GPP criteria set, and the proposal for revision.

Table 14: Lubricants requirements within the current EU GPP criteria set, and the proposal for revision.

Current EU GPP criteria	Is it part of EU Ecolabel criteria set for lubricants?	Proposal for revision
a. Vehicles must use low viscosity engine lubricant oils (LVL) or regenerated lubricant oils, with a minimum of 25% regenerated base oils, in vehicle maintenance. LVL are those corresponding to SAE grade number 0W30 or 5W30	NO	This criterion related to LVL is relevant to improve the engine performance. The use of LVL is a cost effective option. Regarding regenerated oils, the recycling of oils is a waste treatment practice that can reduce the use of raw materials in mineral oils, and it is in line with the principles of

or equivalent 3.		Circular Economy. The term has been switched to re-refined, since re-refining is the process that returns the oil to a quality suitable for its original use. Regeneration does not necessarily mean that the lubricant is suitable for its original use.
b. Hydraulic fluids and greases should have no Health or Environmental Hazard statement or R-phrase at the time of application (Lowest classification limit in Regulation (EC) No. 1272/2008 or Council Directive 99/45/EC).	YES	It is proposed to be kept, as both products are part of the EU Ecolabel scope and they are considered high risk and loss products.
c. No derogation from the exclusion in Article 6(6) of Regulation (EC) No. 66/2010 may be given concerning substances identified as substances of very high concern and included in the list foreseen in Article 59 of Regulation (EC) No. 1907/2006, when present in mixtures, in concentrations higher than 0.010% (w/w).	YES	This is a provision of the EU Ecolabel Regulation about derogation requests for certain hazardous substances. It is proposed to be removed.
d. Carbon content should be ≥45% derived from renewable raw materials.	yes	Synthetic plant based lubricants are common in the automotive industry; however, this criterion comes from the EU Ecolabel for lubricants which does not cover automotive oils. It is proposed to be removed since there is not enough evidence that the threshold proposed is suitable for automotive oils.
e. The cumulative mass percentage of substances present that are both nonbiodegradable and bioaccumulative must not be more than 0.1% (w/w).	yes	In the automotive sector, this criterion would be relevant just for hydraulic fluids and greases.

11.4 Explanatory note on fleet composition requirements

11.4.1 Proposed note

Explanatory note
Whenever a contracting authority requires a service provider to use a fleet with a certain percentage of the vehicles compliant with criteria on CO2 emissions or air pollutant emissions, the contracting authority should consider the means of verification. It can be cumbersome for the contractor to provide information and for the public authority to verify information about which vehicles were used for which distances on which day and calculate the average. Therefore, if it is not considered feasible to ask for all vehicles to meet the requirement, the contracting authority could determine that on specific routes, only compliant vehicles can be used (e.g. in areas with air quality issues), or that one or several vehicle categories has to be compliant. These issues may be less relevant for the outsourcing of public bus services and waste collection services, where the planning and the monitoring of the services facilitate the verification of the fleet performance used to provide the services.

11.4.2 Rationale

Some of the criteria proposed in this technical report are based on fleet composition that fulfil GHG and air pollutant emissions criteria set for LDVs and buses within the scope of the vehicles categories (see Sections 3 and 5). Setting requirements on a share of the fleet or on the average fleet performance does not ensure the performance of the group of vehicles actually providing the service, especially if they are part of a large fleet, or if the service is provided to meet specific mobility needs. The verification of the actual performance of the service would need information about which vehicles are used for which distances on which day and calculate the average, and this can entail administrative burdens for both the contractor and the contracting authority. The alternative would be that the totality of the fleet is compliant with those criteria, but this may be too strict and would create a barrier for the development of these services. Another option would be splitting the service in subsets, meaning for example routes or specific categories or sub-categories of vehicles, and apply the requirements on 100% of the vehicles providing services to those subsets. All these alternatives are gathered in an explanatory note to guide the contracting authority in the writing of the call for tender.

12 Life cycle cost assessment of some case studies

12.1 Introduction

This chapter contains a life cycle cost assessment of some case studies of public procurement applying some of the criteria proposed in this technical report:

- Case study 1: purchase of passenger cars with strict CO_2 emissions
- Case study 2: purchase of electric buses instead of diesel buses for a share of the vehicle fleet
- Case study 3: training on eco-drive for drivers of a post and courier service

The costs of the case scenarios are compared to a business-as-usual scenario without the EU GPP criterion.

The following types of costs will be estimated:

a) Total cost of ownership:
   - Acquisition costs
   - Fuel costs
   - Maintenance costs
   - Insurance
   - Taxes
b) Cost of externalities: emissions of carbon dioxide (CO_2), and emissions of oxides of nitrogen (NOx), non-methane hydrocarbons (NMHC) and particulate matter (PM), which are the ones covered by the Clean Vehicle Directive (Directive 2009/33/EC)

12.2 Case studies overview

The three cases studies are described below, including the main assumptions set for the life cycle cost assessment.

12.2.1 Passenger cars with lower CO_2 emissions

The first case concerns a ministry owning 100 large-size petrol vehicles. This contracting authority will renew their fleet, but instead of purchasing average vehicles in the market, the TS1 criterion is applied, stating that the type approval CO_2 emissions (according to the vehicle's technical sheet) for the vehicles must not exceed values between 106 CO_2 g/km (2018) and 92 CO_2 g/km (2021). The case study is summarised in Table 15

Table 15: Case study 1 Passenger cars with strict CO2 emissions

Definition	**Explanation**
Category	CATEGORY 1: PURCHASE, LEASE OR RENTAL OF CARS, LCVS AND L-CATEGORY VEHICLES
Vehicle	Passenger cars, large-size, petrol
Criterion type	Technical specification, GHG emissions
Criterion	TS1. Type-approval CO_2 value
Public procurer	Ministry (100 vehicles)
Case	The department will purchase new cars, but instead of the average CO_2 of the cars (149 g/km according to the cost analysis - see Annex I Cost analysis), the TS1 criterion is applied. The cars to be replaced are large-size petrol cars

The cars with low CO_2 emissions will be more expensive, but also more fuel efficient, which has a positive impact on the fuel costs and externalities. Calculations will show the life cycle cost for cars purchased between 2018 and 2021.

Assumptions

Table 16 presents the main assumptions that are used for the LCC calculation for this case study.

Table 16: Assumptions case study 1

Variable	**Assumption**
Acquisition costs excl tax	€31 000
Registration tax	4.3%
Average VAT	22%
Mileage	3 scenarios: - 10 000 km/year - 20 000 km/year - 30 000 km/year
Fuel price incl tax	€1.25 / liter
Lifetime	15 years
Maintenance	3.6 EUR cent/km
Insurance	557 €/year
Circulation taxes	245 €/year

Sources available at Annex I Cost analysis

The CO_2 values are taken accordingly to the criterion as defined in the technical report, as displayed in Table 17. These values are type approval and may be significantly higher in real driving

Table 17: EU GPP criterion TS1. Type-approval CO_2 value

Year	**Baseline**	**EU GPP requirement**
2018	149 g/km	106 g/km
2019	149 g/km	101 g/km
2020	149 g/km	96 g/km
2021	149 g/km	92 g/km

12.2.2 Technical options for buses

The second case study is a large municipality in Europe with an average bus fleet of 200 buses. The municipality renews the public transport bus services, applying the TS2 for category 4 which sets that 12% of the fleet to be used under the contract must be vehicles that comply with the core TS1 of category 3. The core TS1 of category 3 criteria is fulfilled, among others, by means of electric buses, which would replace average diesel buses. The case study is summarised in Table 18.

Table 18: Case study 2 Electric buses

Definition	**Explanation**
Category	CATEGORY 4: BUS SERVICES
Vehicle	Buses
Criterion type	Technical specification, GHG emissions
Criterion	TS2 GHG emissions both core and comprehensive
Actor	Large city in Europe with 200 buses
Case	The city renews their bus fleet over the course of 14 years by new buses. Every year, 15 new buses are purchased instead of diesel buses.

Assumptions

Table 19 presents the main assumptions that are used for the LCC calculation for this case.

Table 19: Assumptions case 2

Variable	**Assumption**	**Source / explanation**
Acquisition costs baseline excl tax	€208 000	(CE Delft, 2007)
Registration tax	4.3%	(CE Delft, 2016)
Average VAT	22%	(CE Delft, 2016)
Fuel consumption	0.36 l/km	(AEA, 2011)
Mileage	3 scenarios: - 50 000 km/year - 60 000 km/year - 70 000 km/year	
Fuel price incl. Taxes	€1.04 / liter diesel	(European Commission, 2016)
Electricity price	€0.10 / kWh	(Ricardo, 2013)
Lifetime	14 years	(TIAX, 2011)
Maintenance	15.5 EUR cent /km	(CE Delft, 2007)
Insurance	2 117 €/year	Calculation based on (CE Delft, 2016a).

Circulation taxes	517 €/year	Same proportion to circulation taxes as for passenger cars.

Additionally, the following assumptions were made:

- The investment cost for the electric bus is 82% higher compared to the diesel bus (TNO (CIVITAS WIKI), 2014) .This concerns only the vehicle costs. The cost for the electrical vehicle is higher mainly because of battery costs, but also due to lower production volumes.
- As electric vehicles are given tax exemptions in several countries, it is assumed that the electric bus does not pay circulation taxes. In total the electric bus costs €475 000 (only vehicle). The same assumption is made for hydrogen buses. Other vehicles are given no tax exemptions.
- Infrastructure cost opportunity charging: €10 000 per bus (TNO (CIVITAS WIKI), 2014).
- Electric bus energy efficiency: it consumes 56% less energy than the diesel bus comparator (TNO (CIVITAS WIKI), 2013)., (table 71).
- Dedicated natural gas bus efficiency: it consumes 26% more energy than the diesel bus comparator (TNO (CIVITAS WIKI), 2013). (table 71).
- Hydrogen bus efficiency: it consumes 23% less energy than the diesel bus comparator (TNO (CIVITAS WIKI), 2013)., (table 71).
- Assumption for maintenance: 20% of the diesel bus comparator however, a sensitivity analysis has been carried out due to the large range found in the technical literature. The maintenance costs are potentially 40% lower for electric buses (Olsson, et al., 2016), but based on market experiences also 0% is possible (CE Delft, 2015).
- No change in insurance costs.
- No energy taxation is assumed on electricity used for electric buses. The same assumption is made for hydrogen buses. The energy tax on natural gas is assumed to be 2.6 EUR / GJ (EC, 2017). Note that the taxation of biofuels differs per Member State. Member States that have introduced blending obligations often have limited the tax advantages for biofuels, because this could imply overstimulation and make the government pay for meeting the obligation instead of the industry. Countries without a blending obligation in place will more rely on tax advantages for biofuels. Note that these tax advantages are also often differentiated based on the feedstocks used (for example only tax advantages for biofuels from waste and residues). Due to the variety in approach, it was hardly possible to define an EU average. Therefore, biofuels are treated here similar to their fossil counterparts.
- The investment cost for the CNG bus is 14% higher, infrastructure costs are €7 500 per bus (100 buses per fuelling station of €500 000-€1 000 000).
- The investment cost for the hydrogen bus is 264% higher, infrastructure costs are €100 000 per bus per station,

12.2.3 Staff training on ecodriving in post and courier services

The third case presents a lifecycle cost analysis of staff training on ecodriving. The contracting authority is a central government that purchases the provision of post and courier services. The contract performance clause Drivers training sets that the service contractor must ensure adequate training, with a minimum duration of 16 hours, must be provided to all new staff working under the contract within four weeks of starting employment and an update on the above points, with a minimum duration of 4 hours, for all other staff working under the contract at least once a year. Additionally, the staff is presented feedback on their fuel efficiency monthly, to further ensure that the benefits of the ecodriving training are sustainable on the longer term. The cost calculation will show the cost and benefits of this criterion on a yearly basis. The labour costs of the

driver are excluded from the analysis, as they are the same in all cases. The case study is summarised in Table 18.

Table 20: Case study 3 Staff training on ecodriving in post and courier services

Definition	**Explanation**
Category	CATEGORY 2: POST AND COURIER SERVICES
Vehicle	LCVs
Criterion type	Selection criteria, Optimized vehicle use
Criterion	CPC1. Staff training
Actor	Central government that purchases post and courier services,
Case	Every driver providing the service will follow the ecodriving training. Lifetime assessment for a period of 15 years, 10 000 – 30 000 km/year. All vans are large diesel vans.

Assumptions

Table 21 presents the main assumptions that are used for the LCC calculation for this case.

Table 21: Assumptions case 3

Variable	**Assumption**
Acquisition costs incl tax	€42 000
Registration tax	4.3%
Average VAT	22%
Mileage	3 scenarios: - 10 000 km/year - 20 000 km/year - 30 000 km/year
Fuel price	€1.04 / liter
Lifetime	15 years
Maintenance	3.0 EUR cent /km
Insurance	557 €/year
Circulation taxes	89 €/year
CO_2 emissions test	190 g CO_2 /km

Sources available at Annex I Cost analysis

The starting point for encouraging employees to adopt an eco-driving style is often to implement a driving course, which immediately results in significant fuel reduction. However, these savings reduce rapidly if driving courses are not regularly updated or if the management does not take follow-up measures to evaluate the impact of the

training. These follow-up measures may include monitoring the performance of individual drivers and offering feedback to the drivers about their performance.

The cost of applying a full eco-driving package like outlined above includes:

- The trainer fee for the driving course and loss in man hours when employees are in training. A report by FLEAT (FLEAT, 2010) does include this loss of man hours, which results in costs of €300 to €1 000 per driver. In this cost calculation a full eco-driving package like outlined above includes:
    - 1 training (16 hours) per driver of €650 (including loss in man hours), which is given once per driver over the lifetime of a vehicle (15 years)
    - 1 yearly 4 hours training per driver of €180
- The emission reduction due to eco-driving is approximately 10% (CE Delft, 2012) sustained through yearly repeated training.
- Setting up a monitoring and feedback system, and the actual execution the system. The costs are highly dependent on the complexity of the monitoring and feedback, etc. and assumed to be included in the total package for yearly training as provided by the driving training company.

12.3 Calculation of external costs

The assumptions used for the calculation of external costs apply to calculation of all cases studies. Aside from the Total Cost of Ownership directly to the user, the cost of externalities are also included, meaning CO_2, NOx, NMHC and PM, the ones covered by the Clean Vehicles Directive. In all cases the vehicles are assumed to be Euro 6 / VI, which is relevant for air pollutants external costs.

The emission factors for CO_2, NOx, NMHC and PM for the vehicles are based on STREAM Passenger 2014 (CE Delft, 2014) for car and bus, and STREAM Freight 2016 (CE Delft, 2016) for LCVs.

The emissions that result from the production of the fuels (and electricity) are also included in the calculation. The values used are displayed in Table 22.

Table 22 Upstream emission factors (WTT)

	NOx	**SO_2**	**NMVOC**	**PM**	**CO_2**
	g/MJ	g/MJ	g/MJ	g/MJ	g/MJ
Diesel (fossil)	0,032	0,098	0,033	0,003	20,7
Gasoline (fossil)	0,041	0,126	0,045	0,004	19
Electricity	0,119	0,225	0,001	0,006	106,7

Source: (CE Delft, 2016): diesel and gasoline, IMPACT update (DG MOVE, 2014): (COWI; VHK, 2011): CO_2 electricity.

The report 'EU Reference Scenario 2016 Energy, Transport and GHG Emissions Trends to 2050' (EC, 2016)shows an evolution of the electricity mix towards 35% of renewable energy sources in 2020 and more than 40% in 2030 , which will lead to a steady decrease in carbon intensity of power generation. . The average carbon intensity over the period 2010 - 2020 recommended by the Methodology for Ecodesign of Energy-related Products is based on those projections and will be used in the calculations (COWI; VHK, 2011)

The cost factors used for externalities are taken from (DG MOVE, 2014) and shown in Table 23, after converting to 2015 prices using GDP at market prices (PPS per capita).

Table 23 External cost factors for upstream emissions and direct transport emissions €/tonne (2015)

	Upstream electricity and refineries	**Transport**
EU27	**high height of release**	**low height of release**
CO_2	€ 100	€ 100
NOx	€ 8 954	€ 11 834
NMVOC	€ 1 724	€ 1 742
PM2.5	€ 20 966	€ 121 673*

(CE Delft, 2008)

12.4 Results of the life cycle costs assessment

In this section, the results of the LCC calculations are presented for the three case studies. For every case, the life cycle costs have been estimated in € per vehicle and km with and without taxes, and including external costs from CO_2, NOx, NMHC and PM. Finally, the cost savings for the case study is calculated, compared to the business as usual scenario, i.e. without the application of the EU GPP criteria.

12.4.1 Passenger cars with lower CO_2 emissions

In the first case, the acquisition costs of the cars with lower CO_2 emissions will be higher. However, the fuel costs are lower due to lower fuel consumption. The external costs also decrease due to lower CO_2 emissions. There are no other external cost savings, because for pollutants the same Euro 6 limits apply. Figure 5 and Figure 6 show the life cycle costs with and without taxes per vkm for large petrol cars with and without strict CO_2 norms.

*Figure 5 Life cycle costs **with taxes** per vkm for large petrol cars with and without strict CO_2 norms*

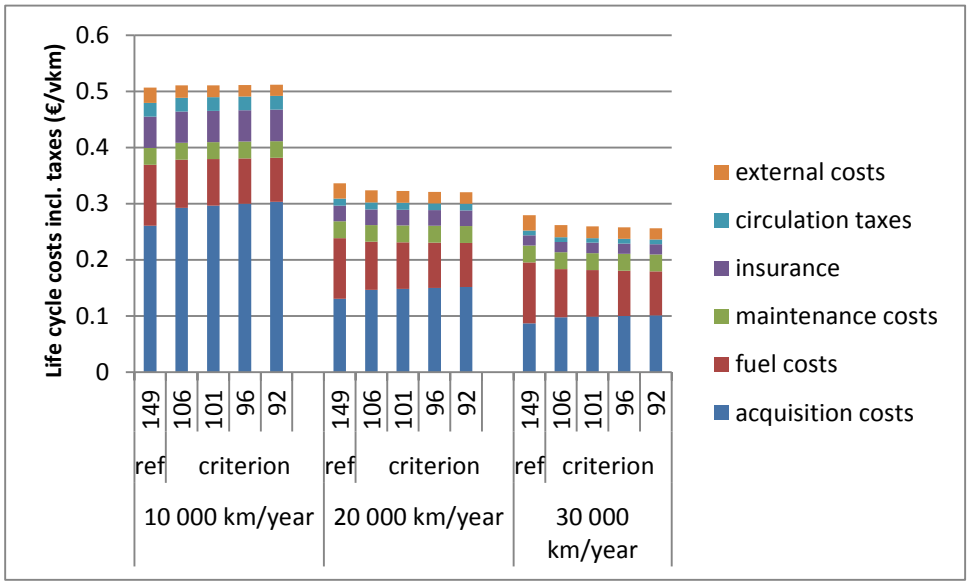
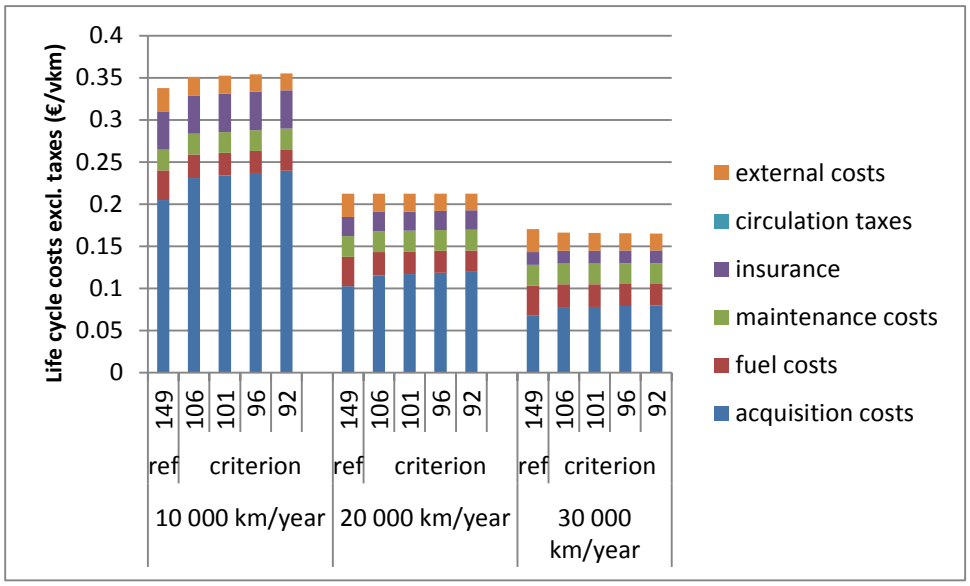


*Figure 6 Life cycle costs **without taxes** per vkm for large petrol cars with and without strict CO_2 norms*



The figures clearly show that acquisition costs are higher for the more fuel efficient cars, but also that fuel costs are lower. The external costs are much lower for more fuel efficient cars. If taxes are taken into account, the additional cost would be paid off in terms of fuel and external cost savings if the mileage is above 20 000 km/year, which is a likely mileage for large cars.

Table 24 and Table 25 present the total social cost savings for a municipality with 100 cars, which is planning to renew their fleet applying the EU GPP criterion. When they invest in large petrol cars with lower CO_2 emissions, the fuel costs will be lower on a yearly basis. From these tables it can be concluded that for higher mileage the cost savings are higher. As can be observed, taxation is a very powerful market driver to increase the uptake of fuel efficient vehicles.

Table 24 Total cost savings strict CO_2 criterion (106 g/km) for 100 large petrol cars for total life cycle including taxes (€)

Parameter	**Scenario**		
	10 000 km/year	**20 000 km/year**	**30 000 km/year**
Total investment costs (106 g/km) (€)	€ -477 000	€ -477 000	€ -477 000
Fuel cost savings in 15 years (€)	€ 337 000	€ 675 000	€ 1 012 000
External cost savings in 15 years (€)	€ 83 000	€ 166 000	€ 249 000
Total (€)	€ -57 000	€ 364 000	€ 784 000

Table 25 Total cost savings strict CO_2 criterion (106 g/km) for 100 large petrol cars for total life cycle excluding taxes (€)

Parameter	**Scenario**		
	10 000 km/year	**20 000 km/year**	**30 000 km/year**
Total investment costs (106 g/km) (€)	€ -391 000	€ -391 000	€ -391 000
Fuel cost savings in 15 years (€)	€ 109 000	€ 218 000	€ 328 000
External cost savings in 15 years (€)	€ 83 000	€ 166 000	€ 249 000
Total (€)	€ -199 000	€ -7 000	€ 185 000

12.4.2 Technical options for buses

Electric buses

In the case study of electric buses, the acquisition costs are higher, but fuel costs (including taxes) are lower. There are also maintenance cost savings, although it is uncertain how much they will amount to.

Figure 7 and Figure 8 show the life cycle costs with and without taxes per vkm for diesel and electric buses. The figures show that the fuel taxes have a high impact on the LCC calculation. For the case with taxes, the total costs of electric buses including external costs are at the same level, or lower, compared to diesel buses.

Figure 7 Life cycle costs with taxes per vkm for diesel and electric buses

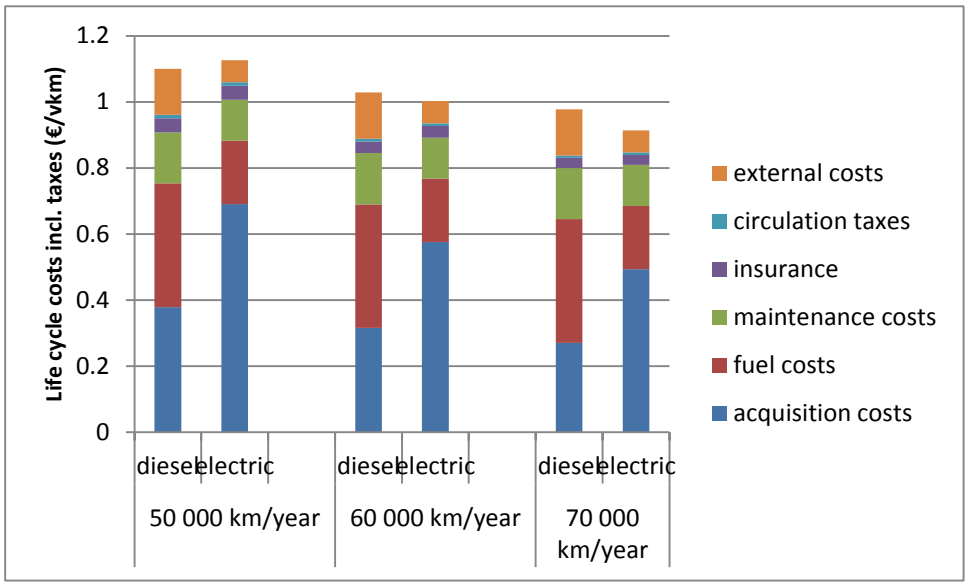


Figure 8 Life cycle costs without taxes per vkm for diesel and electric buses

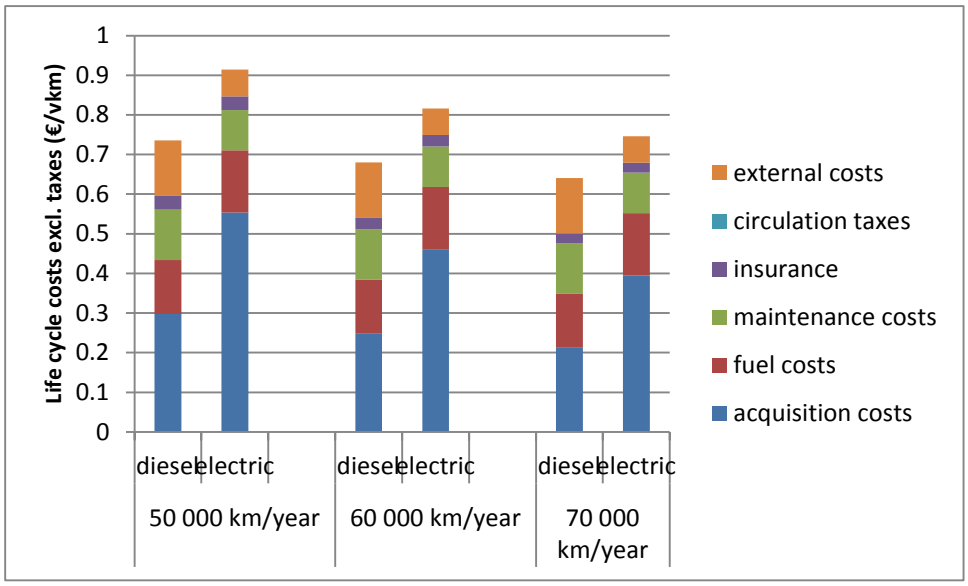


Table 26 and Table 27 show the cost savings per bus, and also for the bus fleet composed by 12% and 25% electric buses. The results show that the investment costs are relatively high in comparison to the cost and maintenance savings, and external costs savings can add up to about a third of the investment costs. However, it is worth to highlight that the air pollutants released upstream by the power plants are usually emitted at considerable heights and often in sparsely populated areas. The emissions are mixed with large volumes of air and their contribution to air quality issues in urban areas is relatively small. Conversely, traffic emissions occur at low levels, in the ambient air layer, and they are the main source of pollution in urban areas. Since electric vehicles do no produce tailpipe emissions they are able to improve the air quality of cities.

Table 26 Cost savings of electric buses criterion per bus and for 12/25% of the 200 bus fleet including taxes (€/year)

Parameter	**Scenario**		
	50 000 km/year	**60 000 km/year**	**70 000 km/year**
Total investment costs per bus (€/year)	€ -15 500	€ -15 500	€ -15 500
Fuel cost savings per bus (€/year)	€ 9 250	€ 11 000	€ 12 750
Maintenance cost savings per bus (€/year)	€ 1 500	€ 1 750	€ 2 250
External cost savings per bus (€/year)	€ 3 500	€ 4 250	€ 5 000
Total cost savings per bus (€/year)*	€ -1 250	€ 1 500	€ 4 500
Total for 12% fleet (€/year)	€ -31 250	€ 37 500	€ 106 250
Total for 25% fleet (€/year)	€ -62 250	€ 75 000	€ 212 250

*cost savings are very dependent on assumptions:

- % maintenance savings (now used: 20%)
- electricity tax (now used: no energy tax)

Table 27 Cost savings of electric buses criterion per bus and for 12/25% of the 200 bus fleet excluding taxes (€/year)

Parameter	**Scenario**		
	50 000 km/year	**60 000 km/year**	**70 000 km/year**
Total investment costs per bus (€/year)	€ -12 750	€ -12 750	€ -12 750
Fuel cost savings per bus (€/year)	€ -1 000	€ -1 250	€ -1 500
Maintenance cost savings per bus (€/year)	€ 1 250	€ 1 500	€ 1 750
External cost savings per bus (€/year)	€ 3 500	€ 4 250	€ 5 000
Total cost savings per bus (€/year)	€ -9 000	€ -8 250	€ -7 500
Total for 12% fleet (€/year)	€ -214 750	€ -196 250	€ -177 750
Total for 25% fleet (€/year)	€ -429 500	€ -392 500	€ -355 500

As can be derived from Table 28, the total cost savings are very dependent on the actual maintenance cost savings. Maintenance costs are expected to be lower for electric vehicles, because there are less moving parts in the engine, less wear and tear and fewer components that break down. However, as the technology for electric buses is on a learning curve, some technical failures can be expected and accompanying reparation costs. Therefore, the outcomes are relatively uncertain, but still give an indication of the LCC for electric buses compared to those of diesel buses.

Table 28 Total cost savings of electric buses criterion per bus including taxes and external cost (€/year) for different maintenance cost assumptions

Parameter	**Scenario**		
	50 000 km/year	**60 000 km/year**	**70 000 km/year**
Total cost savings (€/year): 40% lower maintenance costs	€ 250	€ 3 500	€ 6 500
Total cost savings (€/year): 20% lower maintenance costs	€ -1 250	€ 1 500	€ 4 500
Total cost savings (€/year): 0% lower maintenance costs	€ -2 750	€ -250	€ 2 250

Other technology options

Figure 11 and Figure 10 gather the results of the life cycle costs of the other technology options, for the scenario of 60 000 km/year. The calculations are made for CNG, bio-CNG, B100 bio-diesel (HVO) and hydrogen.

Figure 9 Life cycle costs without taxes per vkm for buses for various fuel technology options

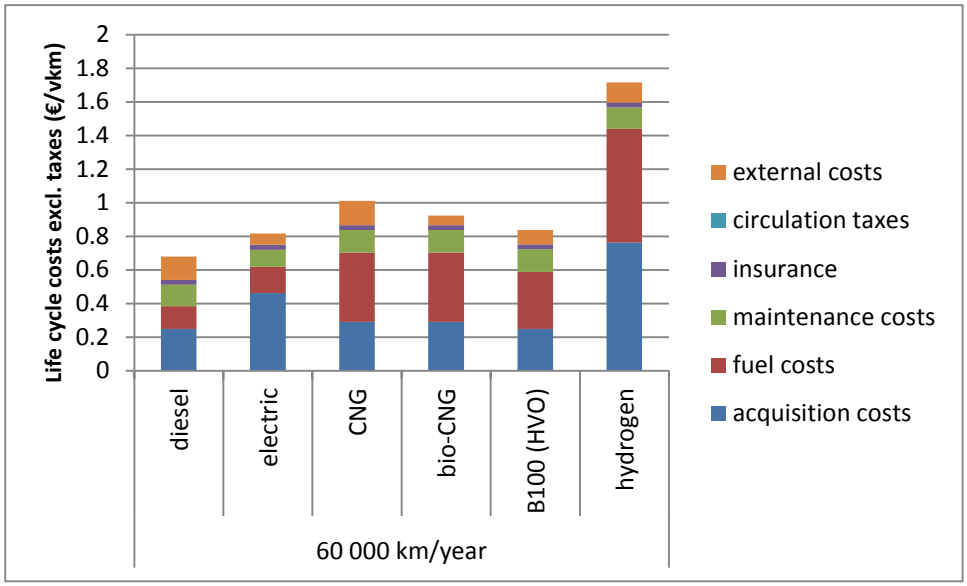
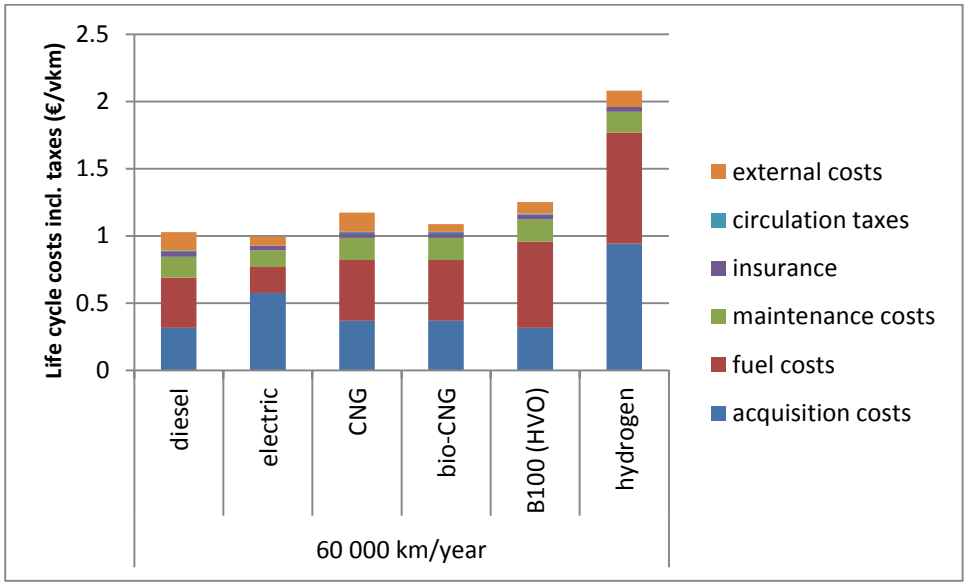


Figure 10 Life cycle costs with taxes per vkm for buses for various fuel technology options



The results show that the investment costs of CNG and biofuels are comparable to diesel buses, but hydrogen buses are expensive, also due to infrastructure costs. Additionally, the fuel costs of CNG, and especially bio-CNG, B100 and hydrogen are much higher than diesel.

12.4.3 Staff training on ecodriving in post and courier services

In the third case, the cost of the staff training on ecodriving is partly compensated by fuel savings and external cost savings. Figure 11 and Figure 12 show the LCC results with and without taxes per vkm for the service with and without strict CO_2 norms.

Figure 11 Life cycle costs with taxes per vkm for LCVs with and without ecodriving training

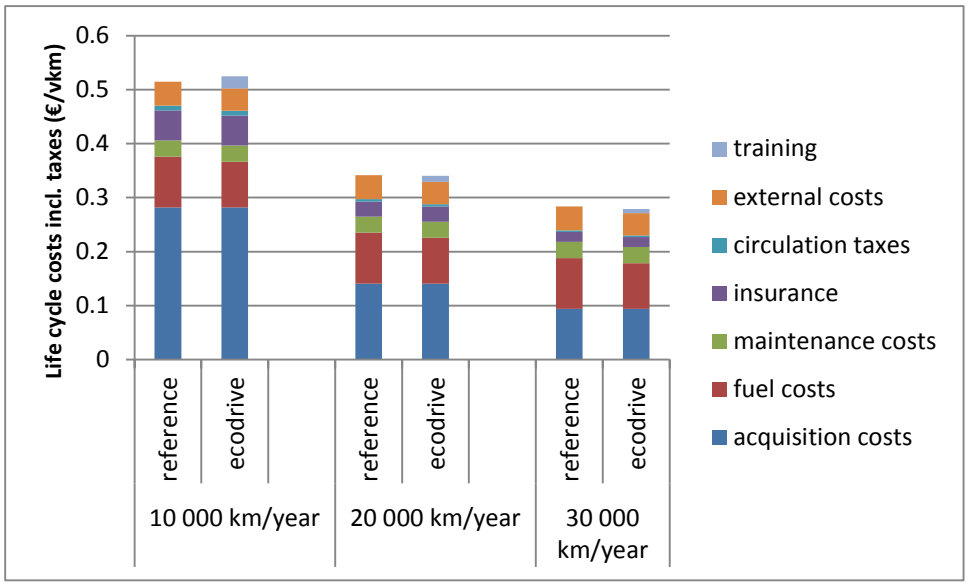


Figure 12 Life cycle costs without taxes per vkm for LCVs with and without ecodriving training

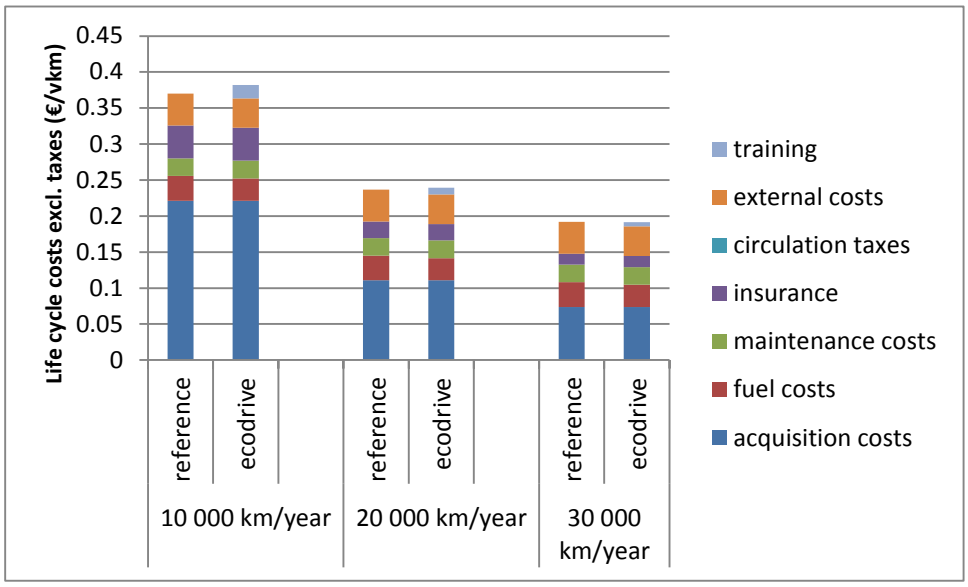


Table 29 and Table 30 show the cost savings of the ecodriving criterion per driver including and excluding taxes in different scenarios. The analysis shows that the training is relatively expensive compared to the cost savings, but for a higher mileage, the criterion is more favourable.

Table 29 Cost savings of ecodrive criterion per driver including taxes (€/year)

Parameter	**Scenario**		
	10 000 km/year	**20 000 km/year**	**30 000 km/year**
Cost of training per driver (€/year)	€ -220	€ -220	€ -220
Fuel cost savings per driver (€/year)	€ 90	€ 190	€ 280
External cost savings per driver (€/year)	€ 30	€ 60	€ 90
Total per driver (€/year)	€ -100	€ 30	€ 150

Table 30 Cost savings of ecodrive criterion per driver excluding taxes (€/year)

Parameter	**Scenario**		
	10 000 km/year	**20 000 km/year**	**30 000 km/year**
Cost of training per driver (€/year)	€ -180	€ -180	€ -180
Fuel cost savings per driver (€/year)	€ 30	€ 70	€ 100
External cost savings per driver (€/year)	€ 30	€ 60	€ 90
Total per driver (€/year)	€ -120	€ -50	€ 10

It is relevant to highlight that the effects of this training go beyond the boundaries of the post and courier services, since it is also likely that drivers will improve their driving behaviour when they use their private cars.

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List of abbreviations

AC – Award criterion/a

CPC – Contract Performance Clause

CNG - Compressed Natural Gas

CO_2 - Carbon dioxide

CPV - Common Procurement Vocabulary

CVD - Clean Vehicle Directive

dB - decibels

DG - Directorate General

EEV - Enhanced environmentally friendly vehicle

EU - European Union

GHG – Green House Gas

GPP - Green Public Procurement

GSI - Gear Shift Indicator

GWP - Global Warming Potential

HDV - Heavy duty vehicle

ICEV – Internal Combustion Engine Vehicle

ITS - Intelligent Transport System

LCV - Light commercial vehicle

LDV - Light duty vehicle, i.e. a car or an LCV

M_1 - Cars

M_2 - Small buses

M_3 - Large buses

NACE - Nomenclature statistique des activités économiques dans la Communauté européenne

N_1 - LCVs

N_2 - Heavy commercial vehicles

N_3 - Heavy commercial vehicles

NEDC – New European Driving Cycle

NMHC - non-methane hydrocarbons

NO_x - Oxides of nitrogen

NRMM - Non-road mobile machinery

PM - Particulate matter

PRODCOM - PRODuction COMmunautaire

REACH - Registration, Evaluation, Authorisation and Restriction of Chemicals

RES – Renewable Energy Source

RDE - Real driving emission

SC – Selection criterion/a

SORT – Standardised On-Road Test cycles

TCO – Total Cost of Ownership

TPMS - Tyre Pressure Monitoring System

TS - Technical Specification

TTW – Tank to Wheel

WTT – Well to Tank

WTW – Well To Wheel

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Annex I Cost analysis

Total Cost of Ownership passenger cars and LCVs

Passenger cars

In this section, the Total Cost of Ownership is calculated for passenger cars in four variations: petrol and diesel, both small and large.

Table 31 shows the parameters that are used for this calculation. The average CO_2 emission as determined at the type approval is corrected for the divergence between real world and type approval (based on the NEDC test) CO_2 emissions and then used to calculate the average fuel consumption of a newly purchased reference passenger car.

Table 31: Parameters used for the cost analysis of passenger cars

Parameter	Small petrol	Large petrol	Small diesel	Large diesel	Source
Acquisition costs excl. taxes (€)[1]	16 000	31 000	24 000	39 000	(CE Delft, 2016a)
Lifetime (years)	15	15	15	15	(Ricardo-AEA, 2012b)
CO_2 emission without correction (g CO_2/km)	116	149	99	126	(2)
Correction CO_2 emission (g CO_2/km)	49	60	40	50	(11)
CO_2 emission with correction g CO_2/km)	165	197	149	175	(TNO, 2014b)
CO_2 emission per L (g CO_2/L)	2 269	2 269	2 606	2 606	(CE Delft, 2014)
Fuel consumption (L/km)	0.073	0.087	0.057	0.067	(calc)
Fuel price incl. taxes (€/L)	1.250	1.250	1.040	1.040	(EC, 2016a)
Fuel price excl. taxes (€/L)	0.404	0.404	0.378	0.378	
Maintenance costs incl. taxes (€/km)[3]	0.03	0.03	0.03	0.03	Website[4]

[1] An average European registration tax of 4.30% is used.
[2] Calculation based on (TNO, 2011).
[3] Maintenance costs are rough estimates, assuming annual maintenance costs ranging between €500 and €1 200. These costs differ significantly between brands and annual mileages. The maintenance costs of diesel cars could be higher due to the change of filter, and NO_x reduction systems, but these are expected to be compensated by the higher mileage which reduces the maintenance per kilometre. For the purpose of this

Parameter	Small petrol	Large petrol	Small diesel	Large diesel	Source
Insurance (€/year)	557	557	557	557	(Insurance Europe, 2015)
Circulation taxes (€/year)	136	136	136	136	(5)

For passenger cars, three scenarios are used, based on different annual mileages of 10 000, 20 000, and 30 000 km/year. Based on these numbers and the previously determined fuel consumption, the lifetime fuel consumption is calculated for the three scenarios, as shown in Table 32. It is important to highlight that the third scenario (lifetime 450 000 km) is unlikely for small cars, and not often either for large cars, but not impossible (Ricardo-AEA, 2012b). For the purpose of this report, this scenario is included to analyse the impact of lifetime in the Total Cost of Ownership.

Table 32: Annual mileage assumed for different scenarios and consequent lifetime mileage and fuel consumption

Parameter	Small petrol	Large petrol	Small diesel	Large diesel	Scenario
Annual mileage (km/year)	10 000	10 000	10 000	10 000	1
Lifetime mileage (km)	150 000	150 000	150 000	150 000	
Lifetime fuel consumption (L)	10 481	11 549	9 618	10 657	
Annual mileage (km/year)	20 000	20 000	20 000	20 000	2
Lifetime mileage (km)	300 000	300 000	300 000	300 000	
Lifetime fuel consumption (L)	20 963	23 098	19 236	21 314	
Annual mileage (km/year)	30 000	30 000	30 000	30 000	3
Lifetime mileage (km)	450 000	450 000	450 000	450 000	
Lifetime fuel consumption (L)	31 444	34 647	28 855	31 971	

analysis, adding more detailed data on maintenance costs is not useful, given the much larger bandwidth and uncertainty in other cost components.

[4] http://www.gewoonovergeld.nl/artikelen/elektrische-auto-vs-benzinewagen/

[5] Calculation based on (CE Delft, 2016a).

Using the values from Table 31 and Table 32, the different contributions to the Total Cost of Ownership are calculated, both with taxes and without, for all three scenarios. The fuel costs and maintenance costs depend on the annual mileage and are therefore different between the scenarios. The other costs are the same for all three scenarios. Table 33 shows the costs with taxes, whereas Table 34 shows the costs without taxes.

Table 33: Contributions to the Total Cost of Ownership with taxes for the three scenarios

Parameter	**Small petrol**	**Large petrol**	**Small diesel**	**Large diesel**	**Scenario**
Acquisition costs incl. Taxes (€)[6]	20 000	39 000	31 000	50 000	All
Fuel costs incl. taxes (€)	14 000	16 000	9 000	10 000	10 000 km
Fuel costs incl. taxes (€)	27 000	32 000	18 000	21 000	20 000 km
Fuel costs incl. taxes (€)	41 000	49 000	27 000	31 000	3 000 km
Maintenance costs incl. taxes (€)	4 500	4 500	4 500	4 500	10 000 km
Maintenance costs incl. taxes (€)	9 000	9 000	9 000	9 000	20 000 km
Maintenance costs incl. taxes (€)	13 500	13 500	13 500	13 500	30 000 km
Insurance incl. taxes (€)	8 000	8 000	8 000	8 000	All
Circulation taxes (€)	2 000	2 000	2 000	2 000	All

Table 34: Contributions to the Total Cost of Ownership without taxes for the three scenarios

Parameter	**Small petrol**	**Large petrol**	**Small diesel**	**Large diesel**	**Scenario**
Acquisition costs excl. taxes (€)[7]	16 000	31 000	24 000	39 000	All
Fuel costs excl. taxes (€)	4 000	5 000	3 000	4 000	10 000 km
Fuel costs excl. taxes (€)	9 000	11 000	6 000	8 000	20 000 km

[6] Calculation based on (ICCT, 2016b).
[7] Based on (CE Delft, 2016a), an average European registration tax of 4.30% is used.

Fuel costs excl. taxes (€)	13 000	16 000	10 000	11 000	30 000 km
Maintenance costs excl. taxes (€)	4 000	4 000	4 000	4 000	10 000 km
Maintenance costs excl. taxes (€)	7 000	7 000	7 000	7 000	20 000 km
Maintenance costs excl. taxes (€)	11 000	11 000	11 000	11 000	30 000 km
Insurance excl. taxes (€)	7 000	7 000	7 000	7 000	All

Figure 13 and Figure 14 show the Total Cost of Ownership for passenger cars per vehicle and km with and without taxes for the four different types and the three scenarios. The first thing that can be deduced from the graphs is that the larger the annual mileage in the scenario, the lower the total cost per km is. This is easily explained by noting that the fixed costs are divided by more kilometres.

Whereas in scenario 1 (10 000 km/year) the acquisition costs are by far the largest portion of the costs, this is no longer the case for scenarios 2 and 3 (20 000 and 30 000 km/year, respectively), where fuel costs can even exceed them. Insurance and circulation taxes are considerable at lower annual mileage, but become less important at higher mileage. Maintenance and fuel costs per km keep constant, since they are proportional to the distance.

Diesel cars have a higher cost than petrol cars and also larger cars have a higher cost than smaller cars, mainly due to the higher acquisition costs. Only at an annual mileage of 30 000 km in Scenario 3, we see that the costs per km of diesel cars match those of petrol cars. This is however only the case when taxes are taken into account.

Figure 13: Total Cost of Ownership with taxes per vkm for passenger cars

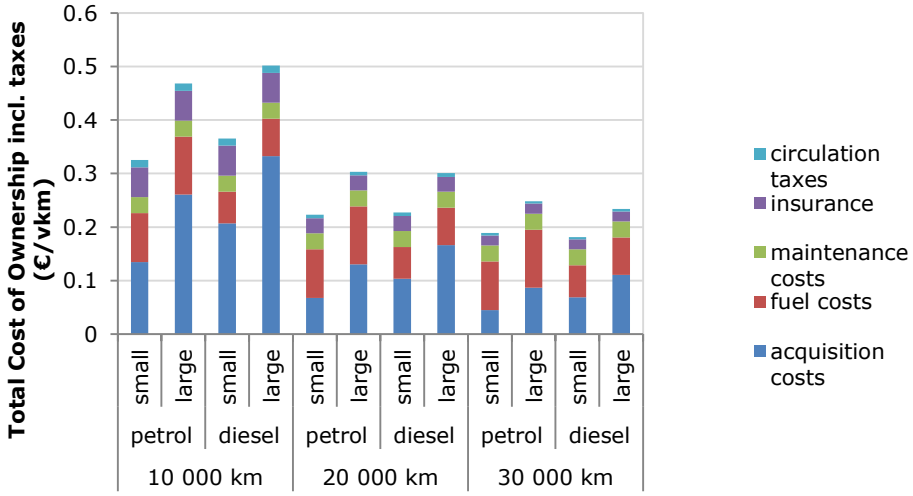

Figure 14: Total Cost of Ownership without taxes per vkm for passenger cars

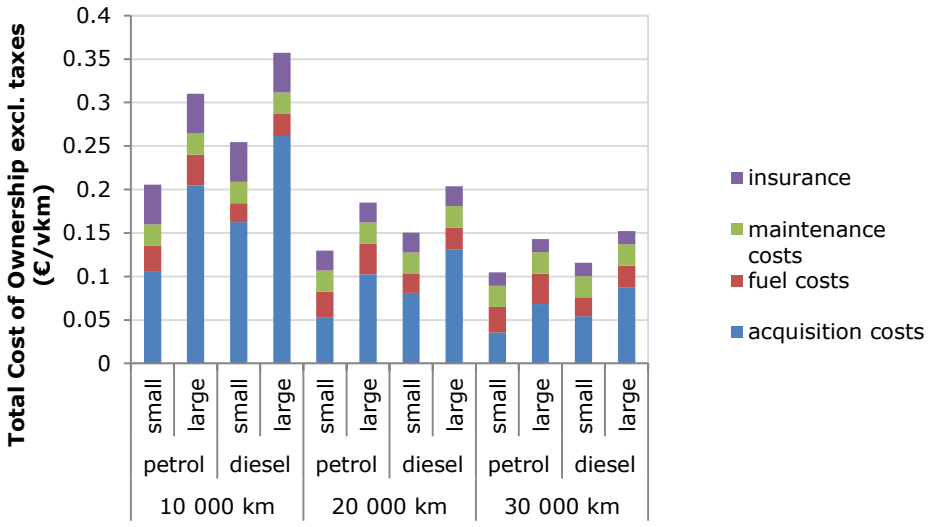

Table 35 (with taxes) and Table 36 (without taxes) give an overview of the Cost of Ownership of a passenger car, over the lifetime, per year, and per km.

Table 35: Total Cost of Ownership with taxes for passenger cars for the three scenarios

Parameter	Small petrol	Large petrol	Small diesel	Large diesel	Scenario
Total Costs of Ownership incl. taxes (€/vehicle)	49 000	70 000	55 000	75 000	10 000 km
Yearly Cost of Ownership incl. taxes (€/year/vehicle)	3 252	4 684	3 656	5 018	
Per km Cost of Ownership incl. taxes (€/vkm)	0.33	0.47	0.37	0.50	
Total Costs of Ownership incl. taxes (€/vehicle)	67 000	91 000	68 000	90 000	20 000 km
Yearly Cost of Ownership incl. taxes (€/year/vehicle)	4 462	6 066	4 551	6 015	
Per km Cost of Ownership incl. taxes (€/vkm)	0.22	0.30	0.23	0.30	
Total Costs of Ownership incl. taxes (€/vehicle)	85 000	112 000	82 000	105 000	30 000 km
Yearly Cost of Ownership incl. taxes (€/year/vehicle)	5 672	7 449	5 446	7 012	
Per km Cost of Ownership incl. taxes (€/vkm)	0.19	0.25	0.18	0.23	

Table 36: Total Cost of Ownership without taxes for passenger cars for the three scenarios

Parameter	Small petrol	Large petrol	Small diesel	Large diesel	Scenario
Total Costs of Ownership excl. taxes (€/vehicle)	31 000	47 000	38 000	54 000	10 000 km
Yearly Cost of Ownership excl. taxes (€/year/vehicle)	2 057	3 103	2 545	3 571	
Per km Cost of Ownership excl. taxes (€/vkm)	0.21	0.31	0.25	0.36	
Total Costs of Ownership incl. taxes (€/vehicle)	39 000	55 000	45 000	61 000	20 000 km
Yearly Cost of Ownership incl. taxes (€/year/vehicle)	2 597	3 699	3 007	4 071	
Per km Cost of Ownership incl. taxes (€/vkm)	0.13	0.18	0.15	0.20	
Total Costs of Ownership incl. taxes (€/vehicle)	47 000	64 000	52 000	69 000	30 000 km
Yearly Cost of Ownership incl. taxes (€/year/vehicle)	3,138	4,295	3,469	4,570	
Per km Cost of Ownership incl. taxes (€/vkm)	0.10	0.14	0.12	0.15	

Light Commercial Vehicles

In this section, the Total Cost of Ownership is calculated for Light Commercial Vehicles (LCVs) in two variations: small and large.

Table 37 shows the parameters that are used for this calculation. The average CO_2 emission as determined at the type approval is corrected (TNO, 2014b) and then used to calculate the average fuel consumption of a newly purchased reference LCV.

Table 37: Parameters used for the cost analysis of LCVs

Parameter	Small	Large	Source
Acquisition costs incl. taxes (€)	24 000	42 000	(8)
Lifetime (years)	15	15	(Ricardo-AEA, 2012b)

[8] Calculation based on (ANWB, 2015).

Parameter	Small	Large	Source
CO_2 emission without correction (g CO_2/km)	123	190	
Correction CO_2 emission (g CO_2/km)	49	46	(TNO, 2014b)
CO_2 emission with correction (g CO_2/km)	172	236	
CO_2 emission per L (g CO_2/L)	2 602	2 602	(CE Delft, 2014)
Fuel consumption (L/km)	0.062	0.085	
Fuel price incl. taxes (€/L)	1.040	1.040	(EC, 2016a)
Fuel price excl. taxes (€/L)	0.378	0.378	
Maintenance costs incl. taxes (€/km)	0.03	0.03	
Insurance (€/year)	557	557	(Insurance Europe, 2015)
Circulation taxes (€/year)	89	89	(9)

For LCVs, three scenarios are used based on different annual mileages of 10 000, 20 000, and 30000 km/year. Based on these numbers and the previously determined fuel consumption, the lifetime fuel consumption is calculated for the three scenarios, as shown in Table 38.

Table 38: Annual mileage assumed for different scenarios and consequent lifetime mileage and fuel consumption

Parameter	Small	Large	Scenario
Annual mileage (km/year)	10 000	10 000	1
Lifetime mileage (km)	150 000	150 000	
Lifetime fuel consumption (l)	9 304	12 755	
Annual mileage (km/year)	20 000	20 000	2
Lifetime mileage (km)	300 000	300 000	
Lifetime fuel consumption (l)	18 609	25 509	
Annual mileage (km/year)	30 000	30 000	3
Lifetime mileage (km)	450 000	450 000	
Lifetime fuel consumption (l)	27 913	38 264	

[9] Calculation based on (CE Delft, 2016a).

Using the values from Table 37 and Table 38, the different contributions to the Total Cost of Ownership are calculated, both with taxes and without, for all three scenarios. The fuel costs and maintenance costs depend on the annual mileage and are therefore different between the scenarios. The other costs are the same for all three scenarios. Table 39 shows the costs with taxes, whereas Table 40 shows the costs without taxes.

Table 39: Contributions to the Total Cost of Ownership with taxes for the three scenarios

Parameter	**Small**	**Large**	**Scenario**
Acquisition costs incl. taxes (€)	24 000	42 000	All
Fuel costs incl. taxes (€)	10 000	14 000	10 000 km
Fuel costs incl. taxes (€)	21 000	28 000	20 000 km
Fuel costs incl. taxes (€)	31 000	42 000	30 000 km
Maintenance costs incl. taxes (€)	4 500	4 500	10 000 km
Maintenance costs incl. taxes (€)	9 000	9 000	20 000 km
Maintenance costs incl. taxes (€)	13 500	13 500	30 000 km
Insurance incl. taxes (€)	8 000	8 000	All
Circulation taxes (€)	1 300	1 300	All

Table 40: Contributions to the Total Cost of Ownership without taxes for the three scenarios

Parameter	**Small**	**Large**	**Scenario**
Acquisition costs excl. taxes (€)	19 000	33 000	All
Fuel costs excl. taxes (€)	4 000	5 000	10 000 km
Fuel costs excl. taxes (€)	7 000	10 000	20 000 km
Fuel costs excl. taxes (€)	11 000	15 000	30 000 km
Maintenance costs excl. taxes (€)	4 000	4 000	10 000 km
Maintenance costs excl. taxes (€)	7 000	7 000	20 000 km
Maintenance costs excl. taxes (€)	11 000	11 000	30 000 km
Insurance excl. taxes (€)	7 000	7 000	All

Figure 15 and Figure 16 show the Total Cost of Ownership for LCVs with and without taxes for the four different types and the three scenarios. The first thing that can be deduced from the graphs is that the shorter the annual mileage in the scenario, the larger the total cost per km is. This is easily explained by noting that the fixed costs are divided by more kilometres.

Whereas in scenario 1 the acquisition costs are by far the largest portion of the costs, this is no longer the case for scenarios 2 and 3. Insurance and circulation taxes are

considerable at lower annual mileage, but become less important at higher mileage. Maintenance and fuel costs per km keep constant, since they are proportional to the distance.

Larger LCVS have a higher cost than smaller LCVs, mainly due to the higher acquisition costs.

Figure 15: Total Cost of Ownership with taxes per vkm for LCVs

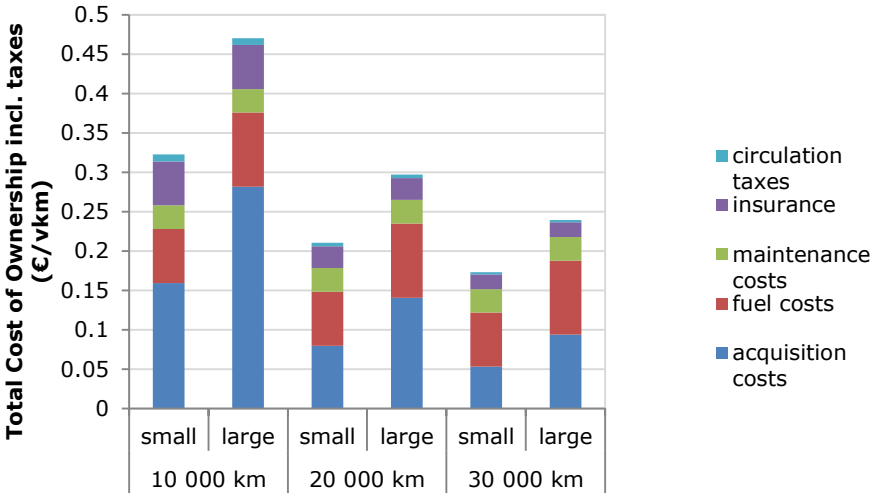

Figure 16: Total Cost of Ownership without taxes per vkm for LCVs

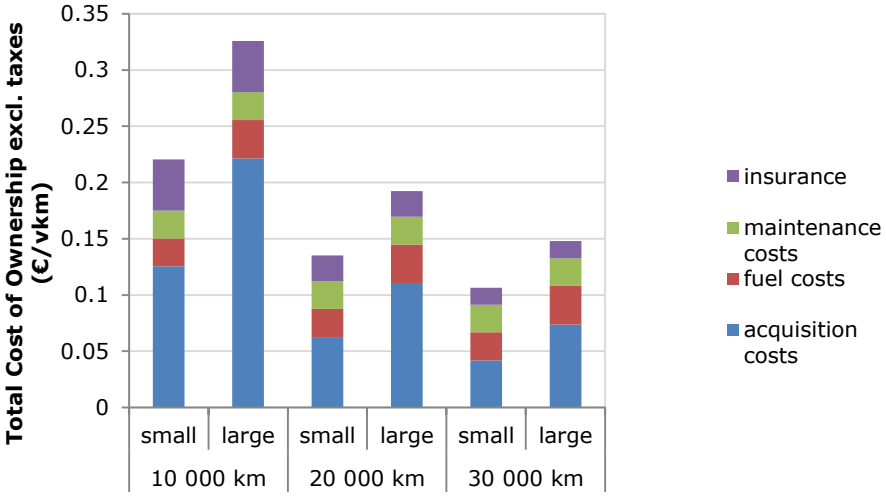

Table 41 (with taxes) and Table 42 (without taxes) give an overview of the Cost of Ownership of an LCV, over the lifetime, per year, and per km.

Table 41: Total Cost of Ownership with taxes for LCVs for the three scenarios

Parameter	**Small**	**Large**	**Scenario**
Total Costs of Ownership incl. taxes (€/vehicle)	48 000	71 000	10 000 km
Yearly Cost of Ownership incl. taxes (€/year/vehicle)	3 226	4 702	
Per km Cost of Ownership incl. taxes (€/vkm)	0.32	0.47	
Total Costs of Ownership incl. taxes (€/vehicle)	63 000	89 000	20 000 km
Yearly Cost of Ownership incl. taxes (€/year/vehicle)	4 213	5 943	
Per km Cost of Ownership incl. taxes (€/vkm)	0.21	0.30	
Total Costs of Ownership incl. taxes (€/vehicle)	78 000	108 000	30 000 km
Yearly Cost of Ownership incl. taxes (€/year/vehicle)	5 200	7 184	
Per km Cost of Ownership incl. taxes (€/vkm)	0.17	0.24	

Table 42: Total Cost of Ownership without taxes for LCVs for the three scenarios

Parameter	Small	Large	Scenario
Total Costs of Ownership excl. taxes (€/vehicle)	33 000	49 000	10 000 km
Yearly Cost of Ownership excl. taxes (€/year/vehicle)	2 206	3 259	
Per km Cost of Ownership excl. taxes (€/vkm)	0.22	0.33	
Total Costs of Ownership excl. taxes (€/vehicle)	41 000	58 000	20 000 km
Yearly Cost of Ownership excl. taxes (€/year/vehicle)	2 702	3 847	
Per km Cost of Ownership excl. taxes (€/vkm)	0.14	0.19	
Total Costs of Ownership excl. taxes (€/vehicle)	48 000	67 000	30 000 km
Yearly Cost of Ownership excl. taxes (€/year/vehicle)	3 198	4 435	
Per km Cost of Ownership excl. taxes (€/vkm)	0.11	0.15	

Cost analysis for fuel efficient passenger cars and LCVs

In the study that supported the impact assessment of the 2021 CO_2 regulation for cars[10] the additional vehicle manufacture costs for meeting the 95 g/km (compared to 130 g/km) were estimated at €1 852 and €1 993 for small and large petrol cars, respectively; and €1 552 and €1 930 for small and large diesel cars, respectively. In these numbers no share of PHEVs or ZEV was assumed. The marginal reduction costs at 95 g/km target were estimated at € 91 per g/km reduction. The cost for the best in class vehicles will however be higher. An indication of these costs has been derived from the cost curves developed for the 2020/2021 CO_2 regulation for cars and LCVs[11] and are included in Table 43. Based on the CO_2 reductions, energy cost savings, change in total cost of ownership (TCO) over the entire vehicle lifetime and the GHG abatement cost has been calculated, assuming a vehicle lifetime of 15 years. The GHG abatement cost is based on the CO_2 emissions savings and energy cost savings over the entire vehicle lifetime and the additional purchase costs (all without taxes); impacts on external costs are not included. The table shows that, in some cases, the GHG abatement cost is lower than zero, meaning that the energy cost savings exceed the higher vehicle purchase prices and so that these can be regarded as no-regret reduction options.

It should be noted that the additional costs of more fuel efficient vehicles depend on many things:

- powertrain technology (regular combustion engine, hybrid, plug-in hybrid, fuel electric, fuel cell, etc.);
- size segment;
- annual mileage;
- tax regime;
- fuel price.

Therefore, the TCO and the GHG abatement cost can vary per car type and application. However, purchasing the relatively most fuel efficient cars (according to the values shown in Section 3.3.1.2), can be expected to be cost effective (meaning negative GHG abatement costs) in almost all cases.

[10] TNO, 2011 Support for the revision of Regulation (EC) No 443/2009 on CO_2 emissions from cars Service request #1 for Framework Contract on Vehicle Emissions.

[11] Recently the cost estimates have been updated as part of the research supporting the preparation the post-2020 CO_2 regulation for cars and LCVs, but this information is not yet publicly available.

Table 43: Cost analysis for fuel efficient passenger cars and LCVs (ICEVs) in 2017 compared to 2015 levels (passenger cars)/2014 levels (LCVs)

Fuel type	Size category	Additional vehicle cost (indicative)[12]	Cumulative energy cost savings (incl. taxes)	Change in TCO in %	GHG abatement cost (€/t CO_2)	Scenario
CARS		Compared to 2015				
Petrol	Small	1 100	2 400	-1.8%	-195	10 000 km
			4 700	-4.8%	-359	20 000 km
			7 100	-6.6%	-414	30 000 km
Petrol	Large	3 700	3 300	2.4%	265	10 000 km
			6 600	-1.8%	-129	20 000 km
			9 900	-4.4%	-261	30 000 km
Diesel	Small	600	1 000	-0.4%	-79	10 000 km
			2 000	-1.8%	-229	20 000 km
			3 100	-2.7%	-279	30 000 km
Diesel	Large	4 300	2 000	5.0%	712	10 000 km
			4 000	2.0%	166	20 000 km
			6 000	-0.2%	-15	30 000 km
LCVs		Compared to 2014				
Diesel	Small	150	500	-0.5%	-189	10 000 km
			1 000	-1.2%	-284	20 000 km
			1 500	-1.7%	-316	30 000 km
	Large	200	1 900	-2.2%	-310	10 000 km
			3 800	-3.8%	-345	20 000 km
			5 600	-4.8%	-357	30 000 km

[12] The Total Cost of Ownership is calculated as the sum of yearly costs as they occur over the lifetime. This entails that financing costs are added to the additional vehicle costs.

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