

PRODUCT CATEGORY RULES (PCR)

PUBLICATION DATE 20YY-MM-DD *(TO BE ADDED BY THE SECRETARIAT)*

PUBLIC AND PRIVATE BUSES AND COACHES



PRODUCT CATEGORY CLASSIFICATION: UN CPC 49112 & 49113

PCR 2016:04
VERSION 3.0.0.

VALID UNTIL 20XX-YY-ZZ *(TO BE ADDED BY THE SECRETARIAT)*

**DRAFT FOR OPEN
CONSULTATION**

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INTRODUCTION TO OPEN CONSULTATION

This draft PCR document is available for open consultation from 2026-03-05 until 2026-05-05. Feel free to forward the draft to any other stakeholder you might think is relevant, including colleagues and other organisations.

We are interested in comments from stakeholders on:

- General
 - Alignment with PCRs available in other programmes for type III environmental declarations, industry-specific LCA guidelines or similar.
- Scope of PCR
 - Product category definition and description
 - Classification of product category using CPC codes
- Goal and scope, life cycle inventory and life cycle impact assessment
 - Functional unit/declared unit
 - System boundary
 - Allocation rules
 - Data quality requirements
 - Recommended databases for generic data
 - Impact categories and impact assessment methodology
- Additional information

Comments shall be sent directly to the PCR Moderator (contact details available in Section 1). There is a template for comments on www.environdec.com that may be used.

For questions about the PCR, please contact the PCR moderator. For general questions about the International EPD System, EPD or PCR development, please contact the Secretariat via <https://www.environdec.com/support>.

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1 INTRODUCTION

This document constitutes Product Category Rules (PCR) developed in the framework of the International EPD System: a programme for Environmental Product Declarations (EPD)¹ according to ISO 14025:2006, ISO 14040:2006, ISO 14044:2006, and product-specific standards, such as EN 15804 and ISO 21930 for construction products. EPDs are voluntary documents for a company or an industry association to present transparent, consistent, and verifiable information about the environmental performance of their products (goods or services).

The General Programme Instructions (GPI), publicly available on www.environdec.com, includes the rules for the overall administration and operation of the programme and the basic rules for developing EPDs registered in the programme. A PCR complements the GPI and the normative standards by providing specific rules, and guidelines for developing an EPD for one or more specific product categories (see Figure 1), thereby enabling the generation of consistent EPDs within a product category. A PCR should not repeat the rules and guidelines of the GPI, but include additions, specifications and deviations to the rules set in the GPI. As such, a PCR shall be used together with the GPI.

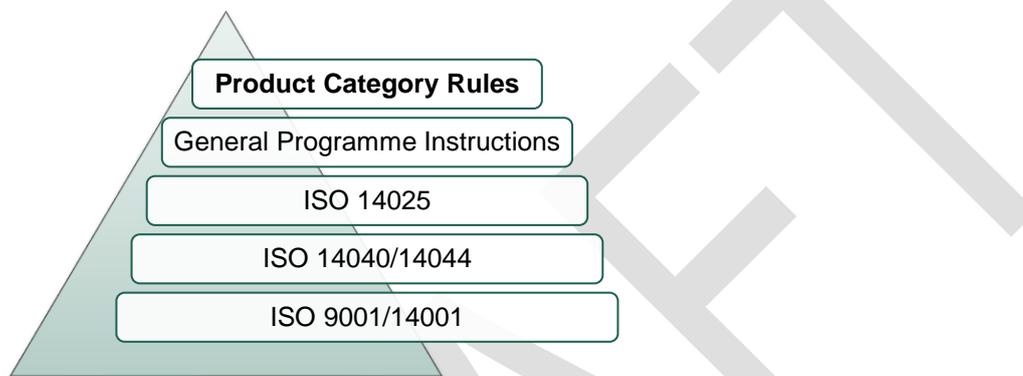


Figure 1. The hierarchy between PCRs, standards, and other documents.

The present PCR uses the following terminology:

- The term “shall” is used to indicate what is obligatory, i.e., a requirement.
- The term “should” is used to indicate a recommendation. Any deviation from a recommendation shall be justified in the EPD development process.
- The terms “may” or “can” are used to indicate an option that is permissible.

For definitions of other terms used in the document, see the GPI and normative standards.

Any references to this PCR shall include the PCR registration number, name, and version number.

The programme operator maintains the copyright of the PCR to ensure that it is possible to publish, update, and make it available to all organisations to develop and register EPDs. Stakeholders participating in PCR development should be acknowledged in the final document and on the website.

¹ Termed type III environmental declarations in ISO 14025.

2 GENERAL INFORMATION

2.1 ADMINISTRATIVE INFORMATION

| | |
|----------------------------------|--|
| Name: | Public and private buses and coaches |
| Registration number and version: | 2016:04, version 3.0.0 |
| Programme: |  <p>INTERNATIONAL EPD SYSTEM The International EPD System</p> |
| Programme operator: | <p>EPD International AB, Box 210 60, SE-100 31 Stockholm, Sweden. Website: www.environdec.com E-mail: support@environdec.com</p> |
| PCR Moderator: | Gorka Benito Alonso, IK INGENIERIA, g.benito@ik-ingenieria.com |
| PCR Committee: | <p>Irizar S.Coop., Volvo Bussar AB, Iveco S.p.A., Daimler Buses GmbH, Ebusco B.V., CaetanoBus - Fabricação de carroçarias SA, MAN Truck & Bus SE, TEMSA, Yutong Bus Co., LTD., Solaris Bus & Coach, EPTO European Passenger Transport Operators association, AET The Association for European Transport, IRU world road transport organisation, CONFEBUS Confederation of Transport by Bus & Coach, ABA American Bus Association, Nihon Bus Association, China Merchants Testing Vehicle Technology Research Institute Co., Ltd. (CMVR), IVL Swedish Environmental Research Institute</p> <p>Special thanks to the following members for their active participation in the PCR update:</p> <ul style="list-style-type: none"> Anna Kutteneich from MAN Truck and Bus Guillermo Fernandez from IRIZAR Julia Lindholm from IVL Swedish Environmental Research Institute Jules PUIG external advisor for IVECO Maria Wallenius Henriksson from VOLVO BUS Bus Corporation Martin from DAIMLER BUSES Oihane Sanz from IRIZAR Qian YANG from CHINA MERCHANTS TESTING VEHICLE TECHNOLOGY RESEARCH INSTITUTE Wang Rui - IVL Swedish Environmental Research Institute (China office) |
| Publication date: | <p><i>To be added by the Secretariat</i> See Section 9 for a version history of the PCR.</p> |
| Valid until: | <p><i>To be added by the Secretariat</i> The validity may change. See www.environdec.com for the latest version of the PCR and the latest information on its validity and transition periods between versions.</p> |
| Development and updates: | <p>The PCR has been developed following ISO 14027, including public consultation and review. The rules for the development and updating processes are described in Section 9 of the GPI.</p> <p>The PCR is valid for a pre-determined time period to ensure that it is updated at regular intervals. When the PCR is about to expire, the PCR Moderator shall initiate a discussion with the Secretariat on if and how to proceed with updating the PCR and renewing its validity. A PCR may be updated before it expires, based on changes in normative standards or provided significant and well-justified proposals for changes or amendments are presented.</p> <p>When there has been an update of the PCR, the new version should be used to develop EPDs. For small updates (change of third-digit version number), the previous version is normally immediately removed from the PCR library on www.environdec.com and there is no transition period. For medium updates (change of second-digit version number), the previous version of the PCR is valid in parallel during a transition period of at least 90 days, but not exceeding its</p> |

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| | <p>previously set validity period. For large updates (change of first-digit version number), the previous version is valid in parallel during a transition period of at least 180 days but not exceeding its previously set validity period.</p> <p>Stakeholder feedback on PCRs is very much encouraged. Any comments on this PCR may be sent directly to the PCR Moderator and/or the Secretariat during its development or during its period of validity.</p> |
| Standards documents and conformance: | General Programme Instructions of the International EPD System, version 5.0.0, based on ISO 14025 and ISO 14040/14044. ² |
| PCR language(s): | At the time of publication, this PCR was available in English. If the PCR is available in several languages, these are available on www.environdec.com . In case of translated versions, the English version takes precedence in case of any discrepancies. |

2.2 SCOPE OF PCR

2.2.1 PRODUCT CATEGORY DEFINITION AND DESCRIPTION

This document provides Product Category Rules (PCR) for the assessment of the environmental performance of public and private passenger buses and coaches, which are every single-deck, double-deck, rigid or articulated road vehicles of category M1, M2 or M3 as defined in Regulation (EU) 2018/858 (and its amendments):

- Category M1: Vehicles designed and constructed for the carriage of passengers and comprising no more than eight seats in addition to the driver's seat, when they are classified as buses (regular cars are not included in the scope of this PCR).
- Category M2: 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 M3: 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.

Inside M2 and M3 Category, it also applies for vehicles of:

- "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

The technology coverage includes the following powertrains:

- Internal Combustion Engine, petrol and diesel (ICE)
- Compressed natural gas vehicles (CNG)
- Liquefied Petroleum Gas vehicles (LPG)
- Battery electric vehicles (BEV)
- Fuel cell electric vehicles (FCEV) and Fuel cell range extended vehicles (FC-REEV), based on hydrogen
- Hydrogen fuelled internal combustion engine vehicle (H2 ICEV)
- Hybrid Electric Vehicle (HEV) and Plug-in Hybrid Electric Vehicle (PHEV)

² Some rules influencing EPD development are independent of the GPI version referred to in the PCR. For example, the latest rules on EPD verification procedures in the GPI shall be followed within 90 days of its publication. See Section 5.1 in the GPI for a description of the four categories of rules and when they shall be followed.

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Other fuels as HVO (Hydrotreated Vegetable Oil) and Biofuels are not yet included under the scope of this PCR, as further research and requirements needs to be developed relating feedstock type (e.g., waste cooking oil vs. virgin vegetable oil) as this heavily influences results, upstream agricultural inputs, transportation of the fuel. It will be considered in future updates.

The product group and CPC code shall be specified in the EPD according to the classification as follows.

- Division: 49 - Transport equipment
 - Group: 491 - Motor vehicles, trailers and semi-trailers; parts and accessories thereof
 - Class: 4911 - Motor vehicles
 - **Subclass: 49112** - Public-transport type passenger motor vehicles
 - **Subclass: 49113** - Motor cars and other motor vehicles principally designed for the transport of persons (except public-transport type vehicles, vehicles specially designed for travelling on snow, and golf cars and similar vehicles)

According to the GPI 5.0.1 section A.9, similar products from the same company may be included in the same EPD.

The requirements in that section must be met. For these requirements, “similar products” means different variants of the same vehicle type covered by this PCR. These vehicles may be manufactured by one company at one or more sites. They may also involve one company producing the chassis (including its core processes) and the same or another company producing the body (including its core processes). These shall be shown in separate columns.

As for today, EPDs for just “Bus Chassis” will need further development, so this PCR does not cover this case.

2.2.2 GEOGRAPHICAL SCOPE

This PCR may be used globally.

2.2.3 EPD VALIDITY

An EPD becomes valid as of its version date (see Section 8.4.5 of the GPI). When an EPD is originally published, the validity period is normally five years starting from the version date or until the EPD has been de-registered from the International EPD System. Shorter validity periods are also accepted, for example if decided by the EPD owner.

For rules on when an EPD shall be updated and re-verified during its validity, see Section 6.8.1 of the GPI. For validity periods in case of updates of EPDs, see Section 6.8 of the GPI.

The version date and the period of validity shall be stated in the EPD.

Publication of a new version of the PCR or the GPI does not affect the validity of already published EPDs.

3 REVIEW AND BACKGROUND INFORMATION

This PCR was developed in accordance with the PCR development process described in the GPI of the International EPD System, including open consultation and review.

3.1 OPEN CONSULTATION

3.1.1 VERSION 1.0

This PCR was available for open consultation from 2015-11-09 until 2016-01-17, during which any stakeholder was able to provide comments by posting on the PCR forum on www.environdec.com or by contacting the PCR moderator.

Stakeholders were invited via e-mail or other means to take part in the open consultation, and were encouraged to forward the invitation to other relevant stakeholders.

3.1.2 VERSION 2.0

This PCR was available for open consultation from 2020-07-03 until 2020-09-02, during which any stakeholder was able to provide comments by posting on the PCR forum on www.environdec.com or by contacting the PCR moderator.

Stakeholders were invited via e-mail or other means to take part in the open consultation, and were encouraged to forward the invitation to other relevant stakeholders.

No comments were received.

3.1.3 VERSION 3.0.0

This PCR update was available for open consultation from XXXXXX until XXXXXX, during which any stakeholder was able to provide comments by contacting the PCR Moderator and/or the Secretariat.

Stakeholders were invited via e-mail or other means to take part in the open consultation and were encouraged to forward the invitation to other relevant stakeholders. The following stakeholders provided comments during the open consultation and agreed to be listed as contributors in the PCR and on www.environdec.com:

- *List of stakeholder names and affiliation (to be added after the open consultation).*

In case no stakeholders provided comments and agreed to be listed as contributors, the above sentence shall be adjusted accordingly ("No stakeholders provided comments during the open consultation and agreed to be listed as contributors in the PCR and on www.environdec.com.") and the bullet list shall be removed.

3.2 PCR REVIEW

3.2.1 VERSION 1.0

| | |
|--------------------------|---|
| PCR review panel: | The Technical Committee of the International EPD System. A full list of members is available on www.environdec.com . The review panel may be contacted via support@environdec.com . Members of the Technical Committee were requested to state any potential conflict of interest with the PCR Committee, and if there were conflicts of interest they were excused from the review. |
| Chair of the PCR review: | Greg Doudrich |

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| | |
|---------------|-----------------------------|
| Review dates: | 2016-03-12 until 2016-04-12 |
|---------------|-----------------------------|

3.2.2 VERSION 2.0

| | |
|--------------------------|---|
| PCR review panel: | The Technical Committee of the International EPD® System. A full list of members available on www.environdec.com . The review panel may be contacted via info@environdec.com . Members of the Technical Committee were requested to state any potential conflict of interest with the PCR moderator or PCR committee, and were excused from the review. |
| Chair of the PCR review: | Maurizio Fieschi |
| Review dates: | 2020-09-10 until 2020-10-09 |

3.2.3 VERSION 3.0.0

| | |
|--------------------------|---|
| PCR review panel: | The Technical Committee of the International EPD® System. A full list of members available on www.environdec.com . The review panel may be contacted via info@environdec.com . Members of the Technical Committee were requested to state any potential conflict of interest with the PCR moderator or PCR committee, and were excused from the review. |
| Chair of the PCR review: | To be added by the secretariat |
| Review dates: | To be added by the secretariat |

3.3 EXISTING PCRS FOR THE PRODUCT CATEGORY

As part of the development of this PCR, existing PCRs and other internationally standardised methods that could potentially act as PCRs were considered to avoid unnecessary overlaps in scope and to ensure harmonisation with established methods of relevance for the product category. The existence of such documents was checked among the following EPD programmes and international standardisation bodies:

- International EPD System. www.environdec.com.
- AENOR Global EPD. <https://www.aenor.com/>
- EPD Norge. <https://www.epd-norge.no/>
- Institut Bauen und Umwelt (IBU): <https://epd-online.com>
- SCS Global Services <https://www.scsglobalservices.com/>

No PCRs identified in programmes operated in accordance with ISO 14025.

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3.4 REASONING FOR DEVELOPMENT OF PCR

This PCR was developed to enable publication of EPDs for the product category defined in Section 2.2.1 based on ISO 14025 and ISO 14040/14044. The PCR enables different practitioners to generate consistent results when assessing the environmental impact of products of the same product category, and thereby it supports comparability of products within a product category.

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3.5 UNDERLYING STUDIES USED FOR PCR DEVELOPMENT

The methodological choices made during the development of this PCR (declared/functional unit, system boundary, allocation methods, impact categories, data quality rules, etc.) were primarily based on the following underlying studies:

LCA & Environmental Product Declaration from Volvo Bussar AB, Volvo BZL Double Dec, 2025-05-22
 LCA & Environmental Product Declaration from Volvo Bussar AB, Volvo 8900ELE, 2024-09-25
 LCA & Environmental Product Declaration from Volvo Bussar AB, Volvo BZL SD Electric, 2024-06-25
 LCA & Environmental Product Declaration from Volvo Bussar AB, Volvo 7900 Electric , 2023-11-02
 LCA & Environmental Product Declaration from Volvo Bussar AB, Volvo 7900 Electric Artic, 2023-11-02
 LCA & Environmental Product Declaration from MAN Truck & Bus SE, MAN Lion's City 10 E and City 18E, 2024-12-04
 LCA & Environmental Product Declaration from MAN Truck & Bus SE, MAN Lion's City 12 G EfficientHybrid, 2022-12-20
 LCA & Environmental Product Declaration from MAN Truck & Bus SE, Lion's City 12 E, 2022-12-15
 LCA & Environmental Product Declaration from Daimler Buses GmbH, Mercedes-Benz Citaro hybrid, 2025-05-20
 LCA & Environmental Product Declaration from Daimler Buses GmbH, Mercedes-Benz Citaro hybrid K, 2025-05-20
 LCA & Environmental Product Declaration from Daimler Buses GmbH, eCitaro and eCitaro G, 2023-07-25
 LCA & Environmental Product Declaration from IRIZAR EMOBILITY S.L, Irizar ie bus Efficient, 2025-10-30
 LCA & Environmental Product Declaration from IRIZAR EMOBILITY S.L, IRIZAR ie bus NG, 2021-07-26
 LCA & Environmental Product Declaration from IRIZAR S.COOP., Irizar i6 Efficient FCEV, 2025-10-08
 LCA & Environmental Product Declaration from IRIZAR S.COOP., Irizar i6 Efficient Integral Coach, 2024-08-02
 LCA & Environmental Product Declaration from IRIZAR S.COOP., Irizar I4 Integral Coach, 2019-05-17
 LCA & Environmental Product Declaration from Karsan, e-ATA 12 Meter Electric Bus, 2025-12-09
 LCA & Environmental Product Declaration from Karsan, e-ATAK 8 meter Electric Bus, 2025-12-09
 LCA & Environmental Product Declaration from Karsan, e-ATA 10 meter Electric Bus, 2025-12-09
 LCA & Environmental Product Declaration from Karsan, e-ATA 18 Meter Electric Bus, 2025-12-09
 LCA & Environmental Product Declaration from Higer Bus Company Ltd., Azure18 Electric Bus, 2025-12-01
 LCA & Environmental Product Declaration from Higer Bus Company Ltd., Azure12 Electric Bus, 2025-10-27
 LCA & Environmental Product Declaration from Higer Bus Company Ltd., Azure9 Electric Bus, 2025-09-23
 LCA & Environmental Product Declaration from ZHONGTONG BUS HOLDING CO.,LTD, N8 Electric Bus, 2025-09-19
 LCA & Environmental Product Declaration from ZHONGTONG BUS HOLDING CO.,LTD, H13E Electric Bus, 2025-08-21
 LCA & Environmental Product Declaration from ZHONGTONG BUS HOLDING CO.,LTD, N18 (LCK6180EVG), 2025-05-08
 LCA & Environmental Product Declaration from Solaris Bus & Coach, Urbino 18 hydrogen, 2025-06-03
 LCA & Environmental Product Declaration from Yutong Bus Co., LTD., U11DD Electric Bus, 2025-05-26
 LCA & Environmental Product Declaration from Yutong Bus Co., LTD., IC15E Electric Bus, 2025-04-11
 LCA & Environmental Product Declaration from Yutong Bus Co., LTD., U10(Low Floor) Electric Bus, 2025-04-11
 LCA & Environmental Product Declaration from Yutong Bus Co., LTD., T14E Electric Bus, 2025-04-11
 LCA & Environmental Product Declaration from Yutong Bus Co., LTD., U10(Low Entrance) Electric Bus, 2025-04-11
 LCA & Environmental Product Declaration from Yutong Bus Co., LTD., E7S Electric Bus, 2025-04-11
 LCA & Environmental Product Declaration from Zonson Smart Auto Corporation,GTZ6129BEVR Electric bus, 2025-05-18
 LCA & Environmental Product Declaration from Zonson Smart Auto Corporation,GTZ6859BEVBF Electric bus, 2025-05-18
 LCA & Environmental Product Declaration from Xiamen Golden Dragon Bus Co., Ltd., GD12E 12m electric coach, 2025-03-07
 LCA & Environmental Product Declaration from Xiamen Golden Dragon Bus Co., Ltd., E12C 12m serial electric bus, 2025-03-07
 TranSensus, Towards a European-wide harmonised transport-specific LCA Approach. Consolidated Guidelines for a transport specific life cycle assessment, Thilo Bein & Felipe Cerdas Fraunhofer LBF & IST. Funded by the European Union. <https://lca4transport.eu/> 2025.
 Laura Lonza, EUROPEAN COMMISSION. Determining the environmental impacts of conventional and alternatively fuelled vehicles through LCA. Directorate-General for Climate Policy. Directorate C - Climate Strategy, governance and emissions from non-trading sectors. Unit C4 — Road Transport

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4 LCA METHOD

This section provides rules for the LCA method used to develop an EPD for the product category as defined in Section 2.2.1. The basic rules of the LCA method are set in Annex A of the GPI, and this section only includes additions, specifications and deviations to the rules set in the GPI. Guidance and examples of applying the LCA method are also available on www.environdec.com/methodology.

4.1 MODELLING APPROACH

See Section A.1 of the GPI.

As a reminder, note that the LCA modelling approach of the International EPD System is attributional LCA (in contrast to consequential LCA), meaning that specific or average data shall be used (i.e., not marginal data), and that allocation problems shall be solved via allocation and not by sub-dividing the unit process into two or more subprocesses, (also called system expansion beyond the system boundaries or “substitution”). Credits for avoided environmental impact shall not be used to solve allocation problems.

4.2 FUNCTIONAL UNIT

The main function of a passenger road vehicle is the transportation of a given number of passengers over a predefined distance.

The functional unit chosen to quantify the main function is transport of **1 passenger for 1 km**.

The environmental impact shall be given per functional unit considering the bus capacity according to available seats and space for standing at 100 % load factor.

The functional unit shall be specified in the EPD.

4.2.1 PRODUCT LIFESPAN

The annual driven distance should be multiplied by the life-time in years to obtain the full driven distance over the lifetime.

4.2.1.1 Lifetime in distance

An annual driven distance should be calculated based on the specific use pattern of the vehicle. This includes the typical trips made, the length of the trips and the frequency. This can also include payload and passengers.

Values consistent with VECTO³-based HDV CO₂ and fuel consumption certification (European Commission) shall be used to determine the lifetime in kilometres.

If unknown or if an average value is preferred, an annual mileage according to Regulation (EU) 2024/1610⁴ may be used:

- 60,000 km per year for vehicle sub-group 31-LF (City)
- 96,000 km per year for 32-C2 (Interurban)
- 96,000 km per year for 34-C3 (Coach)

³ The VECTO tool is prescribed for the calculation of HDV energy consumption for each segment and for different mission profiles as defined in the EU CO₂ and fuel consumption certification legislation for HDVs, and which are also defined in Commission Regulation (EU) 2024/1610 on strengthening CO₂ emissions standards for HDVs. These regulations also define standardized annual km for new HDVs and weighting factors for different mission profiles to be used to calculate a weighted average value for the assessment of compliance with CO₂ reduction targets for different HDV segments

⁴ Regulation (EU) 2024/1610 of the European Parliament and of the Council of 14 May 2024 amending Regulation (EU) 2019/1242 as regards strengthening the CO₂ emission performance standards for new heavy-duty vehicles and integrating reporting obligations, amending Regulation (EU) 2018/858 and repealing Regulation (EU) 2018/956

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4.2.1.2 Lifetime in years

There are different ways to justify the lifetime in years, such as ageing model or data from fleet monitoring.

The following default values for the lifetime in years for shall be used⁵:

- Urban buses: 13 years
- Coaches: 15 years

Other sufficiently justified lifetime assumptions in years are acceptable as well. A transparent documentation of these shall be made in the LCA report and declared in the EPD.

4.2.2 TECHNICAL SPECIFICATION

The following information described on the basis of some essential aspects of construction and design of the vehicle must be provided:

- | | |
|---|--|
| <ul style="list-style-type: none"> ▪ chassis/floor pan, ▪ type of powertrain and engine (diesel, electric, hybrid, GLP). Maximum output, torque, equipment, position and arrangement of the engines ▪ number of axles and wheels ▪ Front axle load (Max), Rear axle load (Max), Gross vehicle weight (GVW) and Curb Weight (Kerb Weight) ▪ Axle distance, Front overhang, Rear overhang ▪ Chassis length and width ▪ Wheel lock (*) ▪ Gearbox | <ul style="list-style-type: none"> ▪ Driving cab (forward, semi-forward or normal) ▪ assenger capacity ▪ Brakes and safety ▪ Suspension ▪ Steering ▪ Electrical systems ▪ Air conditioning system |
|---|--|

4.2.2.1 Material content declaration

The content declaration shall have the form of a list of materials and chemical substances including information on their environmental and hazardous properties. The content of materials shall be declared in the EPD at a minimum of 95% in weight of the final vehicle and shall be classified into the following categories as a minimum, adapted from ISO 22628.

- | | |
|--|---|
| <ul style="list-style-type: none"> ▪ Metals ▪ Polymers, filled and unfilled (excluding elastomers: rubber). ▪ Elastomers ▪ Glass ▪ Fluids | <ul style="list-style-type: none"> ▪ Modified organic natural materials (MONM), such as leather, wood, cardboard and cotton fleece ▪ Electric and electronic equipment ▪ Others, including components and/or materials for which the material contents cannot be established). |
|--|---|

Note: Fiber reinforced polymers materials (carbon fibre reinforced polymer, glass fibre reinforced polymer, aramide) shall be classified as polymers. A detailed material report shall be part of the LCA report.

⁵ TranSensus, Towards a European-wide harmonised transport-specific LCA Approach. Consolidated Guidelines for a transport specific life cycle assessment, Thilo Bein & Felipe Cerdas Fraunhofer LBF & IST. Funded by the European Union. <https://lca4transport.eu/> 2025.

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4.2.2.2 Configuration

For the same passenger Bus different interior's configurations can be considered. That is why the complete layout of passenger accommodation space and number of passenger seats shall be declared in the EPD for the selected configuration.

All other information regarding configuration may be put in the EPD if found relevant.

Suspension and steering, electrical systems, air conditioning systems

4.2.2.3 Battery and Fuel Cell technical information

Additionally, when battery and fuel cells are used in the vehicle (ICE, BEV, FCEV, FC-REEV), the following parameters related to electrochemical performance and durability requirements for electric vehicle batteries shall be declared in the EPD⁶.

- Rated capacity (in Ah or H₂) and capacity fade (in %).
- Power (in W) and power fade (in %).
- Internal resistance (in Ω) and internal resistance increase (in %).
- Where applicable, energy round trip efficiency and its fade (in %).
- The expected life-time of the battery under the reference conditions for which it has been designed, in terms of cycles, except for non-cycle applications, and calendar years.

Where:

- 'Rated capacity' means the total number of ampere-hours (Ah) that can be withdrawn from a fully charged battery under reference conditions.
- 'Capacity fade' means the decrease over time and upon usage in the amount of charge that a battery can deliver at the rated voltage, with respect to the original rated capacity.
- 'Power' means the amount of energy that a battery is capable of providing over a given period under reference conditions.
- 'Power fade' means the decrease over time and upon usage in the amount of power that a battery can deliver at the rated voltage.
- 'Internal resistance' means the opposition to the flow of current within a cell or a battery under reference conditions, that is, the sum of electronic resistance and ionic resistance to the contribution to total effective resistance including inductive/capacitive properties.
- 'Energy round trip efficiency' means the ratio of the net energy delivered by a battery during a discharge test to the total energy required to restore the initial state of charge by a standard charge.

The elements to explain the measurements for the previous parameters listed are:

- Applied discharge rate and charge rate.
- Ratio between nominal battery power (W) and battery energy (Wh).
- Depth of discharge in the cycle-life test.
- Power capability at 80 % and 20 % state of charge.
- Any calculations performed with the measured parameters, if applicable.

⁶ Based on Regulation (EU) 2023/1542 of the European Parliament and of the Council of 12 July 2023 concerning batteries and waste batteries, amending Directive 2008/98/EC and Regulation (EU) 2019/1020 and repealing Directive 2006/66/EC (Text with EEA relevance)

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4.3 SYSTEM BOUNDARY

The scope of this PCR and EPDs based on it is considered as cradle-to-grave.

All environmentally relevant processes from “cradle to grave” shall be included, so that at minimum 95% of the total energy use, mass of product content, and environmental impact is accounted for (see Section 4.5).

4.3.1 LIFE-CYCLE STAGES AND INFORMATION MODULES

The product life cycle shall be divided into the following life-cycle stages and information modules:

- Product stage, modules A1-A3:
 - A1: extraction and production of raw materials for vehicle components (e.g. steel, aluminium, plastics, powder coating) and the production of supplied components (e.g. batteries, forks, lifting systems, wheels, counterweight for counterbalance trucks) that are not internally manufactured
 - Processing of secondary materials from other product life cycles,
 - generation of electricity and production of fuels, steam and other energy carriers used in the module A
 - waste treatment of waste generated in the module A
 - A2: Transports from the suppliers of materials/components to the manufacturer of the vehicle.
 - Transportation from tier 1 (direct) suppliers to the vehicle assembly/manufacturing facility, in at least 80% by weight of the vehicle.
 - A3: Manufacturing of the vehicle⁷.
 - vehicle (and components, if internally performed) manufacturing and assembly, including e.g. carpentry, painting, assembly, testing, packaging (if applicable)
 - generation of electricity and production of fuels, steam and other energy carriers used in the module,
 - waste treatment of waste generated in the module, including its transport to waste treatment platform
 - The following processes shall not be included:
 - manufacturing of production equipment, buildings and other capital goods,
 - business travel of personnel,
 - travel to and from work by personnel, and
 - research and development activities.
- Distribution and installation stage, modules A4-A5:
 - A4: Transport of the vehicle to the distribution site/user, including storage of the vehicle (e.g., warehouse and retail operations). If specific data are too diversified, an average scenario referred to the representative distribution macro-area should be adopted (e.g., Europe, America, Asia).
 - A5: Installation of the vehicle, for example final component assembly at the final user (e.g., including transports, energy consumption and waste processing of material and product losses arising in A5), waste treatment of the product packaging (if applicable).
- Use stage, modules B1-B7:
 - B1: Use/application/operation of the vehicle (e.g., consumptions and emissions not included in B2-B7).

⁷ These are often, but not always, the processes under operational control of the EPD owner.

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- B1 should be (as per EN15804) related to direct emissions. For example, the release of refrigerant gases, oil leakage / grease losses during use according to the maintenance scenario.
- Emissions due to the fuel combustion, including leakages such as emissions of methane and other hydrocarbons, together with emissions from the vehicles (e.g. methane leakage from CNG cars) and the formation of non-CO2 GHG gasses (e.g. N2O) during the fuel combustion, covering WtT and TtW impacts.⁸
- Emissions related to rubber losses from tyres should not be included
- Note that energy consumption during the use and operation of the vehicle shall be included in B6
- B2: Maintenance of the vehicle (e.g. replacing lubricating oil, grease, air filters...). See 4.10.1 for more guidance
- B3: Repair of the vehicle
- B4: Replacement of spare parts (e.g. belts, wheels). See 4.10.2 for more guidance
 - The transport of spare parts is considered not relevant for this type of vehicles, and can be excluded.
- B5: Refurbishment of Industrial Truck components (e.g. batteries, drivers cab components, repainting chassis components, hydraulic system as hoses, valves).
- B6: Energy use in use/application/operation (e.g. electricity, fuel) including related emissions (e.g. for internal combustion). See 4.10.3 for more guidance
- B7: Operational water use: shall be declared "0", as water use is already included in Modules B1 and B2

Each B module includes the production, components, and product inputs to the module e.g. production and transport of consumables used in maintenance (B2), or new product components/spare parts used in replacement, including its transport (B4).

Waste treatment (i.e. up to the end-of-waste state or final disposal) shall be included in each module where the waste is generated, including its transport to waste treatment platform (e.g. the waste treatment of exhausted parts that are replaced, shall be included in the module where wasted).

All modules shall be accounted for the lifespan, according to manufacturer technical data sheets.

Vehicle cell charging point or hydrogen refuelling stations are excluded from the calculation.

- End-of-life stage, modules C1-C4:
 - C1: disassembly of the vehicle (e.g. electricity consumptions for disassembly some components before sending the vehicle to waste treatment, if known)
 - C2: Transport of components and remaining vehicle to waste processing and/or disposal
 - C3: Waste processing for reuse, recovery and/or recycling
 - C4: Disposal
- Environmental benefits and load beyond the product system, consequences of reuse, recycling and/or recovery of materials and energy beyond the product system, module D: this module is not mandatory. If included, these results shall be separately declared. Note that module D is not part of the product system and thus not considered to be a life-cycle stage.

⁸ WtT (Well-to-Tank) impacts: WtT refers to the environmental impacts that occur before the fuel or energy reaches the vehicle. This includes extraction, production, processing, and transportation of the fuel or electricity. In short: energy production and supply chain impacts.

TtW (Tank-to-Wheel) impacts: TtW refers to the environmental impacts that occur when the vehicle uses the fuel or energy to operate. In short: vehicle operation impacts.

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In the EPD, the environmental performance of each of the life-cycle stages and module D (if included) shall be reported separately, and in aggregated form for the life-cycle stages (modules A-C).

Section A.3.1 of the GPI outlines rules for how to assign generation of electricity and production of fuels, steam and other energy carriers used, and losses arising, in each information module.

Note that generation of electricity and production of fuels, steam and other energy carriers shall be assigned to the information module in which the energy carrier is used. Also note that each module shall include the waste processing of waste generated in the module up to the end-of-waste state or final disposal. Related, note the way of assigning losses described in Figure 3 of Section A.3.1 of the GPI.

Processes not listed here may also be included. All elementary flows at resource extraction shall be included, except for the flows that fall under the general cut-off rule in Section 4.5.

4.3.1.1 Excluded processes

See Section A.3.1.1 of the GPI.

4.3.2 OTHER BOUNDARY SETTING RULES

See Section A.3.2 of the GPI for rules on setting boundaries to nature as well as geographical and temporal boundaries. See Section A.4 of the GPI and Section 4.6 below for rules on setting boundaries to other product systems.

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4.4 PROCESS FLOW DIAGRAM

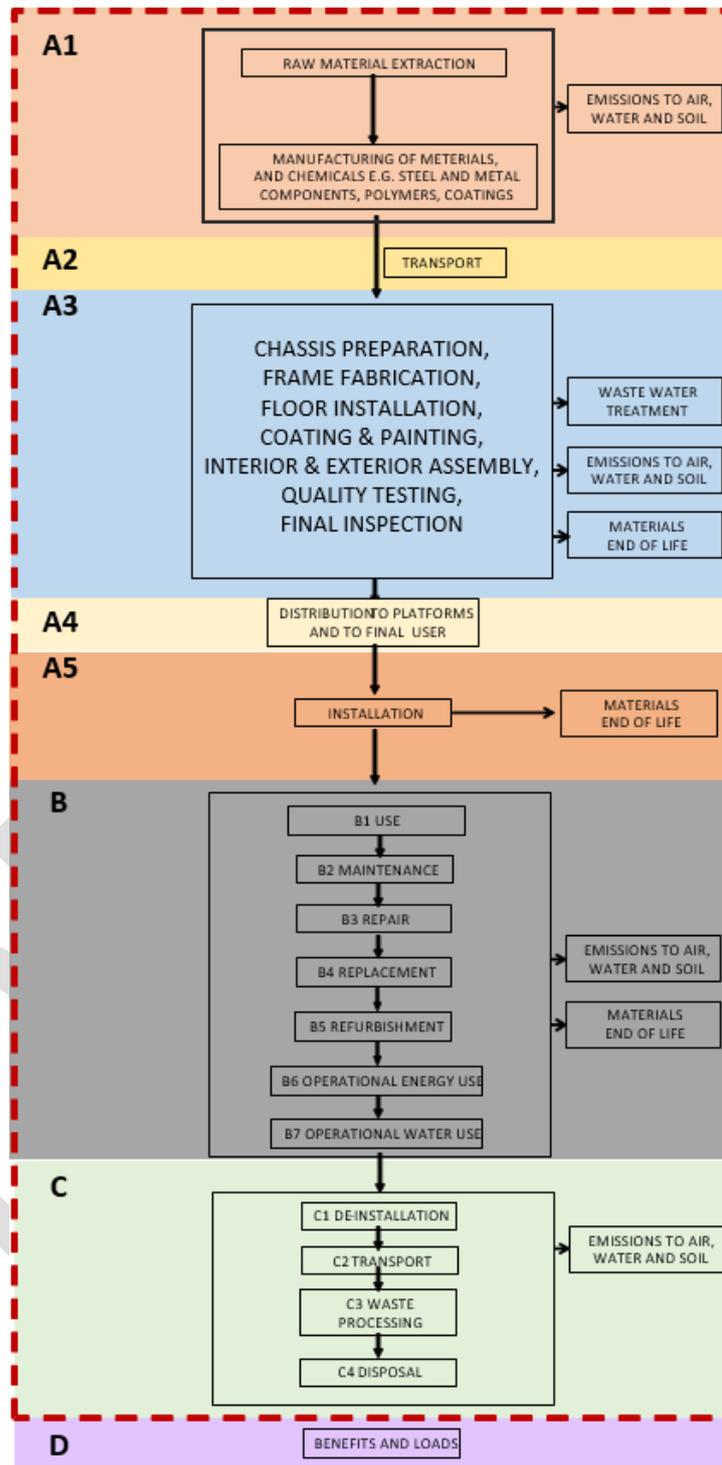


Figure 2. Process flow diagram illustrating the processes that shall be included in the product system, divided into the life-cycle stages. The illustration of processes to include may not be exhaustive. A3 operations could be internally or externally performed. Module D is not mandatory.

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4.5 CUT-OFF RULES

See Section A.3.3 of the GPI.

4.6 ALLOCATION RULES

See Section A.4 of the GPI.

4.6.1 ALLOCATION OF CO-PRODUCTS

See Section A.4.1 of the GPI.

4.6.2 ALLOCATION OF WASTE

See Section A.4.2 of the GPI.

4.7 DATA AND DATA QUALITY RULES

See Section A.5 of the GPI.

4.7.1 DATA CATEGORIES

See Section A.5.1 of the GPI.

4.7.2 DATA QUALITY REQUIREMENTS FOR PRIMARY DATA

See Section A.5.2 of the GPI.

4.7.3 DATA QUALITY REQUIREMENTS FOR REPRESENTATIVE SECONDARY DATA

See Section A.5.3 of the GPI.

4.7.4 DATA QUALITY ASSESSMENT AND DECLARATION

See Section A.5.4 of the GPI.

4.7.5 EXAMPLES OF DATABASES FOR SECONDARY DATA

1 lists examples of databases and datasets to be used for secondary data. Note that a data quality assessment shall be performed also for data listed in the table, and that other data that fulfil the data quality requirements may also be used.

| Process | Geographical scope | Database |
|------------------------------|--------------------|--|
| Steel, Iron ore and Pig Iron | Global | World Steel Association www.worldsteel.org |
| Steel, Iron ore and Pig Iron | Global | Ecoinvent database www.ecoinvent.com |
| Electricity | Global | Data combined with IEA (International Energy Agency) statistics on electricity generation mixes for nations, regions, etc. http://www.iea.org/statistics/ |
| Electricity | Global | Ecoinvent database www.ecoinvent.com |
| Chemicals | Global | Ecoinvent database www.ecoinvent.com |
| Transports | Global | Ecoinvent database www.ecoinvent.com |
| Waste management | Global | Ecoinvent database www.ecoinvent.com |

Table 1. Examples of databases and datasets to use for secondary data.

4.8 OTHER LCA RULES

See Section A.6 of the GPI.

4.8.1 MASS BALANCE

See Section A.6.1 of the GPI.

4.8.2 ELECTRICITY MODELLING

See Section A.6.2 of the GPI.

4.8.3 BIOGAS MODELLING

See Section A.6.3 of the GPI.

4.9 SPECIFIC RULES PER LIFE-CYCLE STAGE

See Section A.7 of the GPI.

Below are further data quality requirements and other LCA rules per life-cycle stage, and for module D, of relevance for the product category.

4.9.1 B2. MAINTENANCE

Maintenance shall be modelled according to specific or documented studies, based on the road vehicle preventive maintenance program and according with average or typical vehicle, based on manufacturer technical data sheets/actual data, as well as waste generated from maintenance activities.

The following list of maintenance and wear parts and consumables are to be considered. Items marked as mandatory shall be included in all studies (values can be zero if no replacements are required). Inspired by UNECE A-LCA IWG: SG4 - 7th meeting - Transport - Vehicle Regulations - UNECE Wiki.

| | | ICE Petrol and diesel | BEV | FCEV & FC- REEV | H2 ICEV | CNG | LPG |
|----------------------------|---|-----------------------------|-----|--------------------|---------|-----|-----|
| Consumables | Engine lubricant | YES | N/A | N/A | YES | N/A | N/A |
| | Engine/oil filters | YES | N/A | N/A | YES | N/A | N/A |
| | AdBlue/Urea | YES | N/A | N/A | YES | N/A | N/A |
| | Coolants | YES | YES | YES | YES | YES | YES |
| | Screen wash | YES | YES | YES | YES | YES | YES |
| | Electric drive unit / trans-mission fluid | YES | YES | YES | YES | YES | YES |
| | Brake fluids | YES | YES | YES | YES | YES | YES |
| | Refrigerants for Heating, Ventilation and Air conditioning (HVAC) | YES | YES | YES | YES | YES | YES |
| | Other fluids or filters | YES | YES | YES | YES | YES | YES |
| Maintenance and wear parts | Passenger air filter | YES | YES | YES | YES | YES | YES |
| | Windscreen wiper blades | YES | YES | YES | YES | YES | YES |
| | Tires | YES | YES | YES | YES | YES | YES |
| | Starter battery (i.e., 12V) | YES | YES | YES | YES | YES | YES |
| | Brake pads | YES | YES | YES | YES | YES | YES |
| | Brake discs | YES | YES | YES | YES | YES | YES |
| | Steering joint | YES | YES | YES | YES | YES | YES |
| | Link arm | YES | YES | YES | YES | YES | YES |
| | Traction/storage battery (See below) | N/A | YES | YES | N/A | N/A | N/A |
| | Fuel cell stack (See below) | N/A | N/A | YES | N/A | N/A | N/A |
| Other auxiliary batteries | YES | YES | YES | YES | YES | YES | |

Table 2. maintenance and wear parts and consumables are to be considered.

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4.9.2 B4. BATTERY AND FUEL CELLS DURABILITY AND REPLACEMENT ASSUMPTIONS

Due to the major impact of battery and fuel cell on the vehicle LCA, the need for replacement or not of these systems in the context of the LCA study shall be checked and justified.

Heavy-Duty EV batteries service life depends on the total number of full equivalent discharge cycles (from 100% to 0% State of Charge). These cycles, along with the battery's expected lifetime, total energy throughput, and evaluation methods, must be documented in the LCA report and EPD⁹.

Service life for EV batteries aligns with Article 10, Annex IV of the Regulation (EU) 2023/1542. It reflects the expected lifetime under reference conditions, defined in terms of cycles.

The parameter for determining the state of health of electric Bus batteries is the State of certified energy (SOCE).

For battery or fuel cell replacement, the following hierarchy shall be applied:

- 1) Determine the frequency of replacement using the ageing model specific to the system and its mission profile (justification should be documented to explain that the ageing model is consistent with the study, i.e., in terms of service life, lifetime km and resulting delivered energy for the vehicle, etc.; the conditions to decide that the battery has reached its end-of-life, typically state of health <80%, should also be documented).
- 2) Only if the previous option is not available then a simplified methodology outlined below should be used. This simplified methodology below does not include the calendar ageing of the battery system. In that case, a sensitivity analysis should be applied. The following approach is based on a combination of parameters including the anticipated battery cycle life (i.e., number full charge/discharge cycles). This methodology also provides a dynamic link to the vehicle battery capacity and the lifetime activity. The methodology for determining the number of traction battery replacements is as follows (i.e., where a value of $N > 1$ means at least one complete battery replacement is likely to be needed):

$$N = \frac{E[\text{Average}] \times A[\text{Lifetime}]}{(C[\text{Battery usable}] \times CL[\text{Battery}])}$$

Where:

- N = Total number of traction batteries needed over the vehicle lifetime
- C [Battery usable] = usable (i.e., 'net') traction battery capacity in kWh
- CL [Battery] = average battery cycle life – number of full charge/discharge cycles (within the usable capacity)
- A [Lifetime] = vehicle lifetime activity (in km) *
- E [Average] = vehicle average electrical energy consumption, in kWh per km

For the simplified methodology to decide the need for fuel cell system replacement(s) if no specific data is available, refer to subsection III.2.1 in which the methodology to calculate fuel cell degradation and durability is described.

3) In the absence of manufacturer-specific data on the battery cycle life (parameter 'CL' in the equation above), then default values below should be used:

- 2 000 charge/discharge cycles, for light duty vehicles (i.e., passenger cars and light commercial vehicles)
- 3 000 charges/discharge cycles, for heavy duty vehicles (i.e., lorries, busses and coaches)

In that case, a sensitivity analysis should also be applied.

Should the battery come with an expected calendar lifetime lower than the defined vehicle life-time, then a replacement will also be required.

⁹ As stated in the c-PCR Batteries draft of the International EPD System

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4.9.3 B6. OPERATIONAL ENERGY CONSUMPTIONS

Operational energy consumptions shall be modelled according to specific test cycles or documented studies, according with average or typical vehicle, based on manufacturer technical data sheets/actual data.

Lifetime energy consumption =

Energy consumption × Degradation Factor (in the case of Fuel Cell presence. [See 4.10.1.2](#))

For EU countries vehicle manufacturing and/or operation, the estimation of the energy requirements should be based upon certified energy consumption values according to the Vehicle Energy Consumption calculation Tool (VECTO) developed for the European Commission (European Commission, 2023). By default, the weighted average values (according to the cycle weighting defined in VECTO and consider passengers loads on different cycles and according to the respective mission profile weights (Wsg,mp) for heavy-duty vehicles in category M) shall be used.

For non EU countries, the applicant regulatory framework shall apply (as for example, The Chassis dynamometer testing using defined duty cycles in United States, Canada and China... Fuel-economy testing under Japanese driving cycles in Japan...

The energy consumption rate (in kWh/h, L of fuel/h or kg fuel/hr) shall be declared in the EPD.

Consumption due to heating and air conditioning, auxiliaries, losses in batteries, charging stations, etc., shall be included in the energy use in operation as they are related with the vehicle operation.

Some additional specifications:

4.9.3.1 For Electric buses

The electricity mix/source and the GWP-GHG intensity of the electricity (in kg CO₂e/kWh) used in module B shall be declared in the EPD.

The use of the electricity mix in the region/country where the vehicle is operated shall be used in LCA calculations. If it is unknown or if the EPD represents an average use of the vehicle, it could be approximated as the average electricity mix of the region of the scope of the EPD.

Dynamic electricity mix modelling is not allowed, as evolution of the grid and assumptions on how this affects the emission factors and how these could change over the years have high uncertainty, it is complicated, very source dependant and reduces comparability between EPDs.

4.9.3.2 For Hydrogen buses

The classification of the hydrogen supply source and the GWP-GHG intensity of the hydrogen used as fuel (in kg CO₂e/kWh) in module B shall be declared in the EPD. Hydrogen is classified by colors based on its production/supply source and environmental impact, ranging from high-emission fossil fuel methods to clean-renewable processes:

- Green Hydrogen (Renewable): Produced via water electrolysis powered by renewable energy sources like wind or solar.
- Blue Hydrogen (Low-Carbon Fossil): Derived from natural gas (methane) using Steam Methane Reforming (SMR) or Autothermal Reforming (ATR), but with Carbon Capture and Storage (CCS) to prevent CO₂ emissions.
- Grey Hydrogen (Fossil - Standard): Produced from natural gas via steam reforming without capturing the resulting CO₂ emissions.
- Pink/Purple/Red Hydrogen (Nuclear): Generated through electrolysis powered by nuclear energy.
- Turquoise Hydrogen (Pyrolysis): Produced through the pyrolysis of methane, which splits natural gas into hydrogen and solid carbon, offering a lower-emission alternative.
- Yellow Hydrogen (Solar): Specifically refers to hydrogen produced through electrolysis using solar power.
- White Hydrogen (Natural): Naturally occurring geological hydrogen found in underground deposits.
- Black/Brown Hydrogen (Coal): Produced through the gasification of black coal or lignite (brown coal), representing the most polluting production method.

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The following step-by-step methodological approach shall be followed for the modelling of hydrogen supply mixes feeding into the use stage of FCEVs¹⁰. The base is that the scenario for the expected default conservative state of the hydrogen supply mix in the geographical region of interest shall be selected, according to the following order of preference:

- a) The official published scenario directly agreed by the relevant authority to be the one to be used for vehicle LCA studies or related analyses, specifically for hydrogen supply mix for the country or geographical region of interest. For EU operated vehicle, EU by default could be used.
- b) The official general scenario based on currently implemented policy for the country or geographical region of interest providing this has been updated within less than 3 years.
- c) Hydrogen produced by electrolysis using a conservative grid electricity mix scenario.
- d) If none of the previous options (a to c) is available for the geographical region of interest, then hydrogen produced by electrolysis using the most recent “static” grid mix composition shall be modelled instead.

In case either option 1(c) or 1(d) is applied, then an alternative assessment using (i) hydrogen production from steam reforming of natural gas, and (ii) a 100% renewable electricity (RE) mix for comparison should be provided. The latter is considered as a hypothetical scenario corresponding to an optimistic assumption to provide counterpoint to the otherwise likely pessimistic assumption of the current static grid mix or production from natural gas. It is acknowledged that in some countries, the 100% RE scenario may be unrealistic

Dynamic electricity mix or hydrogen supply mix modelling is not allowed, as evolution of the grid and assumptions on how this affects the emission factors and how these could change over the years have high uncertainty, it is complicated, very source dependant and reduces comparability between EPDs.

4.9.3.3 Degradation factor for Fuel Cells¹¹

A degradation factor shall be considered for operation on hydrogen in FCEV, to account for fuel cell degradation and the resulting reduction in efficiency over the operational life of the vehicle. The maximum efficiency loss shall be set to a maximum of 5% average degradation over the life of the vehicle, i.e. in the case where FC[lifetime energy]>FC[max energy], where a fuel cell replacement will be required in any case. The following formula shall be used to calculate the average efficiency reduction in the intermediate cases up to this point:

$$EnCon [AvLife] = \frac{EnCon[Start]}{1 - (10\% \times \frac{FCEV [lifetime energy]}{FC[max energy]})}$$

Where:

- EnCon [AvLife] = average input hydrogen energy consumption in MJ/km over the entire lifetime of the vehicle.
- EnCon [Start] = input hydrogen energy consumption in MJ/km at the start of the vehicle life (i.e., before any FC degradation), as defined in vehicle certification (i.e. before any real-world adjust-ments being applied) whether from WLTP for LDVs or from relevant VECTO-based fuel con-sumption and CO2 emission certification cycles for HDVs
- FCEV[lifetime energy] = Lifetime vehicle operational electrical energy requirement (i.e., fuel cell output, kWh) based on the input hydrogen energy consumption (in kWh/km), the lifetime activity (in km) and the average fuel cell efficiency (%). FCEV[lifetime energy] shall be calculated as follows:

¹⁰ ¹⁰ Based on guidance from TranSensus, Towards a European-wide harmonised transport-specific LCA Approach. Consolidated Guidelines for a transport specific life cycle assessment, Thilo Bein & Felipe Cerdas Fraunhofer LBF & IST. Funded by the European Union. <https://lca4transport.eu/> . 2025.

As of the development of these guidelines (2026), there are no official projections for future hydrogen supply mix, in practice it is anticipated that 1-c or 1-d will be the de default default approach in near term

¹¹ Based on guidance from TranSensus, Towards a European-wide harmonised transport-specific LCA Approach. Consolidated Guidelines for a transport specific life cycle assessment, Thilo Bein & Felipe Cerdas Fraunhofer LBF & IST. Funded by the European Union. <https://lca4transport.eu/> . 2025.

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$$\begin{aligned}
 & \mathbf{FCEV[lifetime\ energy](kWh)} \\
 & = \mathit{EnCons\ [Start]} \left(\frac{\mathit{MJ}}{\mathit{km}} \right) \times \mathit{fuel\ cell\ average\ efficiency\ (\%)} \\
 & \times \mathit{EnConConversion} \left(\frac{\mathit{kWh}}{\mathit{MJ}} \right) \times \mathit{Lifetime\ activity\ (km)}
 \end{aligned}$$

Where:

- EnCons [Start] = input hydrogen energy consumption in MJ/km at the start of the vehicle life (i.e., before any FC degradation), as defined in vehicle certification (i.e., before any real-world adjustments being applied) whether from WLTP for LDVs or from VECTO-based fuel consumption and CO2 emission certification cycles for HDVs
- EnConConversion = conversion factor for converting MJ to kWh
- FC[max energy] = maximum energy delivered by the fuel cell (in kWh) over the defined service life (in hours) at the average fuel cell running power (in kW). FC[max energy] shall be calculated as follows:

$$\begin{aligned}
 & \mathbf{FC[max\ energy](kWh)} \\
 & = \mathit{Fuel\ cell\ durability\ (hrs)} \times \mathit{Fuel\ cell\ average\ running\ power\ (kW)}
 \end{aligned}$$

Where:

- Fuel cell average running power (kW) = maximum rated fuel cell power (kW) * average operation % of rated fuel cell power. See paragraph underneath to define assumptions and values.

To be noted: Fuel cell durability or service life is defined as based on the number of operational hours to 90% of original peak power rating, hence an efficiency loss of 10% over the life of the fuel cell, equal to an average reduction in overall efficiency of 10% divided by 2.)

4.9.4 C1-C4. END-OF-LIFE

The end-of-life modelling shall follow ISO 22628:2002 Road vehicles - Recyclability and recoverability - Calculation method, based in company-specific data if it already possesses partnerships, owns facilities in that field, or is certain about the fate of the End-of-Life vehicle (ELV) in the future. If not, the LCA practitioner may use secondary generic data.

The calculation method prescribed in Annex B to the standard ISO 22628:2002 shall apply and the manufacturer shall submit a data presentation form fully completed during the verification audit, established in accordance with Annex A to the standard ISO 22628:2002. It shall include the materials breakdown.

The recyclability and recoverability rates of the vehicle shall be declared in the EPD, calculated according to ISO 22628:2002.

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4.10 ENVIRONMENTAL PERFORMANCE INDICATORS

See Section A.8 of the GPI.

4.11 SPECIFIC RULES PER EPD TYPE

4.11.1 MULTIPLE VEHICLES FROM THE SAME COMPANY

See Section A.9.1 of the GPI.

As a reminder, note that several sets of results reflecting different vehicles configurations, shall not be declared in the same EPD.

However, similar vehicles may be grouped and thereby included in the same EPD under one only set of results.

Similar vehicles are defined as products covered by the same PCR, with identical or similar functions, manufactured by a single company at one or several manufacturing sites, with the same major steps in the A3/core processes.

For such an EPD, there are three options:

- For each indicator, declare the average results of the included vehicles. This average shall be weighted according to the production volumes of the included vehicles. In this option, the average content shall be declared in the content declaration.
- Declare the results of one of the included vehicles i.e., one representative vehicles. The choice of the representative vehicles shall be justified in the EPD, for example based on production volumes. In this option, the content of the representative product shall be declared in the content declaration.
- For each indicator and module, declare the highest result of the included vehicles. This options thus corresponds to the results of a “worst-case product”, which may be consists of results from one or several of the included vehicles. In this option, the content declaration shall include the lowest amounts of recycled content of the included vehicles and their packaging, respectively, and the information on environmental and hazardous properties of substances shall reflect the highest share and most hazardous such substances contained in the any of the included vehicles.

For all options, the range of the content of the included vehicles should be included in the content declaration, in addition to the average/representative/worst-case content as specified above.

The option chosen shall be clearly described at the cover page of the EPD, as “EPD of multiple products, based on the average results of the product group”, “EPD of multiple products, based on a representative product”, “EPD of multiple products, based on several representative products”, or “EPD of multiple products, based on worst-case results”.

4.11.2 SECTOR EPD

See Section A.9.2 of the GPI.

4.11.3 EPD OWNED BY A TRADER

See Section A.9.3 of the GPI.

4.11.4 EPD OF PRODUCT NOT YET ON THE MARKET

See Section A.9.4 of the GPI.

4.11.5 EPD OF PRODUCT RECENTLY ON THE MARKET

See Section A.9.5 of the GPI.

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5 CONTENT OF LCA REPORT

Data for verification shall be presented in the form of an LCA report – a systematic and comprehensive summary of the project documentation that supports the verification of an EPD. The LCA report is not part of the public communication.

See Section 8.3.1 of the GPI for rules on the content of the LCA report.

Note that there may be rules on the content of the LCA report elsewhere in the GPI or in this PCR.

6 CONTENT AND FORMAT OF EPD

See Section 7 of the GPI.

6.1 EPD LANGUAGES

See Section 7.1 of the GPI.

6.2 UNITS AND QUANTITIES

See Section 7.2 of the GPI.

6.3 USE OF IMAGES IN EPD

See Section 7.3 of the GPI.

6.4 SECTIONS OF THE EPD

See Section 7.4 of the GPI.

6.4.1 COVER PAGE

See Section 7.4.1 of the GPI.

6.4.2 GENERAL INFORMATION

See Section 7.4.2 of the GPI.

6.4.3 INFORMATION ABOUT EPD OWNER

See Section 7.4.3 of the GPI.

6.4.4 PRODUCT INFORMATION

See 4.3.2 and section 7.4.4 of the GPI.

6.4.5 CONTENT DECLARATION

See Section 7.4.5 of the GPI.

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Information about the content of the vehicle in the form of a list of materials and substances, and their mass, shall be declared.

Proprietary materials and substances of confidential nature are exempted from the above requirement (see Section 8.2.3 of the GPI). If not declared, these shall be replaced by a generic term/description of the material/substance and/or a range of values (instead of specific values), provided that the applicable rules for declaration of hazardous are followed.

The recycled content of steel in the final product, if not known, as average, shall be declared.

6.4.6 LCA INFORMATION

See Section 7.4.6 of the GPI.

6.4.7 ENVIRONMENTAL PERFORMANCE

See Section 7.4.7 of the GPI.

The EPD shall declare the environmental performance indicators listed or referred to in Section 4.10, per declared unit, per life-cycle stage, and in aggregated A1-A3 form.

6.4.8 ADDITIONAL ENVIRONMENTAL INFORMATION

See Section 7.4.8 of the GPI.

6.4.9 ADDITIONAL SOCIAL AND ECONOMIC INFORMATION

See Section 7.4.9 of the GPI.

6.4.10 INFORMATION RELATED TO SECTOR EPDS

See Section 7.4.10 of the GPI.

6.4.11 VERSION HISTORY

See Section 7.4.11 of the GPI.

6.4.12 ABBREVIATIONS

See Section 7.4.12 of the GPI.

6.4.13 REFERENCES

See Section 7.4.13 of the GPI.

PRODUCT CATEGORY CLASSIFICATION: UN CPC 49112 & 49113

7 LIST OF ABBREVIATIONS

| | |
|---------------------|--|
| CPC | Central product classification |
| EPD | Environmental product declaration |
| GPI | General Programme Instructions |
| ISO | International Organization for Standardization |
| LCA | Life cycle assessment |
| PCR | Product category rules |
| RSL | Reference service life |
| UN | United Nations |
| SI | The International System of Units |
| BOF | Basic Oxygen Furnace |
| EAF | Electric Arc Furnace |
| CO ₂ | Carbon dioxide |
| NMVO _C | Non-methane volatile organic compounds |
| SO ₂ | Sulphur dioxide |
| ICE | Internal Combustion Engine |
| ICEV | Internal Combustion Engine Vehicle |
| EV | Electric Vehicles |
| FCEV | Fuel Cell Electric Vehicle ¿(running on hydrogen)? |
| FC-REEV | Fuel Cell Range Extended Electric Vehicle |
| H ₂ ICEV | Hydrogen Internal Combustion Engine Vehicle |
| LFP | lithium iron phosphate |
| REEV | Range-Extended Electric Vehicle |
| LCV: | Light Commercial Vehicle |
| LDV | Light-Duty Vehicle |
| HDV | Heavy-Duty Vehicle |
| HEV: | ybrid Electric Vehicle |

PRODUCT CATEGORY CLASSIFICATION: UN CPC 49112 & 49113

8 REFERENCES

General Programme Instruction version 5.01. 2025-02-07

PCR 2024-02 Passenger cars (v1.0.2)

PCR 2009-05 Rolling stock (v4.0.2)

PCR 2015-06 Yachts, small crafts, other vessels, and components thereof (v2.0.0)

PCR 2018-09 Business jets (v1.0.4)

The UNECE Transport Division Vehicle Regulations, providing services to the World Forum for Harmonization of Vehicle Regulations (WP.29)

Regulation (EU) 2017/2400 as regards the determination of the CO₂ emissions and fuel consumption of heavy-duty vehicles

Regulation (EU) 2018/858 of the European Parliament and of the Council of 30 May 2018 on the approval and market surveillance of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles, amending Regulations (EC) No 715/2007 and (EC) No 595/2009 and repealing Directive 2007/46/EC (Text with EEA relevance.)

Regulation (EU) 2024/1257 of the European Parliament and of the Council of 24 April 2024 on type-approval of motor vehicles and engines and of systems, components and separate technical units intended for such vehicles, with respect to their emissions and battery durability (Euro 7)

Regulation (EC) No 595/2009 of the European Parliament and of the Council of 18 June 2009 on type-approval of motor vehicles and engines with respect to emissions from heavy duty vehicles (Euro VI) and on access to vehicle repair and maintenance information

ISO 22628 Road vehicles-Recyclability and recoverability –Calculation method

TranSensus, Towards a European-wide harmonised transport-specific LCA Approach. Consolidated Guidelines for a transport specific life cycle assessment, Thilo Bein & Felipe Cerdas Fraunhofer LBF & IST. Funded by the European Union. <https://lca4transport.eu/> 2025.

Laura Lonza, EUROPEAN COMMISSION. Determining the environmental impacts of conventional and alternatively fuelled vehicles through LCA. Directorate-General for Climate Policy. Directorate C - Climate Strategy, governance and emissions from non-trading sectors. Unit C4 — Road Transport

PRODUCT CATEGORY CLASSIFICATION: UN CPC 49112 & 49113

9 VERSION HISTORY OF PCR

VERSION 1.0, 2016-05-02

Original version.

VERSION 1.01, 2016-05-09

Editorial update to correct broken references.

VERSION 1.1, 2018-06-19

- PCR update to fulfil GPI 3.0 requirements.
- Section about “operation of the vehicle: fuel and energy consumption, pollutant emissions and maintenance” rewritten for better understanding and update of reference regulations and test-methods used.
- Editorial changes

VERSION 1.2, 2019-05-16

- Corrected reference to characterisation factors to be used (not EN 15804)
- Editorial changes

VERSION 1.21, 2019-09-06

- Clarified terms of use
- Editorial changes

VERSION 2.0, 2020-12-04

- PCR updated after the validity period of the previous version had ended
- Update of reference EU directives and regulations
- Editorial changes to fulfil GPI 3.01 requirements.

VERSION 2.0.1, 2022-06-20

- Correction of “transport of the vehicle to the customer” appearing in “Downstream” in Section **Error! Reference source not found.** It has been corrected to appear in “Core” (Section **Error! Reference source not found.**).
- Editorial changes in Sections **Error! Reference source not found.** to **Error! Reference source not found.**, to clarify the indicator list at YPERLINK "http://www.environdec.com/indicators" www.environdec.com/indicators applies also for the indicators of resource use, waste production and other output flows.

VERSION 2.0.2, 2023-01-23

- Update of the LCI data requirement (from 99% to 95%) in 4.4 and 5.4.4, to harmonize with other PCR for transportation vehicles.
- Removal of recyclability and recoverability objective requirements in 4.2.1.3.4, as the PCR shall not include requirements about the environmental performance.

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- Removal of requirements of the Regulation (EC) No 595/2009 regarding emission limits in 4.2.1.3.1, as the PCR shall not include requirements about the already applicable legal regulations.
- Editorial changes in Section **Error! Reference source not found.** for better clarification.

VERSION 2.0.3, 2024-10-30

- The validity period was prolonged with one year due to the initiation of the updating process.

VERSION 2.0.4, 2025-08-05

- The validity period of the PCR was extended by 6 months, until 2026-06-04, due to the initiation of an updating process

VERSION 3.0.0, 2026-XX-XX

- PCR updated content adapted to requirements in GPI 5.0.1

PRODUCT CATEGORY RULES (PCR)

PUBLICATION DATE 20YY-MM-DD (TO BE ADDED BY THE SECRETARIAT)

PUBLIC AND PRIVATE BUSES AND COACHES



PRODUCT CATEGORY CLASSIFICATION: UN CPC 49112 & 49113

DRAFT

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