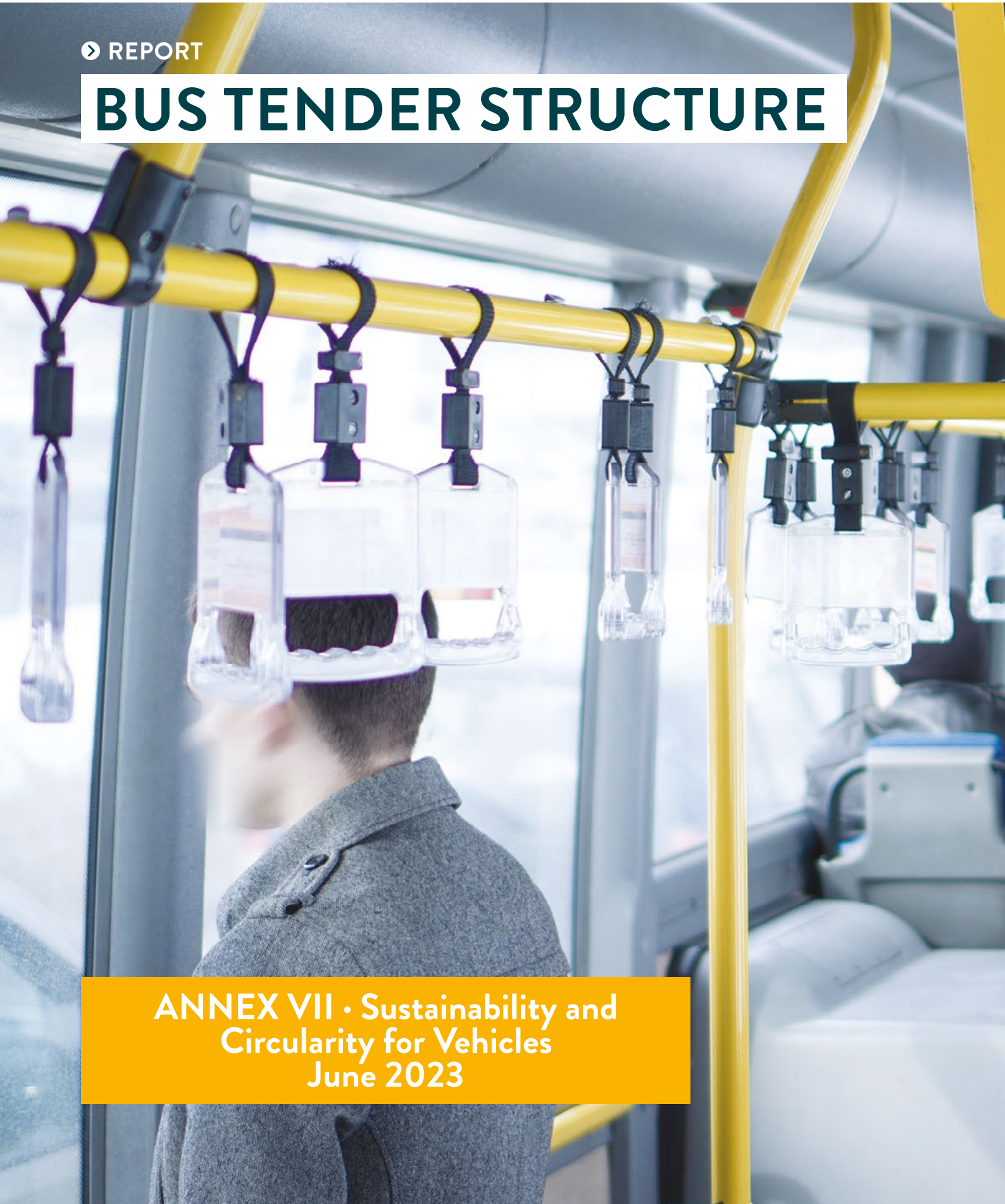
UITP ADVANCING PUBLIC TRANSPORT

REPORT

BUS TENDER STRUCTURE



ANNEX VII · Sustainability and Circularity for Vehicles
June 2023

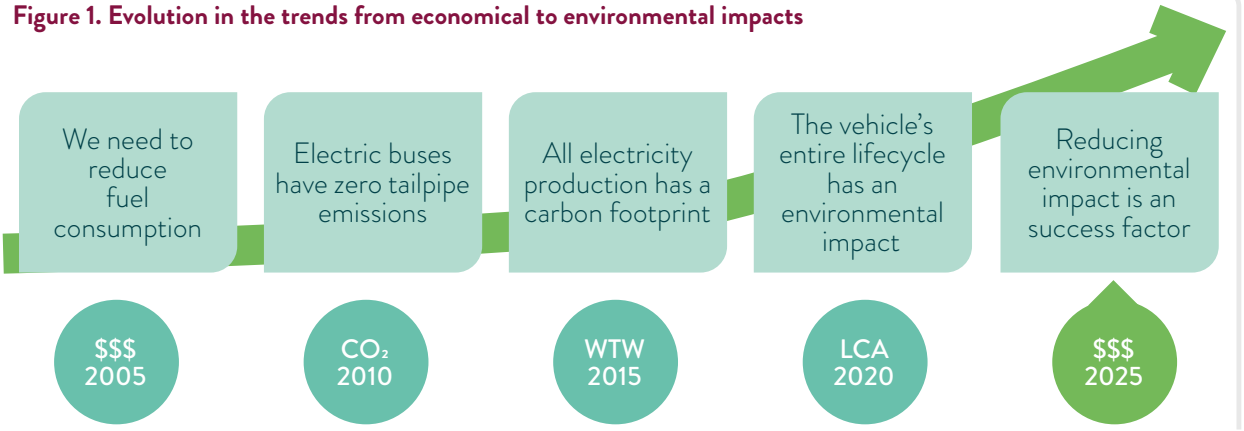
ANNEX VII

SUSTAINABILITY AND CIRCULARITY FOR VEHICLES

Introduction

This Annex VII is intended to provide guidance for assessing the environmental impact of buses in public transport, from a cradle-to-grave perspective. The public transport industry has become increasingly environmentally aware over time, leading to an agreement that environmental efficiency has commercial worth and considerable socio-economic benefits in its own right. Annex VII can be viewed as an expansion of, and a complement to, Annex IV, which is a UITP-endorsed comparison instrument addressing worldwide emissions and localised pollutants.

Figure 1. Evolution in the trends from economical to environmental impacts



Nevertheless, the extent of sustainability and circularity concepts among the parties involved in public transportation is considerably broader. It includes both the evaluation of the environmental impact of buses and the implementation of sustainable practices in other areas. These topics encompass how materials and natural resources are used, working conditions and human rights, energy and climate, as well as material reuse, recycling and recoverability. While some of these aspects can be easily quantified, others are less tangible.

The main areas are:

- • Greenhouse gas emissions: This involves the reduction in emissions of CO_2 and other greenhouse gases that contribute to climate change.
- Pollution and depletion of natural resources: reducing pollution and preserving natural resources - such as water, air and biodiversity - through following sustainable practices.

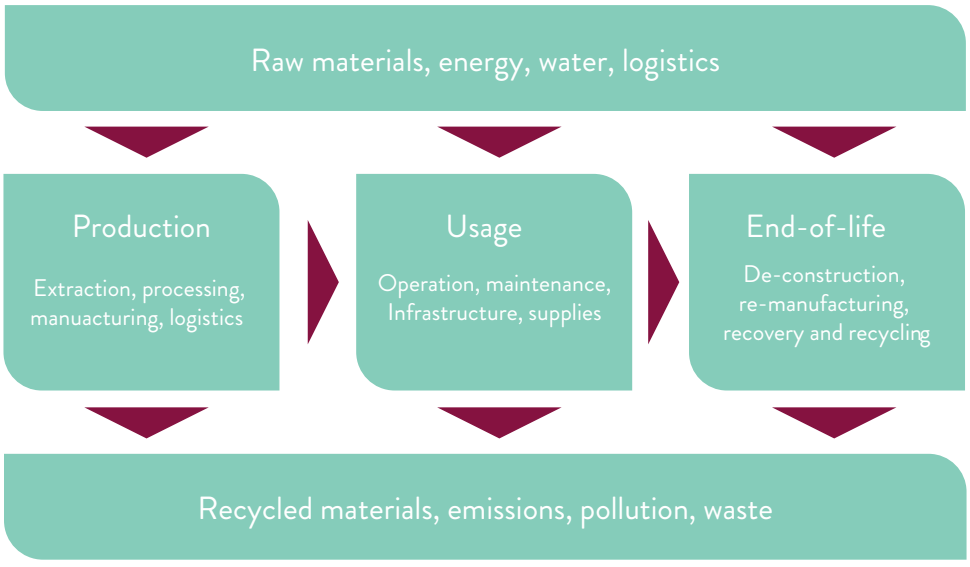
- Sourcing and supplier commitments: sourcing materials and services from suppliers who are committed to sustainability and ethical business practices.
- Business ethics and working conditions: verifying that all aspects of the business are conducted ethically, including the fair treatment of employees and adherence to labour laws
- Material content: This includes evaluating the environmental impact of the materials used in products or services.
  - Virgin and recycled materials: using recycled materials to reduce waste and promote circularity whenever possible.
  - Conflict minerals and substances of concern: minding the use of materials associated with financing armed conflict or that are mined using forced labour.
  - Sourcing of sensitive materials: sourcing materials that with a high environmental impact responsibly.

These areas are crucial for achieving sustainability and circularity in various industries, and companies must take a holistic approach to addressing them.

An LCA study for the bus and coach industry includes:

- Production phase: extracting and transporting raw materials, processing and manufacturing as well as the logistics associated with production.
- Usage phase: Operating of buses or coaches as well as any associated service, maintenance and repairs.
- End of-life phase: deconstructing, remanufacturing and processing of recyclable materials and waste.

Figure 2. Holistic approach of product "bus" in the life cycle



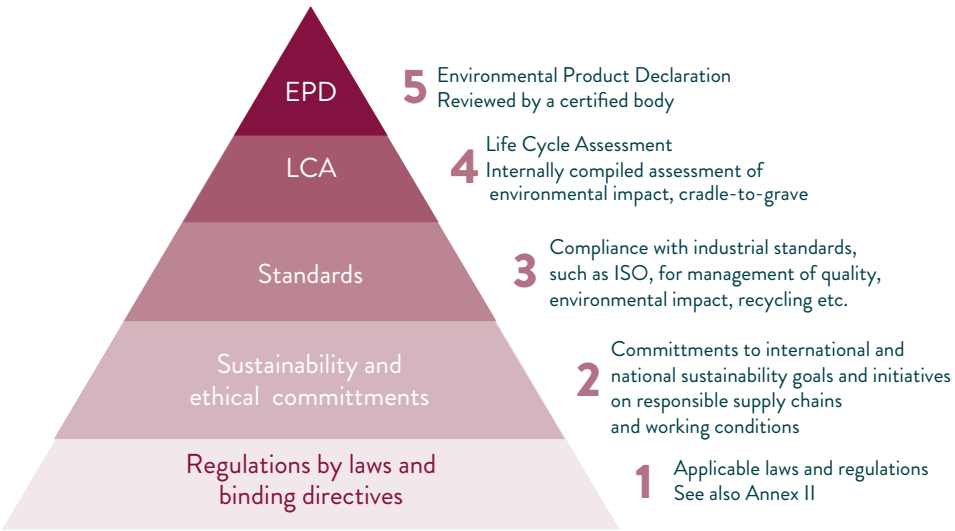
Meeting sustainability objectives requires that both purchasers and suppliers take into account a number of prerequisites. Some of these are defined in regulations, such as those laws and policies mandating certain sustainability standards. Other prerequisites are commitments to international and national goals, such as the United Nations[1] Sustainable Development Goals (SDGs) or industry-specific sustainability frameworks.

Furthermore, working to achieve sustainability objectives requires a collaborative effort from all stakeholders involved in the value chain, including purchasers, suppliers, customers and regulators. It also requires a long-term commitment to continuous improvement and innovation in order to address emerging sustainability challenges and opportunities.

The building blocks supporting the evaluation of sustainability and environmental performance

The graphic below shows the building blocks that support the evaluation of sustainability and environmental performance for a vehicle in a bus tender.

Figure 3: Layers for sustainability and environmental performance evaluation described in this chapter.



1 Laws and regulations

Laws and regulations must, of course, be complied with; this is certified through homologations and type approvals. Moving up a level to the sustainability goals, manufacturers need to declare their commitments to specific initiatives. Vehicle manufacturers are expected to comply with industrial standards; this serves as a baseline to ensure a certain level of corporate responsibility in procurement.

1 SDG goals published by United Nations : https://sdgs.un.org/goals

Annex II[2] provides an overview of the existing regulations, as well as the proposed and forthcoming legislation affecting the bus and coach market from the operators' perspective. The focus is primarily on technical provisions concerning buses rather than rules for operating services.

2 Sustainability and ethical

Manufacturers can demonstrate their commitment to international treaties - such as the Paris Agreement and the United Nations' Sustainable Development Goals - by publishing documents that outline their working conditions, supply chain code of conduct, renewable energy usage, landfill practices and carbon footprint. When issuing a tender, the procurer should clearly state the specific documents required from the manufacturer. This will ensure that the manufacturer's commitment to sustainability and ethical practices is verified and aligned with the procurer's requirements.

3 Standardization

The procurement process should include references to relevant ISO standards to ensure compliance with industry best practices. Examples of applicable ISO standards include:

- ISO 9001: Quality management systems
- ISO 14001: Environmental management systems
- ISO 14025: Environmental product declarations
- ISO 14040: Environmental management - Life cycle assessment
- ISO 14044: Environmental management - Life cycle assessment
- ISO 22628: Recyclability and recoverability

4 Life Cycle Assessment (LCA)

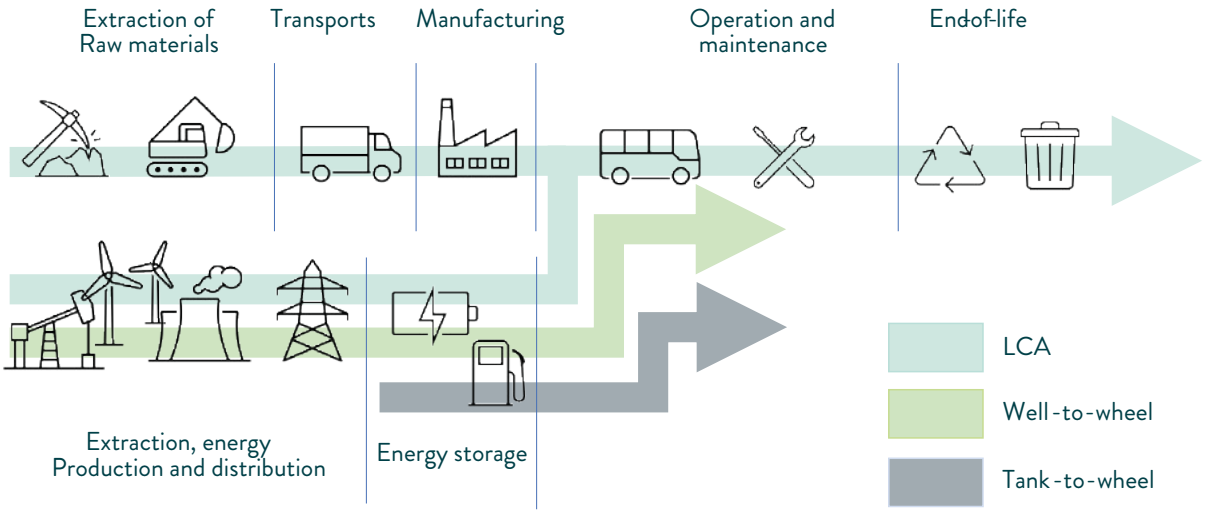
An LCA is a tool for quantifying the environmental impact of a product or service. It is a comprehensive and detailed approach, normalised through a set of ISO standards, that allows a manufacturer to assess all aspects of the environmental impact of a product. This covers the materials used, the manufacturing process, logistics, operation and maintenance and end-of-life activities. The impact measured is not limited to CO2 emissions; it also covers pollutants, water usage, energy consumption and the depletion of natural resources. However, as the manufacturer defines the scope and goals of the LCA study, the content and accuracy can vary, within the framework of ISO standards.

2 https://www.uitp.org/publications/bus-tender-structure-report-2020/

It is important to note that an LCA study is not a scorecard, and it is not intended to be used to rank manufacturers based on their environmental performance.

For buses, the operations phase is the most significant contributor to emissions. It is therefore it is important to consider energy use from a well-to-wheel perspective. This means looking at the entire energy chain, from fuel production to vehicle operation in order to accurately assess the environmental impact.

Figure 4: Evolution of the system boundaries – from tank-to-wheel to well-to-wheel & LCA. Source: Volvo Buses



Annex IV[3] provides a calculations/support tool from a Tank-To-Wheel perspective, offering a detailed view of the local impact. However, in an LCA study, it is important to consider the Well-To-Wheel impact as well, including for instance the effects of energy production during operations and the end-of-life impacts.

5 Environmental Product Declaration

In order to make the results of an LCA study more accessible, the main findings can be presented in an Environmental Product Declaration (EPD). This is an environmental declaration of type III according to ISO 14025, which provides condensed, transparent and comparable information on the environmental impact of a product or service. The EPD is an independently verified document, compiled and reviewed by an independent certified body.

3 https://www.uitp.org/publications/bus-tender-structure-report-2020/

Figure 5. Towards an Environmental Product Declaration (EPD)

The PCR provides rules for assessment of environmental impact

The LCA procedure is regulated in the standards ISO 14040 and 14044

ED is a proprietary description of the product's environmental impact

EPD is a third-party certified declaration of according to ISO 14025.

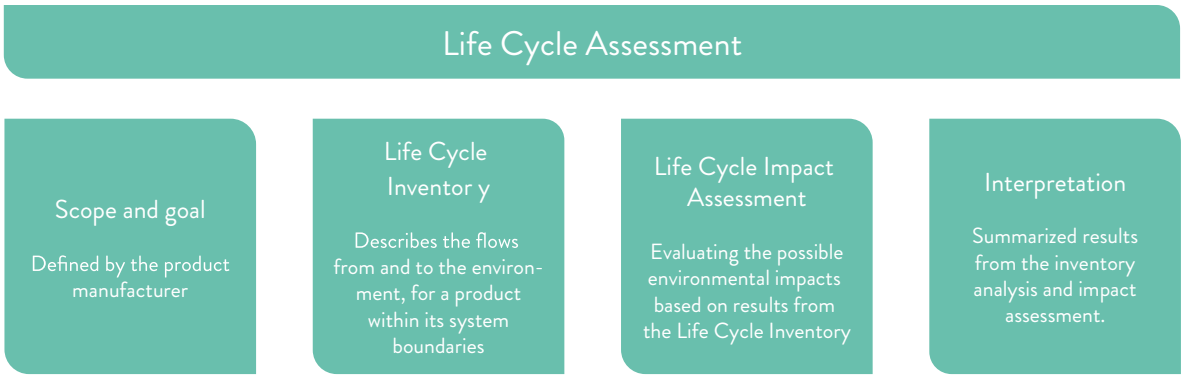
By presenting the results of an LCA study in an EPD, manufacturers can provide clear and concise information to customers, and other stake-holders about the environmental impact of their products or services.

In addition to the information provided above, a "Sustainability & Environmental Questionnaire" is provided as a decision support tool and released as an appendix to this annex VII that includes several questions per block (2-5), which can be included by purchaser in a tender to assess the sustainability and environmental performance of bidding/potential suppliers.

A standardised LCA method in detail

An LCA is a standardised method for studying and measuring the overall environmental impact associated with a particular product or process. The LCA process, as outlined in the ISO 14040 and 14044 standards, covers four distinct phases.

Figure 6. Stages in an LCA assessment



1 Definition of the goal and scope

The first phase of an LCA study is critical in establishing clear objectives and identifying the target audience for the study results.

2 Life Cycle Inventory

In the Life Cycle Inventory (LCI) phase, the required flows to and from nature for a product system are described in detail. This includes collecting data on inputs of water, energy and raw materials as well as releases to air, land and water. Input and output data are collected for all activities within the system boundary, including those from the entire supply chain. The data collected is restricted to the unit defined in the goal and scope phase, and some conclusions can be made already at this stage. The results of the LCI provide a comprehensive overview of all inputs, outputs and flows, from all the processes involved in the study, which are relevant to the environmental impact assessment in the next phase of the LCA study.

3 Life cycle impact assessment

After the inventory analysis, the next phase in LCA is the Life Cycle Impact Assessment (LCIA). This aims to assess the potential environmental impacts of a product system, based on the inventory results. It involves:

- Selecting the categories, indicators and characterisation models that will be used to evaluate the LCI result.
- Classifying the inventory parameters identified in step two in specific impact categories.
- Impact measurement, where the categorised LCI flows are characterised into common equivalence units, which are then tallied to provide an overall impact category total.

This is the last compulsory stage according to ISO 14044. However, ISO 14044 also identifies normalisation, grouping and weighting as optional LCIA elements, depending on the goal and scope of the study. Furthermore, ISO 14044 generally advises against the use of weighting in comparative assertions when disclosing to the public." Ignoring this introduces a high level of subjectivity, and thus should be avoided.

Environmental impacts in LCA can be classified under the different phases of development, production, use and disposal (end-of-life) of a product. Broadly, these impacts can be divided into:

- Production impacts, which include the extraction and transportation of raw materials, manufacturing, transportation of the product to a market or site, commissioning and the beginning of their use.
- Use impacts, which include the physical impacts of operating and maintaining the bus.
- End-of-life impacts, which include the dismantling and processing of recyclable materials and waste.

4 Interpretation

Life Cycle Interpretation is a systematic technique for identifying, quantifying and evaluating information from the results of the LCA and/or the LCIA. The results from these are summarised as part of the interpretation phase. The outcome of this is a set of conclusions and recommendations for the study. According to ISO 14040:2006, the interpretation should include:

- The identification of significant issues based on the results of the LCI and LCIA phases of a total LCA study.
- The evaluation of the study considering completeness, sensitivity and consistency checks.
- The relevant conclusions, limitations and recommendations.

The primary objective of conducting life cycle interpretation is to ascertain the level of confidence in the results, and to present them in a manner that is fair, comprehensive and accurate. To evaluate the outcomes of an LCA study effectively, it is crucial to understand their accuracy and how well they align with the study's goal. This is accomplished by identifying the data elements contributing to each impact category, evaluating its sensitivity and assessing the completeness and consistency of the study. This understanding of how the LCA was conducted allows accurate conclusions and recommendations to be drawn.

It is worth pointing out that, in the industrial context, an LCA is usually related to the impact assessment. However, in the ISO standards 14040 and 14044, the impact assessment is only one of the four LCA phases. The other three are goal and scope definition, inventory analysis and interpretation. All four are equally important, and the ISO standards require that they are all clearly defined and conducted in a systematically, transparently and consistently. This ensures that the results of the LCA study are reliable, comparable and suitable for decision-making.

Examples

Examples and additional information relating to the third phase – LCIA – are provided in this section.

- The PCR 2016:04[4] Product Category Rules (PCR) for preparing Environmental Product Declarations (EPD) for public and private buses and coaches provides specific guidelines for conducting LCAs of public and private buses and coaches.

- Environmental impact in all product life phases. Below is a sample table showing the environmental impact in all product life phases and three impact categories as described in ISO 14040 and 14044. The figures refer to a high-level example of LCA results on two specific electricity mixes for a 12-metre generic battery electric city bus. Please note that for the purposes of this example, SE stands for Sweden and EU stands for the European Union.

Figure 7. Example output table of a product environmental impact analysis

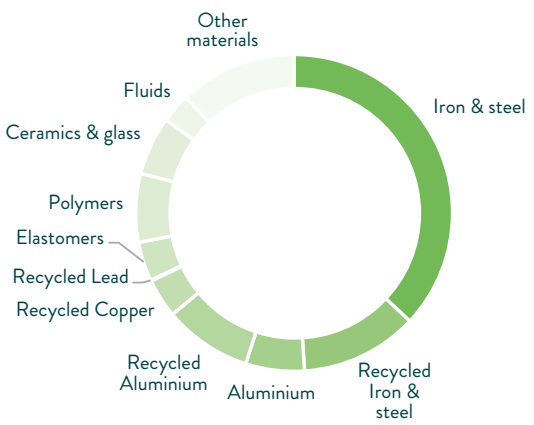
Emissions/pkm	Production	Use incl maintenance		End-of-life	Total	
Electricity mix		SE	EU		SE	EU
CO_2 (grams)	0.78	0.42	4.19	-0.16	1.03	4.81
VOC (milligrams)	1.71	0.51	7.67	-0.42	1.80	8.96
NOx (milligrams)	1.80	0.97	6.66	-0.32	2.44	8.14
SOx (milligrams)	2.14	0.53	7.53	-0.40	2.27	9.27
PM (micrograms)	213.91	33.57	229.99	-46.16	201.32	397.74

- Material composition. The material composition of a product can be analysed and presented as a pie chart, showing the share of weight for each material used in the product. The ISO standards 14025, 14040, and 14044 standardise the analysis and presentation of material composition in an LCA.

  The pie chart pie chart in the next page shows the percentage of the total weight each material used in manufacturing the product, such as metals, plastics, rubber, glass and other materials. This information can be used to evaluate the product's environmental impact in terms of the depletion of natural resources and the potential for recycling or recovery of materials at end-of-life.

4 https://www.environdec.com/

Figure 8. Example pie chart of a product material composition



- ISO 22628 is a standard providing guidelines for assessing the recyclability and recoverability of materials and components used in road vehicles. This standard specifies the principles for evaluating the recyclability and recoverability at the design stage, assuming that the vehicle can be recycled, reused or both (recyclability rate), or recovered, reused or both (recoverability rate).[5]

The recyclability rate depends on the handling of the chassis or bus after the end of its life, whether the vehicle is being repurposed or dismantled. For example, if a bus is refurbished and repurposed, the recyclability rate will be higher than if it were simply scrapped and recycled. Therefore, it is important to consider the entire life cycle, from production to end-of-life, to determine its overall environmental impact of a product.

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5 *https://www.iso.org/standard/35061.html*

Appendix to ANNEX VII
Sustainability & Environmental Questionnaire

1. Laws and regulations Please refer to the regulations applicable for the tender (annex II)	
2. Sustainability and ethical	
2.1	Do you have a code of conduct/ethical guidelines/ethical contract performance clauses in place?
2.2	Do you conduct supplier audits for rare earth metals/conflict minerals, working conditions, and child labour?
2.3	Do you publish a sustainability report, or include sustainability information in a broader report such as annual report? Please provide a copy if available.
2.4	Within the past 12 months, has the bus manufacturer performed due diligence according to the OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas? Please provide a copy of the due diligence report.
2.5	Has the welding been undertaken only between the same type of metals?
2.6	Are fasteners made from non-corrosive materials?
2.7	Is the bus equipped with a heat pump or air conditioning system?
2.8	What type of refrigerant is used in the heat pump/air conditioning system?
2.9	Please specify the ASHRAE-designated number of the refrigerant.
2.10	Please specify the Global Warming Potential (GWP) of the refrigerant.
3. Standardisation	
3.1	Please provide a certificate of compliance with the standard ISO 9001 if available.
3.2	Please provide a certificate of compliance with the standard ISO 14001 if available.
3.3	Do you declare recoverability and recyclability according to ISO 22628?
4. Life Cycle Assessment	
4.1	Do you conduct Life Cycle Assessment (LCA) studies for the company's products?
4.2	Are your LCA studies conducted in accordance with the relevant Product Category Rules (PCR)?
4.3	Does your LCA process follow the standards ISO 14040 and 14044?
5. Environmental Product Declaration	
5.1	Do you provide a third-party-reviewed EPD? Please note that only individual verifiers listed on www.environdec.com are approved to conduct third-party reviews.
5.2	Please provide documentation for the independent verification of the carbon footprint study.
5.3	What is the recyclability rate according to ISO 22628:2002?

This is an official publication of UITP, the International Association of Public Transport. Its membership includes transport authorities, operators, both private and public, in all modes of collective passenger transport, and the industry. UITP addresses the economic, technical, organisation and management aspects of passenger transport, as well as the development of policy for mobility and public transport worldwide.

This report was prepared by the UITP Bus Committee and the UITP VEI Committee

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