ACCOUNTING FOR WASTE & RECYCLING **GUIDANCE**

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Catena-X
Your Automotive Network

Introduction

Importance of Waste and Recycling in PCF

The distinction between waste, product or co-product is important in the calculation of the carbon footprint of a product. As mentioned in the Rulebook Version 4, the waste vs co-product hierarchy shall be applied to ensure comparability, transparency, and credibility in PCF reporting across the supply chain.

Purpose of this Document

This document provides guidance on accounting for waste treatment and recycling emissions in the context of Product Carbon Footprint (PCF) calculations, as required by the Catena-X PCF Rulebook Version 4. It aligns with the EU Waste framework Directive ‚2008/98' that distinguishes product, waste and co-product.

The guidance document will give examples of waste and co-products to illustrate the way to calculate the carbon footprint considering that distinction.

General Approach

The PCF calculation for the accounting of waste and recycling follows three key steps:

Step 1: material classification – Determine whether the material/component is a waste, a co-product, or product.

Step 2: system boundary definition – Decide what part of the process should be included in the PCF calculation.

Step 3: carbon footprint calculation – Apply appropriate emission factors and allocation rules to arrive at carbon footprint.

Examples for the Application of the Waste and Co-Product Decision Tree

Steel Sheet Production

Process Description:

This example illustrates the PCF calculation for a stamped steel component used in the body-in-white of a vehicle (see Figure 1). It describes the material input, stamping process, and treatment of generated scrap, including its qualification as waste under EU Waste Regulation. In this case, the input material is 1 kg of steel sheet (coil). The material is processed by stamping. The stamping process creates cut scraps that are mainly treated and recycled externally.

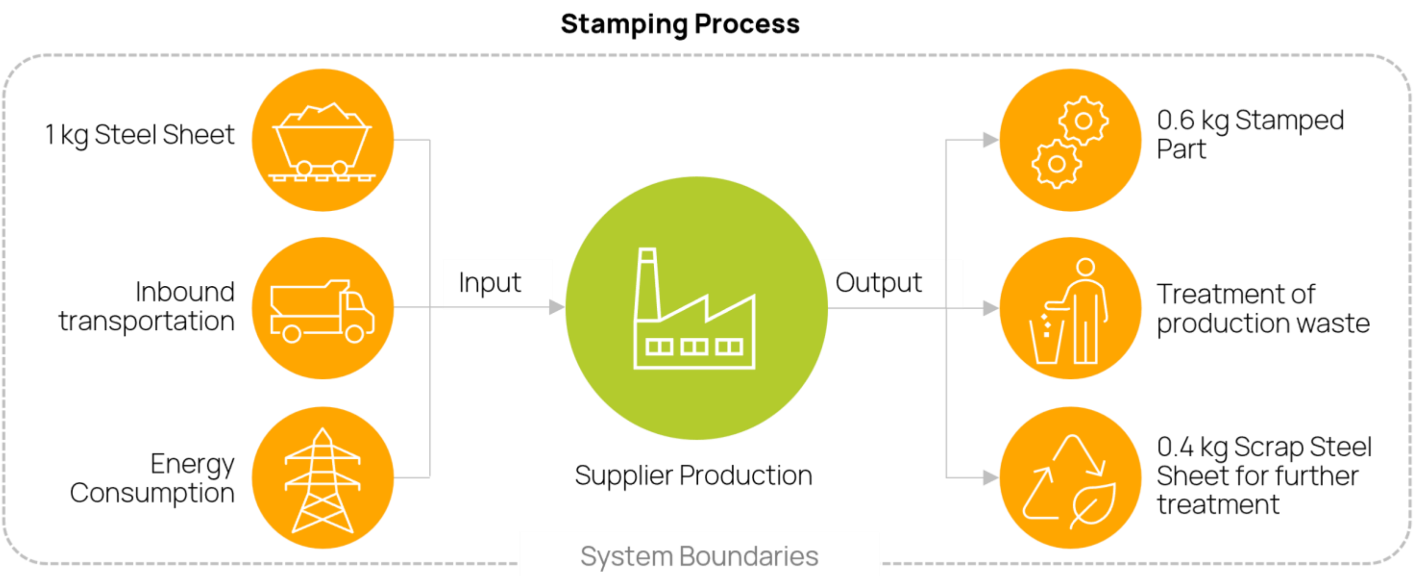

Figure 1: Process description for stamping process.

Step 1: Material Classification

The first step is to assess if the produced scraps can be qualified as waste as per the hierarchy proposed by EU Waste Framework Directive shown in

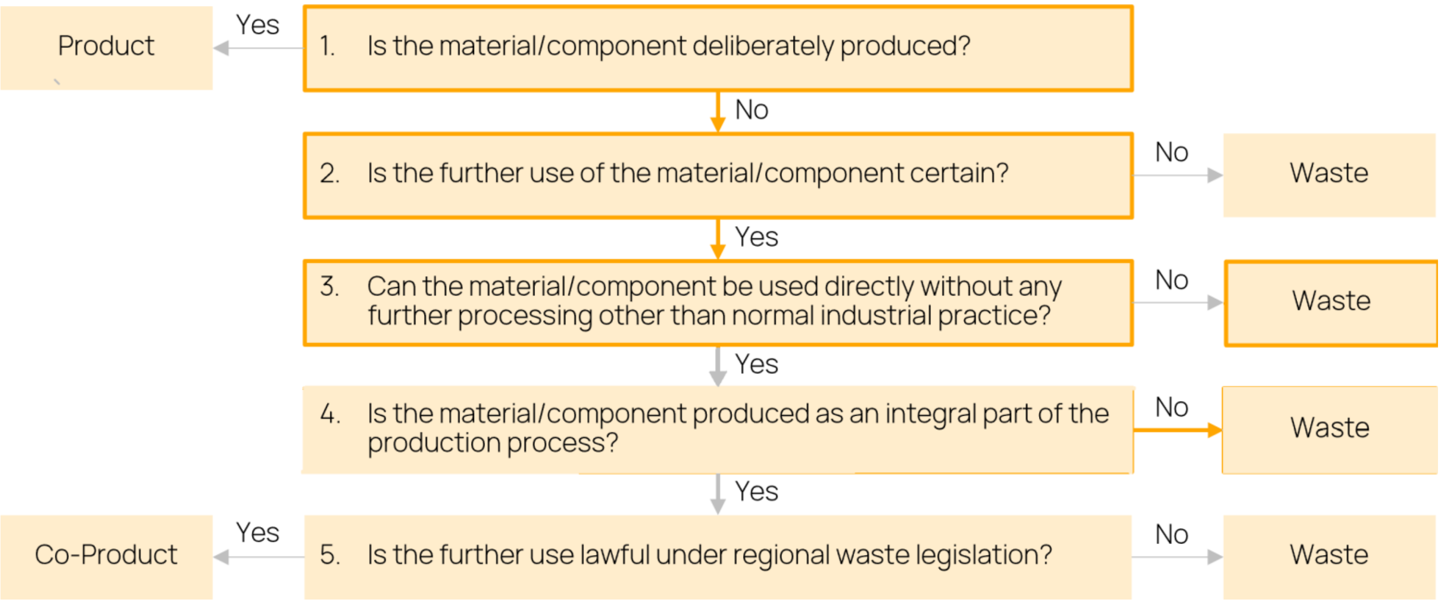

Figure 2:

Question 1: Is the material deliberately produced? **NO**, these scraps are not produced deliberately.

Question 2: Is the further use of the material/component certain? **YES**, the further use of these materials is certain (recycling), even though the route of recycling depends on many parameters.

Question 3: Can the material/component be used directly without any further processing other than normal industrial practices? **NO**, the material scraps can not be used directly.

Conclusion: The materials are confirmed to be **considered as waste**.

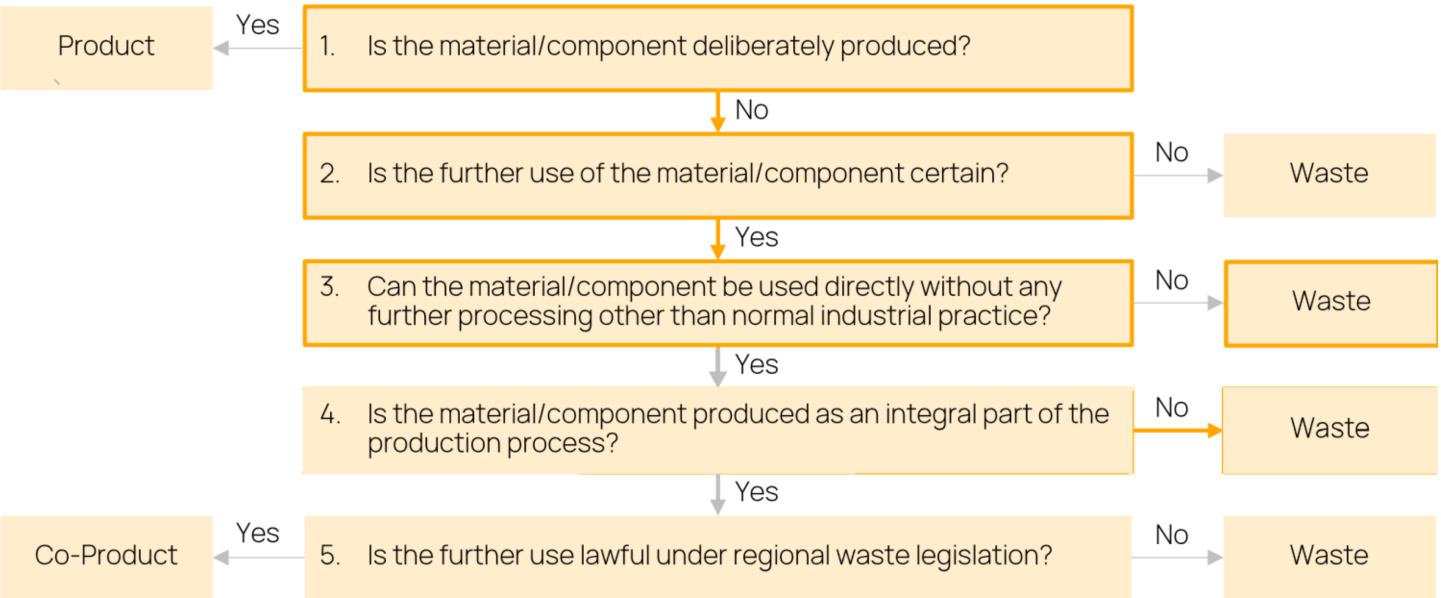

Figure 2: Material classification for steel scrap (EUROPEAN PARLIAMENT, 2008)

Step 2: System Boundary Definition

The second step is the definition of the system boundaries and can be seen in Figure 3 for the present example. The scrap is treated externally and not directly reused in the stamping process.

Per CX PCF Rulebook section *Accounting for waste treatment*, transport of the scrap from the stamping site to the recycler (collection, transportation) is allocated to the waste-generating system and is therefore included in the stamped-part PCF (polluter-pays principle). Per CX PCF Rulebook section *Accounting for recycling*, all preparatory steps for recycling that are owned by an external party are allocated to the waste-receiving system; any preparatory steps owned by the stamping company (e.g. on-site sorting/shredding) remain with the stamper. The downstream recycling treatment itself is outside the boundary.

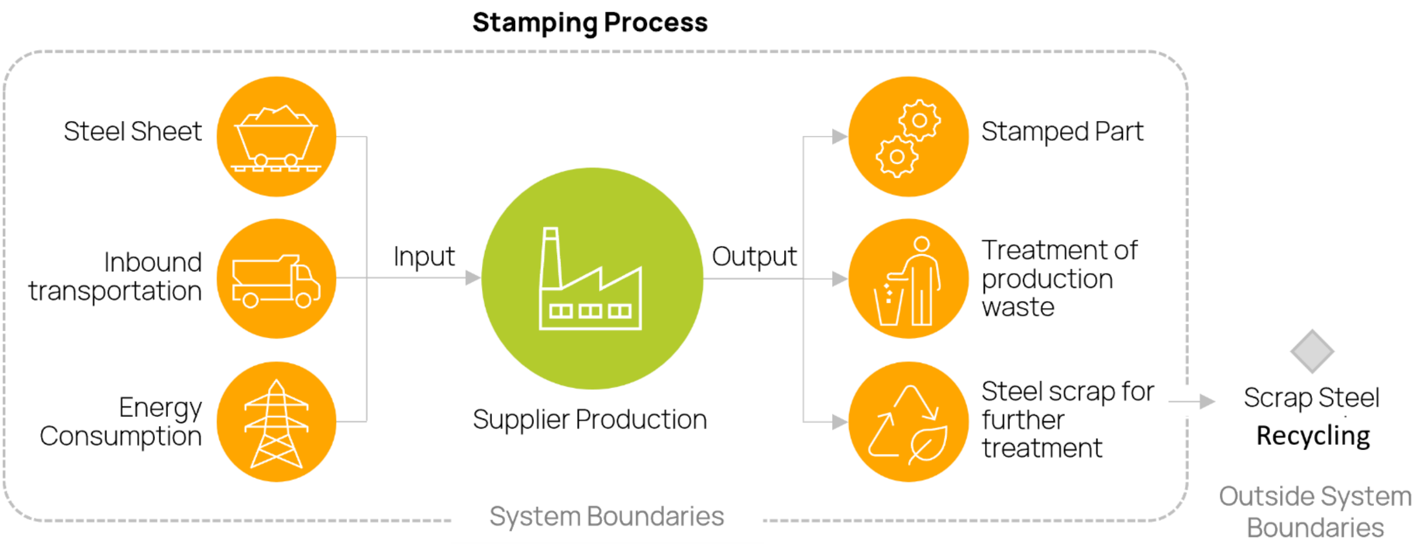

Figure 3: System boundary definition for stamping process

Step 3: Carbon Footprint Calculation

The third step is to calculate the carbon footprint of the stamped part by quantifying emissions associated with each stage of its production. It is demonstrated in the context of the present example in Equation 1.

Equation 1: Formula to calculate carbon footprint of a stamped part

$$\boldsymbol{CFP_{Stamped\ Part}} = Weight_{steel\ sheet} \cdot EF_{steel\ sheet} + Weight_{steel\ sheet} \cdot EF_{stamping\ factor}$$

$$= 1\ kg \cdot 2.2\ \frac{kgCO_2e}{kg} + 1\ kg \cdot 0.1\ \frac{kgCO_2e}{kg} = \mathbf{2.3}\ \boldsymbol{\frac{kgCO_2e}{stamped\ part}}$$

Considering the emission factor of:

- Average EU hot roll steel sheet: 2.2 kg CO_2e/kg (secondary data from World steel, including Scraps transport)
- Average EU stamping process: 0.1 kg CO_2e/kg of steel sheet processed (for example)

Plastic Part Production

Process Description:

The example is related to the production of a plastic part containing an injection molding process (see Figure 4). The kind of part considered here is particularly used for bumpers and interior parts of vehicles. In the present example, the input material is 1 kg of plastics polypropylene granules. The material is processed by injection molding. The injection molding creates scraps that are reintroduced in the initial process after regrinding. The final part weight is 1 kg.

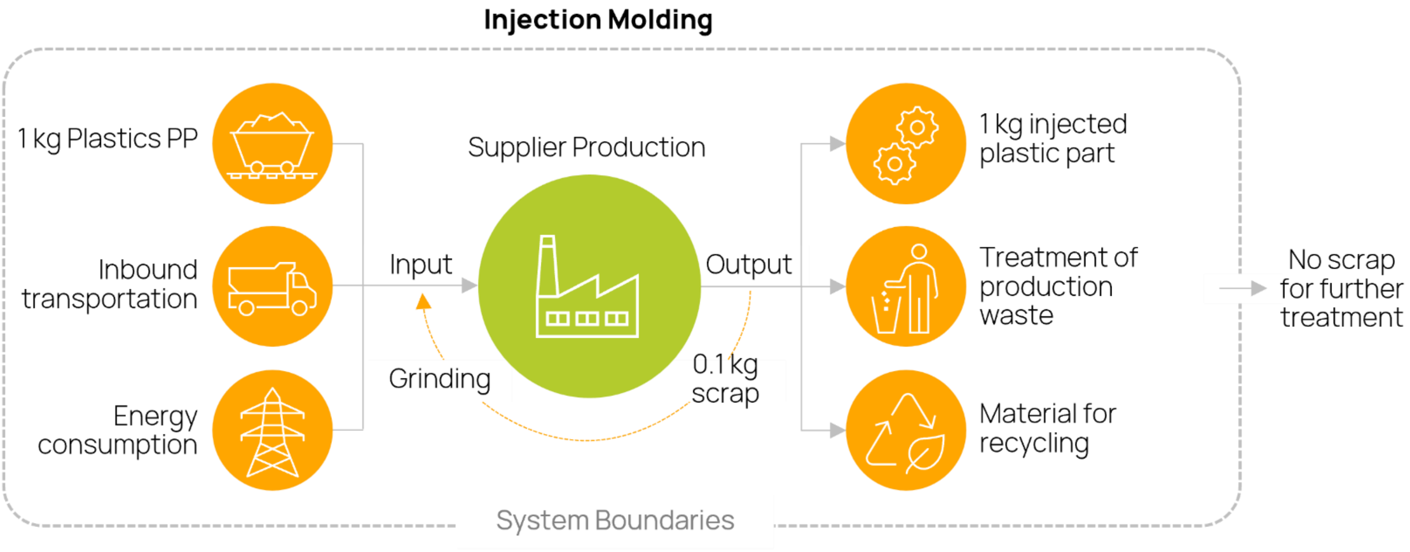

Figure 4: Process description for injection molding process.

Step 1: Material Classification

The first step would typically be an assessment of the produced scraps regarding their qualification as waste as per the hierarchy proposed by EU Waste Framework Directive. In this case, no classification is needed. Allocation rules do not apply for run-around scraps (or closed loops). Therefore, a classification into waste or co-product is considered not necessary.

Step 2: System Boundary Definition

The second step is the definition of system boundaries. As the scrap is reintroduced in the same process, there is no need to account for this flow in the carbon footprint calculation. No burden will be allocated to it. In case of a preparation treatment dedicated to this flow (here: grinding), this treatment is included in the carbon footprint calculation.

Step 3: Carbon Footprint Calculation

The third step is to calculate the carbon footprint of the injection molded part by measuring the emissions generated at each phase of its manufacturing process. It is demonstrated in the context of the present example in Equation 2.

Equation 2: Formula to calculate carbon footprint of an injection molded PP part

$$\begin{aligned} \boldsymbol{CFP_{Injection\ molded\ part}} &= Weight_{input\ PP} \cdot EF_{PP\ granules} + Weight_{injection\ molded\ PP} \cdot EF_{EU\ injection\ molding\ process} \\ &\quad + Weight_{run\ around} * EF_{EU\ grinding\ process} \\ &= 1\ kg * 1.6\ \frac{kgCO_2e}{kg} + 1.1\ kg \cdot 0.5\ \frac{kgCO_2e}{kg} + 0{,}1\ kg \cdot 0.1\ \frac{kgCO_2e}{kg} = \boldsymbol{2.16\ \frac{kgCO_2e}{injection\ molded\ part}} \end{aligned}$$

Considering the emission factor of

- Average EU plastics PP granules: 1.6 kg CO_2e/kg (secondary data from Plastics Europe)
- Average EU injection molding process: 0.5 kg CO_2e/kg (for example)
- Average EU plastics grinding: 0.1 kg CO_2e/kg (for example)

Remark: Weight of PP passed through injection molded process: $Weight_{part} + Weight_{run\ around}$

Painting of Plastic Parts

Process description:

This example case relates to a painting process of an injection molded plastic part that generates paint scraps (paint sprayed outside the part shape) that are incinerated (see Figure 5).

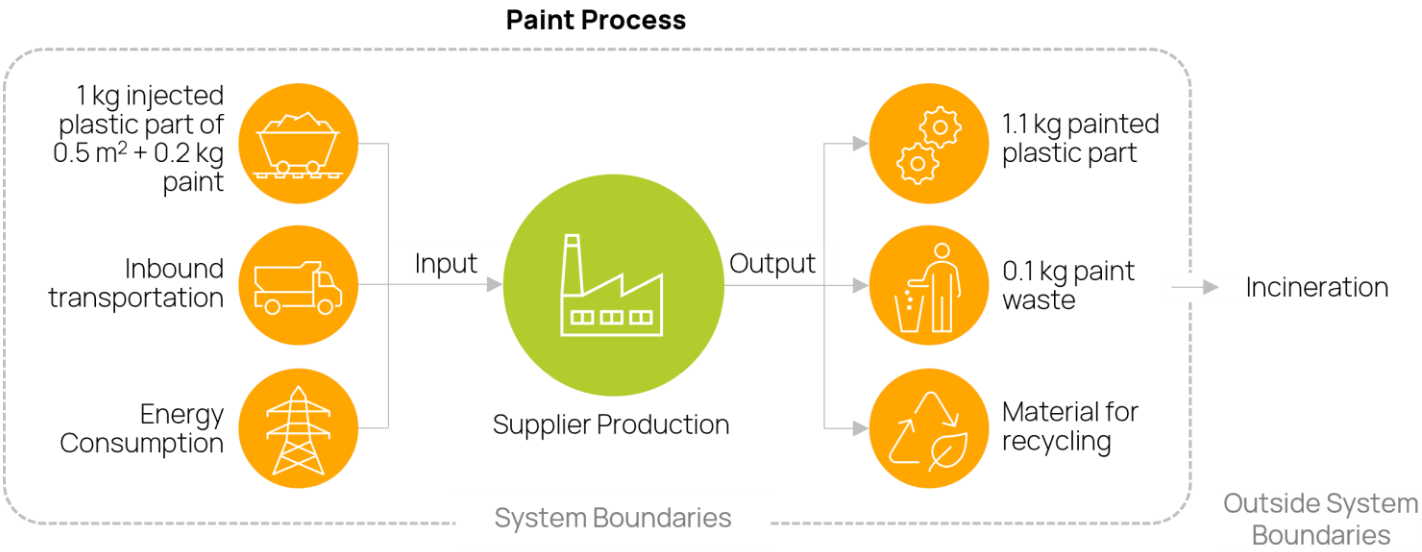

Figure 5: Process description for painting process

Step 1: Material Classification

The first step is to assess if the produced paint scraps can be qualified as waste as per the hierarchy proposed by EU Waste Framework Directive shown in Figure 6.

Question 1: Is the material deliberately produced? **NO**, these paint scraps are not produced deliberately.

Question 2: Is the further use of the material/component certain? **NO**, there is no further use of these materials.

Conclusion: The paint scraps are confirmed to be considered **waste.**

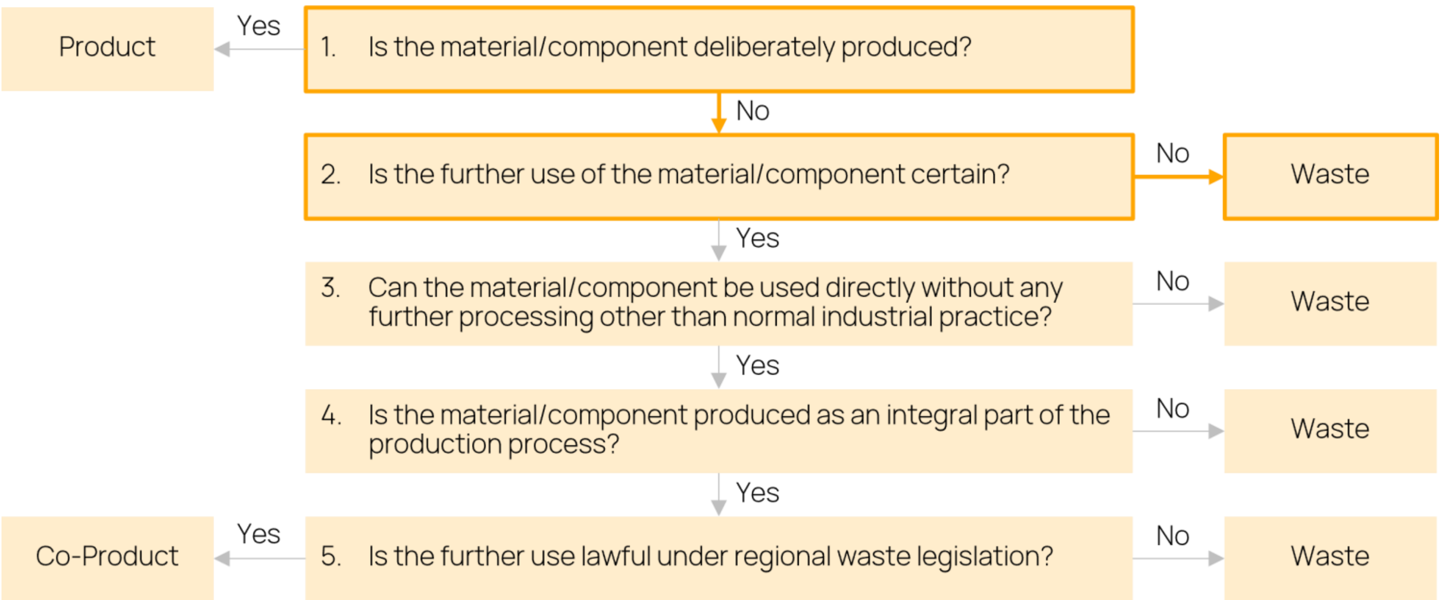

Figure 6: Material classification for paint scraps (EUROPEAN PARLIAMENT, 2008)

Step 2: System Boundary Definition

The second step is the definition of system boundaries. Since there is no recycling, the "Polluter Pays" principle is applied. The emissions from incinerating the waste are included in the boundary of the painted part.

Step 3: Carbon Footprint Calculation

The third step is to calculate the carbon footprint of the painted plastic part by measuring the greenhouse gas emissions generated at each phase of its manufacturing process. It is demonstrated in the context of the present example in Equation 3.

Equation 3: Formula to calculate carbon footprint of a painted injection molded PP part

$$\boldsymbol{CFP_{painted\ plastic\ part}} = CFP_{injection\ molded\ part} + surface_{painted} \cdot EF_{EU\ painting\ process} + Weight_{paint} \cdot EF_{EU\ paint} + Weight_{paint\ waste} * EF_{EU\ incineration\ of\ paint\ waste}$$

$$= 2.16\ kg \cdot CO_2e + 0.5\ m^2 \cdot 0.4\ \frac{kgCO_2e}{m^2} + 0{,}2\ kg \cdot 3.5\ \frac{kgCO_2e}{kg} + 0.1\ kg \cdot 3\ \frac{kgCO_2e}{kg}$$

$$= \mathbf{3.36}\ \frac{\boldsymbol{kg*CO_2e}}{\boldsymbol{painted\ plastic\ part}}$$

Considering the Emission Factor of

- Injected plastic part: 2.16 kg CO_2e/kg (from previous example)
- Average EU Paint: 3.5 kg CO_2e/kg (for example)
- Average EU Plastic Paint process: 0.4 kg CO_2e/m^2 (for example)
- Average EU Paint Waste Incineration: 3 kg CO_2e/kg (for example)

Bovine Hide for Leather Production

Process Description:

The example is related to the production of leather, more precisely to the raw hide produced from the same process as the production of meat (see Figure 7). Leather is used for automotive upholstery or steering wheels covering. In this example, the input is 1 Live animal to slaughter for meat production. The first step of the calculation is to define how to consider the upstream process, so how to consider the slaughtering process. The upstream process consists of cattle farming with different output products whose main ones are milk and meat. At slaughtering, meat and other products are separated from carcass.

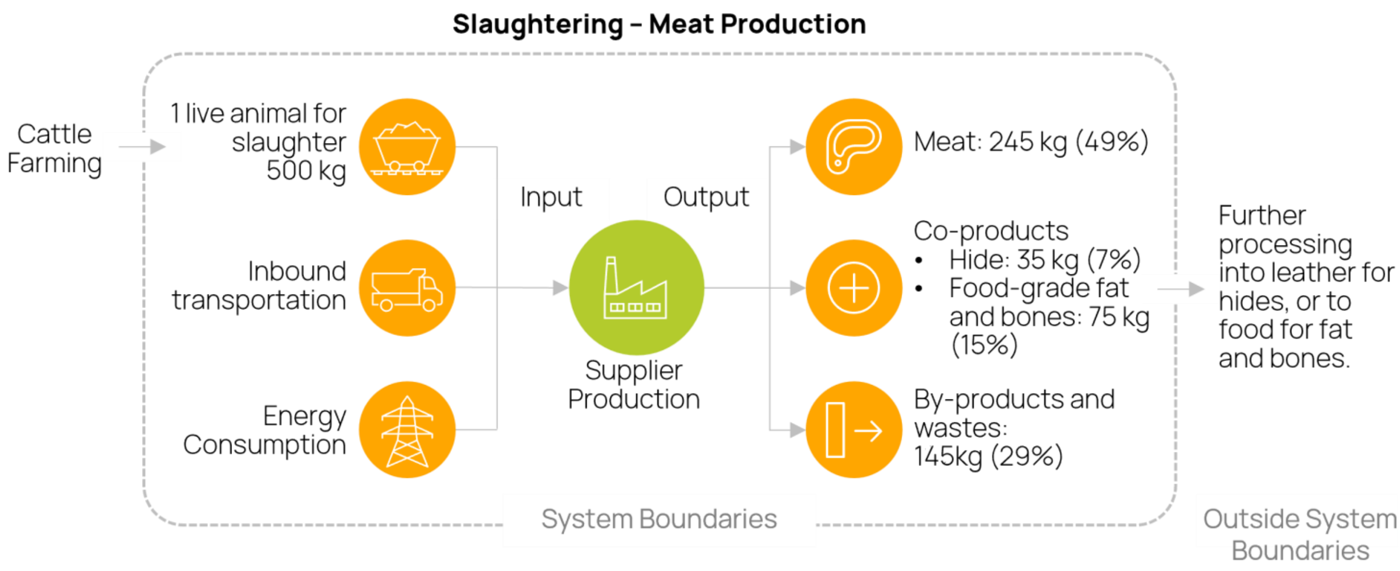

Figure 7: Process description for leather production

Step 1: Material Classification

The first step is to check if the hide can be qualified as co-product as per the hierarchy proposed by EU Waste Framework Directive shown in Figure 8:

Question 1: Is the material deliberately produced? **NO**, the hide is not deliberately produced by the meat production process.

Question 2: Is the further use of the material/component certain? **YES**, the further use of hide is certain, processing to leather.

Question 3: Can the material/component be used directly without any further processing other than normal industrial practices? **YES**, the further processing of leather belongs to normal industrial practices (tannery process)

Question 4: Is the material/component produced as an integral part of the production process? **YES,** the hide is the main product of further processing to Leather.

Question 5: Is further use lawful under regional waste legislation? **YES**, further use is lawful under the regional waste legislation.

Conclusion: Hide is then confirmed to be considered as **co-product.**

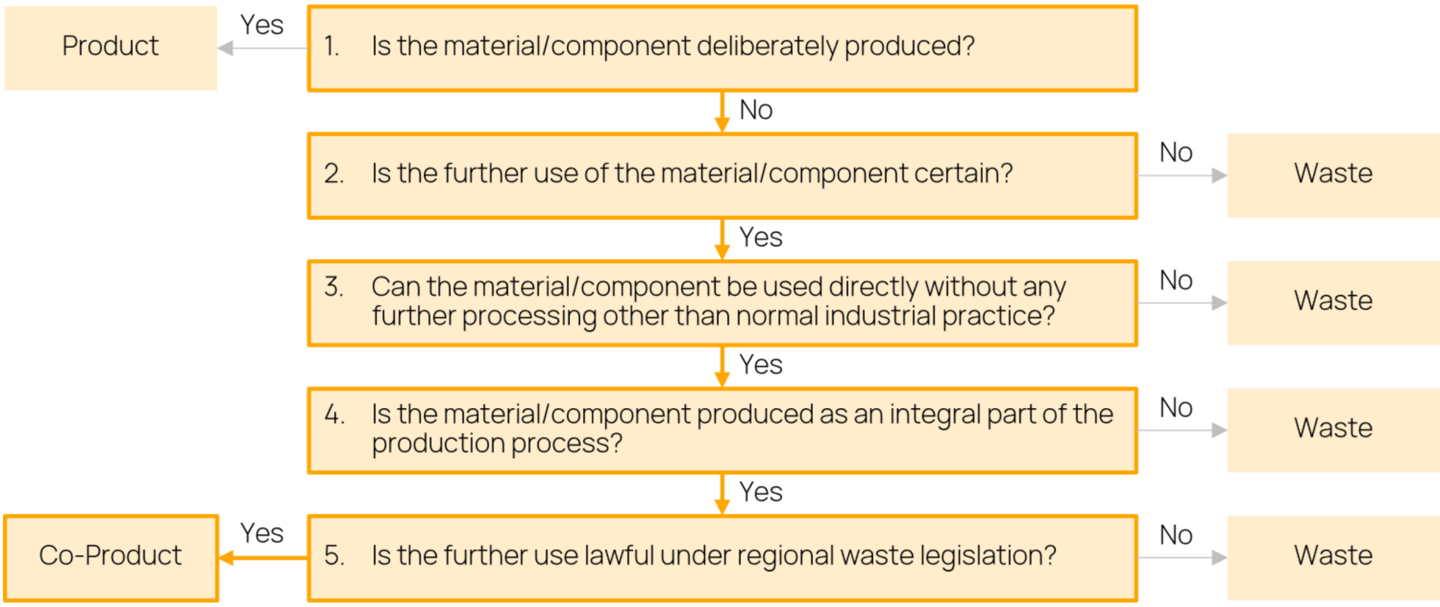

Figure 8: Material classification for bovine hide (EUROPEAN PARLIAMENT, 2008)

Step 2: System Boundary Definition

As the hide is defined as co-product from a multifunctional process, an allocation process should be defined, and the system boundaries of leather production are also defined. In the PEFCR of leather (April 2018) the processes shown in Figure 9 are all regarded as co-products.

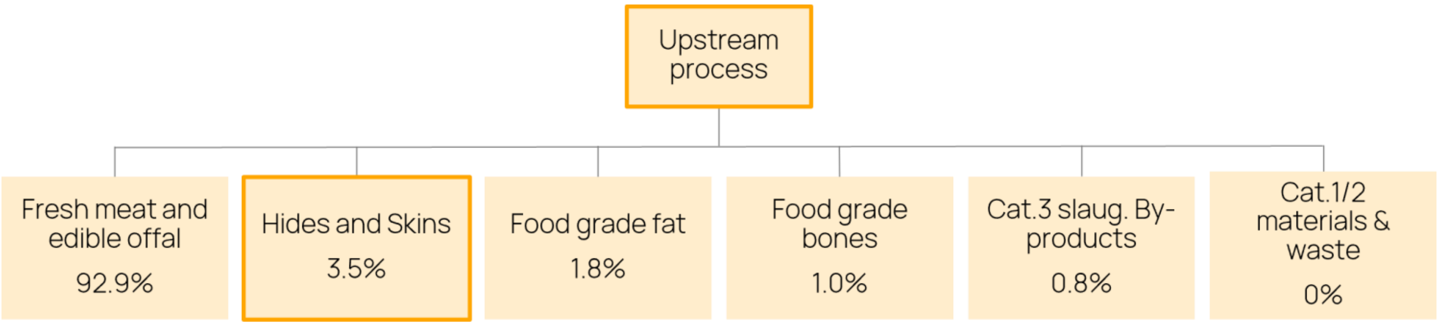

Figure 9: System boundary definition for bovine hide

Step 3: Carbon Footprint Calculation

The third step is to calculate the carbon footprint of the bovine hide by assessing the emissions generated throughout each phase of its production process. It is demonstrated in the context of the present example in Equation 3.

Equation 4: Formula to calculate carbon footprint of bovine hide.

$$\boldsymbol{CFP} = allocation\ factor * mass * emission\ factor$$

$$\boldsymbol{CFP_{raw\ hide}} = CFP_{live\ animal\ to\ slaughter} * economic\ allocation \div mass\ fraction$$

$$= 16.94\ kg * CO_2e \cdot 3.5\% \div 7\ \% = \mathbf{8,47}\,\frac{\boldsymbol{kgCO_2e}}{\boldsymbol{kg\ raw\ hide}}$$

Considering the Emission Factor of

- Beef cattle for slaughter, at beef farm, PEF compliant: 16.94 kg CO_2e/kg live animal
- Economic allocation: 3.5 %

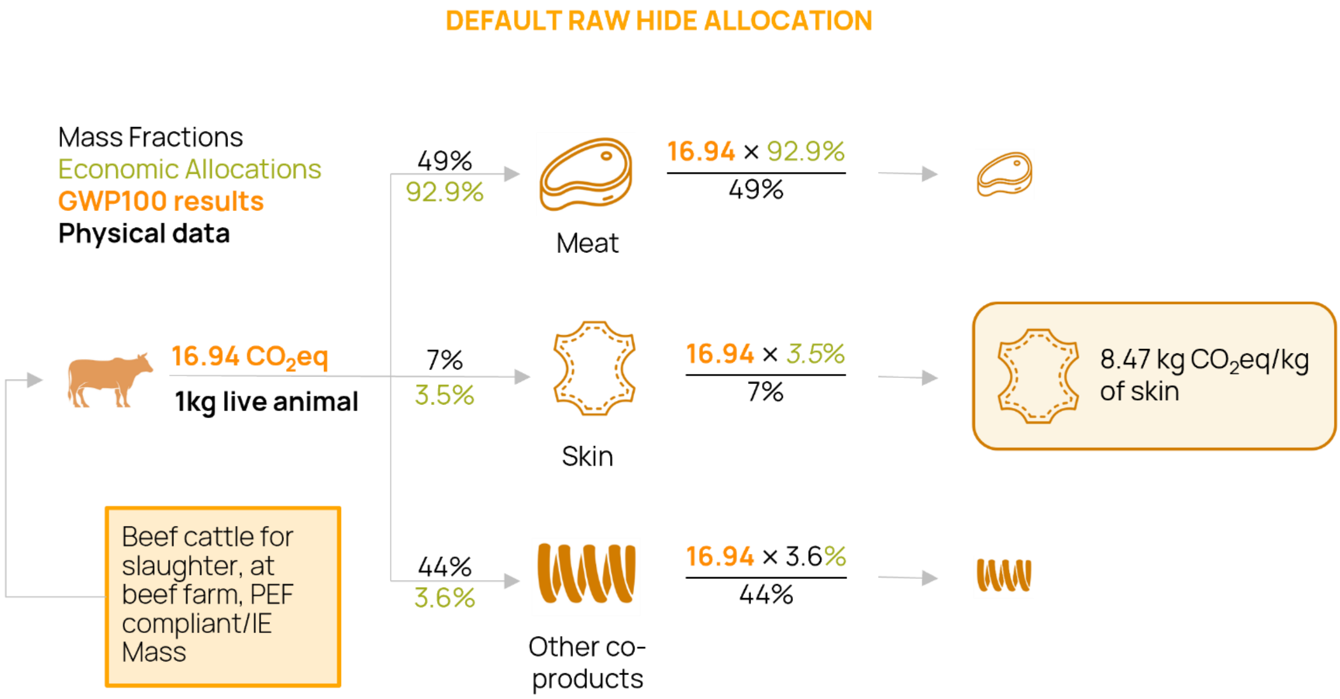

Figure 10: Allocation for raw hide

REFERENCES

EUROPEAN PARLIAMENT. (2008, November 19). *WASTE DIRECTIVE 2008/98/EC.* Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02008L0098-20180705

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