HOMOGENEOUS PARTS GUIDANCE

Released November 2026
Released Version: 1.4

Catena-X
Your Automotive Network

Introduction

Many companies offer a product in a large number of variants that differ only in one or very few physical characteristics. Calculating an individual PCF for each variant is costly and often adds little insight, because the carbon footprint varies systematically with that one characteristic.

In such cases the variants may be treated as a homogeneous product family. The PCF of a single variant is then derived from a regression across the family instead of being calculated individually — typically from a physical parameter such as weight, length or diameter.

This guide explains which criteria a product family has to meet, how to prove that the criteria are fulfilled, and what has to be documented. The binding requirements are set out in the Catena-X PCF Rulebook.

Requirements

Challenges in calculating a PCF for homogeneous parts

1 Generic criteria to be met by homogeneous parts

Not all different products can be treated as homogeneous parts. Four general requirements need to be met to qualify a product family as a family of homogeneous parts:

1. The same main function
2. The same product standards
3. The same manufacturing technology, processes, and materials
4. The same supply routes

2 Detailed proof of homogeneous parts

To prove that products are homogeneous, a product parameter (a physical characteristic such as weight, length or diameter) must be identified that systematically differentiates the otherwise identical parts with respect to their PCF. The relevance of this parameter must be confirmed by a sensitivity analysis.

A linear regression of the PCF against this parameter must render a coefficient of determination R^2 of more than 90 %. At least three product variants ($n \geq 3$) must be included, and the selected samples must cover the expected range of the parameter used for interpolation.

3 Applying the interpolation

Once a homogeneous product family is established, the PCF of a member of that family must be calculated by interpolation only.

4 Documentation and review

The proof of a homogeneous product family must be documented and provided to customers on request. The documentation should cover the four generic criteria, the chosen interpolation parameter, the sensitivity analysis and the regression including the underlying sample.
The proof must be reviewed after five years at the latest — and earlier whenever the manufacturing technology, the materials or the supply routes of the family change.

5 Intermediate production stages

For some products, the required correlation between product variants may be shown for intermediate production stages, whereas the final product does not show the correlation anymore due to specific additional process steps or add-on parts. In this situation, the PCF quantification for the intermediate part may be done via interpolation for homogeneous parts and addition of the CO2e emissions for later process steps or add-on parts.

6 Primary data share and prospective PCF

For the calculation of the primary data share, the data does not need to originate from the individual product. It may relate to the homogeneous part it was derived from.
The interpolation may also be used for a product that will become a new member of an existing homogeneous product family in the future. If the whole family is projected into the future, the interpolation parameters must be recalculated from the prospective PCF of the variant with the lowest and the variant with the highest PCF.

Use Case – Example: High Pressure Gasoline Injectors

High-pressure injectors for direct petrol injection are manufactured in many different variants to enable different installation positions in the engine and use in a wide variety of engine combustion processes.

die

How to do the Analysis?

Step 1 – Check generic requirements for homogeneous parts: the product group HDEV6 under consideration consists exclusively of fuel injectors for petrol engines with direct injection that meet similar technical specifications. The same production processes are used and the materials and components come from the same suppliers.

Step 2 – Identify relevant interpolation parameters: the PCF was determined individually for 24 different variants of the injector. Plotting the PCF of the 24 variants against the weight of the injector shows an obvious linear correlation. When checking the quality of the correlation, an R^2 value of 97.7 % is obtained. This fulfills the requirement for the verification of homogeneous components. The PCF for all other variants of the HDEV6 injector can be determined by simple interpolation for the respective injector weight.

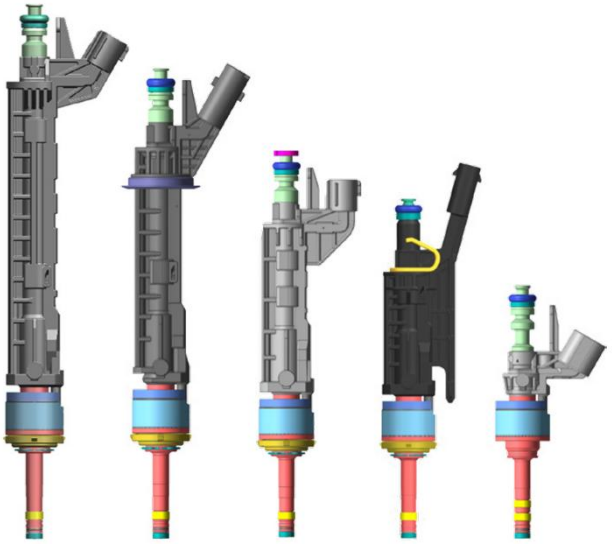

Figure 1 Five different variants of the HDEV6 injector are shown here as examples.

PCF Correlation

Results and Findings

The PCF calculation for homogeneous parts allows to simplify the quantification of a variant specific product carbon footprint drastically. A simple interpolation provides the specific PCF of the variant, if a sufficient quality of correlation can be shown.

In this example the weight was identified as the physical parameter for correlation, but any other parameter e.g. length, diameter might be suitable for defining a homogeneous part.

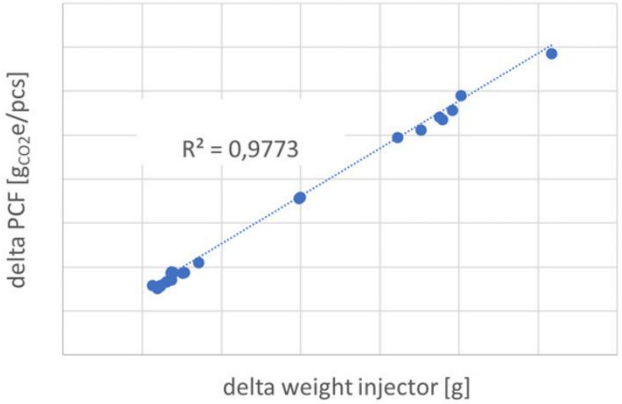

Figure 2: PCF plotted against injector weight – all injectors correlate on one line (R^2 = 0.9773).

Catena-X Automotive Network e.V.

Reinhardtstr. 58,

10117 Berlin Germany

Tel: +49. 030.5360.7799

E-Mail: info[@]catena-x[.]net

Register of associations at the district court Berlin (Charlottenburg) Nr D1537

Authorized representatives of the board:

Oliver Ganser (Chairman)

Prof Dr. Boris Otto (Vice Chairman)

Claus Cremers (Treasurer)

Catena-X
Your Automotive Network