

Press Release

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Calculating the Carbon Footprint of an Industrial Product in a Consistent, Comparable, and Understandable Way: Factory-X “PCF Guidance” Explains How

How can a product’s carbon footprint be determined in a standardized, automated, and cross-company manner along the value chain? And how can this be achieved by companies with limited personnel and financial resources? “PCF Guidance,” the new guidance document published by the Factory-X initiative, with contributions from Fraunhofer IWU, addresses these questions. It describes calculation methodologies and provides concrete examples for manufacturing processes such as milling, forging, and additive manufacturing. The guidance extends the scope to industrial production of products consisting of multiple parts or assemblies (discrete manufacturing). It complements the Catena-X Rulebook, which defines fundamental calculation standards at a higher level of abstraction with a primary focus on the automotive industry.

Why Measure a Carbon Footprint? What Is PCF?

Large companies are already required, or soon will be required, to report climate- and emissions-related data under the European Union’s Corporate Sustainability Reporting Directive (CSRD). These reporting obligations often include emissions associated with products and supply chains. While the Ecodesign for Sustainable Products Regulation (ESPR), which will gradually introduce the Digital Product Passport (DPP) with comprehensive sustainability data, does not yet apply to most manufacturers, emerging regulations are already driving customers to request product- and material-level carbon data from their suppliers.

Factory-X addresses the Product Carbon Footprint (PCF) as a key challenge in discrete manufacturing. A product PCF requires aggregating all contributions to a complete carbon footprint, from raw material extraction through to the factory gate (“cradle-to-gate”). A PCF quantifies the greenhouse gas emissions attributable to a specific product, typically expressed in kilograms of CO₂ equivalent (kg CO₂e). In discrete manufacturing, this includes raw materials such as steel, aluminum, and plastics; energy consumption of production equipment; auxiliary materials; transportation; and upstream supplier processes, all allocated down to the individual component level.

What the “PCF Guidance” Delivers

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The guidance provides a framework for calculating product carbon footprints consistently and automatically, from process, energy, material, and logistics data, enabling transparent and verifiable emissions accounting across organizations. The guidance clearly explains how companies can systematically collect emissions data from their own operations and supply chains, consolidate it into a cradle-to-gate PCF, and account for requirements such as system boundaries and cut-off rules (for example, thresholds, reporting dates, or exclusion criteria).

A major focus is the accurate attribution of energy and material consumption to individual products. To illustrate this, the guidance presents three detailed calculation examples covering a milled component, a forged component, and an additively manufactured suspension fork, including formulas, data sources, and treatment of scrap, packaging, and transportation.

In addition, the document explains how emissions can be distributed within multi-product manufacturing environments using process subdivision, system expansion, or allocation methods (physical or economic). To improve accuracy, the guidance advocates spatial and temporal process separation through submetering, combined with production data, thereby reducing reliance on estimates and allocation assumptions. The guidance also includes practical examples of allocating building-related emissions, downtime-related emissions, and machine energy consumption.

Guidance, Support, and Opportunities for Collaboration

Developed with contributions from ESTAINIUM, Siemens, Fraunhofer IWU, and other partners, the Product Carbon Footprint Guidance (PCF Guidance) is based on the Catena-X PCF Rulebook Version 4.0. It provides valuable orientation, particularly for small and medium-sized enterprises. Fraunhofer IWU also offers support in the accurate calculation of product carbon footprints.

Data Interoperability and Exchange

The Factory-X data space enables suppliers and customers to exchange PCF data in a standardized format, making carbon-related information traceable throughout the entire value chain. This forms a foundation for meeting future regulatory and customer-driven sustainability requirements.

Factory-X specifically focuses on the cradle-to-gate approach. Looking ahead, Catena-X–based data exchange is expected to become accessible to small and medium-sized enterprises as well. Companies retain full control over their data at all times, ensuring data sovereignty. For manufacturing processes distributed across multiple companies, an efficient cradle-to-gate carbon footprint assessment depends on automated workflows and secure data-sharing ecosystems.



Factory-X and the PCF Guidance receive funding from the EU and the German Federal Ministry for Economic Affairs and Energy

What is Discrete Manufacturing?

Discrete manufacturing refers to the production of products consisting of multiple parts or assemblies that can generally be disassembled into their individual components. These products are countable as individual units, assembled from separate components, and often exhibit a high degree of variant diversity. Their production is typically based on bills of materials and manufacturing routings.

What is Factory-X?

Factory-X is a project funded by the German Federal Ministry for Economic Affairs and Energy that is building an open data space for industry. Its objective is to enable secure, standardized, and sovereign data exchange between companies without requiring participants to relinquish control over their data. Key use cases include Product Carbon Footprints (PCF), Digital Product Passports (DPP), supply chain transparency, resilience, and sustainability.

What is Catena-X?

Technically, Factory-X is built on concepts from Catena-X and the Asset Administration Shell (AAS) to enable interoperable data exchange across entire value chains. Catena-X is an open, collaborative data ecosystem primarily serving the automotive industry.

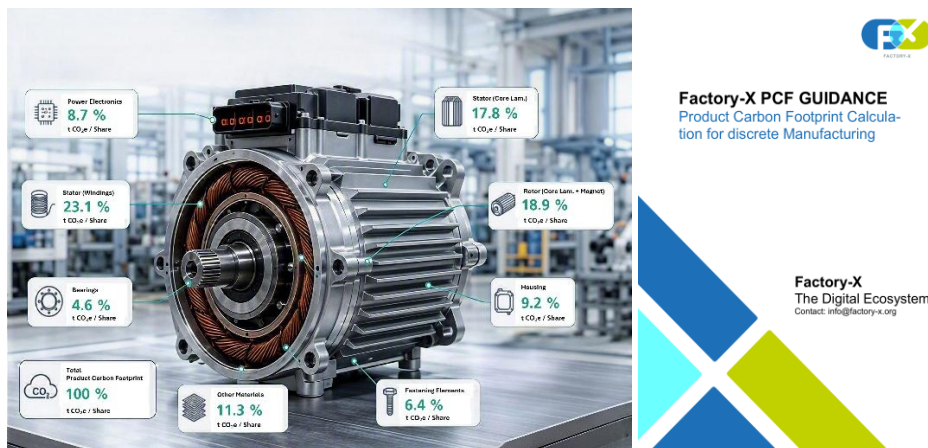


Fig. 1 The new Factory-X PCF Guidance enables organizations to determine a product's CO₂ footprint in a standardized, transparent, and component-level manner. © Fraunhofer IWU | AI-generated illustration

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Contact

Andreas Hemmerle

Fraunhofer Institute for Machine Tools and Forming Technology IWU
Spokesperson

Phone +49 371 5397 1372

andreas.hemmerle@iwu.fraunhofer.de
www.iwu.fraunhofer.de