PRESS RELEASE

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Simple calculation of the CO_2 footprint of a machine tool

Experts draft practical guidelines for more transparency in the supply chain

Frankfurt am Main, 13 January 25 - What is the CO_2 footprint of a machine tool? Anyone who wants to prepare a sustainability report for a manufacturing company or document progress in greenhouse gas emissions will probably pass this question on to the supply chain. The answer is not easy: After all, a machine tool consists of tens of thousands of individual parts, including purchased materials and preliminary products. There is a huge variety of products, ranging from compact milling machines for intricate clock mechanisms to presses for aircraft parts: Almost every machine is unique. How do you arrive at a value that is also valid and comparable for accountants?

"The CO_2 assessment itself is already complex," says Prof. Felix Hackelöer from the Institute for Automation and Industrial IT at Cologne University of Applied Sciences, "and it is *very* complex for machine tools." Hackelöer is a member of a group of experts formed on the initiative of the VDW (German Machine Tool Builders' Association). The group was faced with the task of developing so-called Product Category Rules (PCR) for machine tools. This involves a calculation approach that can be used to determine the product carbon footprint (PCF), i.e. the CO_2 of a machine tool. Also on the team: Experts from six VDW member companies - Chiron, DMG Mori, Grob, Heller, Schuler and United Grinding - as well as experts from the VDW and VDMA

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departments involved in standardization. The aim should be to use a VDMA standard to create a guideline that can ideally be developed into an ISO standard.

Premise: Ensure applicability also for SMEs
The project group met for the first time in February 2024. There was a short discovery phase in which different experiences were reported and possible approaches were discussed. Jörg Süssdorf, Global Quality Manager at Schuler Pressen, Göppingen, reports that agreement was quickly reached on a few key points: "Many companies long for a simple, well-structured paper," he says. "We agreed that our rules must also be able to be implemented for SMEs without a great deal of bureaucracy." The results should be comparable and internationally adaptable. However, they should also make it possible to recalculate or check if market participants appear to be less trustworthy. Finally, the goal was set that the PCF could be calculated in a single day using the method to be developed. Until now, three months at best was considered realistic. "If all these requirements are met," says Süssdorf, "there is a clear benefit for companies."

The method: Just don't get too lost in the details
The PCF includes all greenhouse gas emissions caused by a product in the various phases of its life cycle. In the first step, the VDW project group agreed on the cradle-to-gate approach, i.e. an approach that focuses on resources, the manufacture of preliminary products and finally the production of the end product - right up to the point at which the machine leaves the manufacturer's factory.

Henning Bornkessel, Senior Manager Sustainability & Process Management at DMG Mori, Bielefeld, explains the reasons for this approach. "The decisive factor for us was the customer perspective," he says. "Cradle-to-gate is a well-defined area for which we can make reliable statements. This is exactly what our customers are interested in for their CO_2 footprint."

The "most heated" discussions in the expert group were - as they say - about the question of how much detail was needed. "Higher-level approaches require a detailed consideration of up to 99 percent of a machine's mass," says Felix Hackelöer and emphasizes: "This is not possible with machine tools." According to the Cologne scientist, the question arose as to what sense it makes to calculate the PCF down to the smallest washer. The aim of the working group was therefore to develop a methodology for the PCF of machine tools that combines good accuracy with reasonable effort.

New VDMA standard: A streamlined complete package
In the PCRs now available from the VDW project group, users are guided through the process in nine steps. Of course, this is primarily about the machine and its individual parts. In addition, the emissions generated directly on site by the machine manufacturer are taken into account, as well as purchased energy sources, which are allocated to the machines produced accordingly.

In principle, the manufacturer must first define the coverage limits. Is it just about a company's own product or the entire scope of delivery, including the loading robots, for example? The machine is then virtually dismantled. All individual parts are sorted by weight using the parts list. Control cabinets and motors must be considered separately, as they may contain CRM (Critical Raw Materials) such as rare earths, copper or cobalt, which are associated with high CO_2 emissions. The guideline provides a practical approach for their accounting.

It gets exciting when the remaining mass of the machine (after deducting the control cabinet and motors) is considered. Here the experts decided to apply the *Pareto principle* (80/20 rule), named after the Italian economist Vilfredo Pareto, to simplify matters. Applied to the machine tool, this means that a few parts make up the majority of the mass - and therefore also the carbon footprint. The task now is to use the sorted parts list to identify the parts that make up at least 80 percent of the remaining mass. Their PCF can then be calculated by multiplying the weight by the appropriate emission factor. The emission factors of the various materials can be obtained either from the supplier or from relevant databases. The remaining parts that have not yet been reported can be extrapolated accordingly, which is quick and, according to the experience of the experts involved, leads to a comparable level of accuracy as a complete consideration of all parts, as Hackelöer emphasizes.

In the end, the addition of the individual footprints results in the product carbon footprint of the entire machine tool, which is specified as a CO_2 equivalent in kilograms – a value that can be included in any sustainability report, checked and compared with others.

In addition to the procedure described, the VDMA standard provides a sample calculation and definitions, explanations of relevant ISO standards and references to databases for emission factors, which can be accessed free of charge. "All the necessary information can be found in our paper or in specified public sources," emphasizes Jörg Süssdorf. For the first time, there is an approach that is also practicable for the many SMEs represented in the sector,

he promises. Everything is easy to understand and can be carried out without any training.

Recommendation at the right time
For Dr. Matthias Baur, Team Coordinator for Structural and Process Dynamics at Grob-Werke, Mindelheim, the work on the VDMA standard came at just the right time. The EU CSRD (Corporate Sustainability Reporting Directive) will require the majority of companies to produce comprehensive sustainability reports from 2025. "Standardization helps with common understanding and the elimination of numerous uncertainty factors," emphasizes Dr. Baur, who has already participated in various standardization processes, including energy efficiency.

This view is likely to be shared by the VDW, which is committed to improving the ecological footprint of machine tools. And for good reason: Two years ago, a visitor survey at EMO Hanover revealed that the focus on the *Future of Sustainability in Production* was high up on the priority list for 68 percent of visitors, and even more so for foreign visitors (three quarters) than for German visitors. As the organizer of EMO Hanover 2025, the VDW is likely to be very interested in providing the impetus for a new standard that makes the ecological footprint of machine tools comparable and could raise it to a new level in the long term.

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Background

EMO Hanover 2025 - the world's leading trade fair for production technology

Under the motto *Innovate Manufacturing*, EMO will showcase the entire metalworking value chain from September 22 to 26, 2025. This includes cutting and forming machine tools, manufacturing systems, precision tools, automated material flow systems, computer technology, industrial electronics and accessories. EMO takes place in a sequence of "Hanover – Hanover – Milan" every two years and will celebrate its 50th anniversary in 2025. Most recently in 2023, more than 1800 exhibitors attracted a good 92,000 visitors from all over the world to Hanover. As the most important platform for metalworking worldwide, the event stands for **innovation**; EMO is a source of inspiration and a global leader when it comes to new products, manufacturing solutions and services. **Internationality**: International market leaders from 45 countries exhibit at EMO. The trade visitors come from all major customer industries such as mechanical and plant engineering, the automotive industry and its suppliers, aerospace technology, precision mechanics and optics, shipbuilding, medical technology, tool and mold making, steel and lightweight construction, and from around 140 countries. **Inspiration**: No other trade fair presents the full breadth and depth of international manufacturing technology like EMO. Exhibitors and visitors with a high level of expertise discuss the megatrends in manufacturing, exchange ideas with representatives of international production research and develop solutions to existing challenges. **The future of metalworking**: *Innovate Manufacturing* remains a constant challenge for the industry. EMO points the way to the limitless possibilities of industrial manufacturing.

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