# How Würth is Using the Sustainability Data Science Life Cycle to Detect Environmental Hotspots

Würth places a lot of value on culture, values, and attitudes – which helps them think and act in a future-oriented way. The company has a long-term vision of developing and operating sustainably, and considers economic, social, and environmental factors to be the three key pillars in achieving this.

## Objective: Develop Products Sustainably

One of the collective objectives is to actively shape the future and develop sustainably by following the concept of the circular economy. Specifically, one of their goals is to detect environmental hotspots in the screw product portfolio. Würth has made steps in achieving this by transforming parts of their product portfolio to sustainable and circular products. Other objectives include:

- Increasing data transparency of products with regards to carbon footprint
- Strengthening and expanding the role as a driver for sustainable innovation

## The Problem: Time-Intensive, Manual Data Blending

Identifying environmental hotspots comes with several challenges and requires expertise from multiple domains such as Life Cycle Assessment (LCA), data engineering and analysis, as well as all technical fields involved along the value and supply chains of the analyzed products. On the product portfolio level, such analyses often involve millions of data points and multiple internal and external data sources.

Because of these challenges, Würth worked with the Department of Life Cycle Engineering at the **Fraunhofer Institute for Building Physics IBP** - a research unit with more than 30 years' experience in applied LCA and sustainability analysis. Fraunhofer IBP built a reusable and scalable solution for Würth's end users: sustainability professionals tasked with detecting environmental hotspots and ensuring circular products.

Following the Sustainability Data Science Life Cycle (S-DSLC) approach, Würth and Fraunhofer IBP started the project by inspecting one product category: Standardized metric screws. These make up one of the most relevant parts of the Würth product portfolio. And with about 30,000 distinct products of the most common technical standards, it was a huge challenge to tackle.

### Company

**Adolf Würth GmbH & Co. KG + Fraunhofer Institute for Building Physics IBP**

Würth Group is market leader in its core business: the production of assembly and fastening materials. It consists of over 400 companies in more than 80 countries and has 81,000+ employees.

Manufacturing | ETL | Sustainability Management

**Solution highlights**

Analyzing

**24,000**

$CO_2$ footprints in less than two minutes.

To understand the environmental hotspots of screws, it's necessary to understand their data. Fraunhofer IBP sustainability experts had to prepare the various data for LCA. With millions of data points, it simply wasn't economically feasible to prepare data the conventional way.

They were also faced with a common but serious challenge in data preparation: Blending different data that have no natural link (i.e., no matching columns in the different data tables). This so-called "mapping problem" is common to any LCA project as corporate data on the analyzed product must be enriched with data from external LCA databases. For example, adding representative data for the carbon footprint of a sourced material to the bill of materials of the analyzed product. Such mapping lists are usually prepared manually involving experts from all required domains, which is a time-intensive process that must be automated to scale up LCA on the portfolio level.

## The Solution: Mapping Algorithm for Blending Core Data Sources

Based on the S-DSLC and the automation capabilities of KNIME Analytics Platform, Fraunhofer IBP developed a mapping algorithm that creates matching columns for blending the three core data sources:

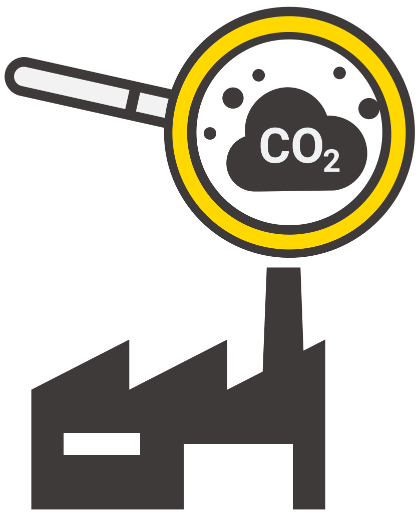
1. The product list (bill of materials) with all product specifications provided by Würth's ERP system
2. Data on how the different screws are produced, stored in 'manufacturing modules' with quantified inputs and outputs for material provision, energy use, and other environmental data
3. LCA-background data from Fraunhofer IBP covering emissions and environmental impacts happening in the supply chains of the sourced materials and energy

The mapping algorithm was a decision tree implemented in KNIME Analytics Platform and constituted the heart of Fraunhofer IBP's modular and scalable solution to LCA of large product portfolios.

All core modules of the solution were implemented as components or metanodes in KNIME. This provided the flexibility to automate all processes; from loading, cleaning, and preparing all data, blending the product list with certain manufacturing models and LCA-background data, and defining the production route per screw. Through to performing all required LCA computations, visualizing results for interpretation by sustainability experts, and preparing the results for deployment at Würth.

## Results: 24,000 $CO_2$ footprints could be analyzed in less than two minutes

Data science approaches and efficient tools for their implementation made all the difference in this project. Not only did this enable efficient understanding of the data and the data preparation process, but it also laid the groundwork for automation and continuous deployment of the developed solution.




The project took approximately six months to implement and involved stakeholders from various domains such as sustainability management, product management, manufacturing, cost engineering, strategic procurement and controlling, as well as upper management.
This investment was worth it. With one click, 24,000 $CO_2$ footprints could be analyzed in less than two minutes. This wouldn't have been feasible with traditional methods, as these are made for manually defining models and production plans. Without data science approaches and tools, this model would have taken years to build.

These results allowed identification of hotspots at both the product portfolio and process levels through high-quality estimates on the product level. The modeling also included ten typical production routes, each including a unique set of processing steps (aka modules). The deep insights generated include:

- Contribution of screws from different production routes to the $CO_2$ footprint of the overall portfolio
- Minimum and maximum $CO_2$ footprint for key production countries
- Median $CO_2$ footprint per production route
- Contribution from modules to the $CO_2$ footprint per screw

The approach also identified gaps in data size and quality. These were identified either in the ERP database or in the relevant LCA data, and through this process were able to be repaired. This was identified as another project win.

The next step for Würth, is to transfer all results and insights into business practice, focusing on three main aspects:

## Outlook

1. Increase measurement and transparency regarding the environmental impact of production processes. Furthermore, identify factors such as production processes or locations to close the circle (of the circular economy). These can then be used as drivers for further transformation.
2. Increase communication and product data transparency to fulfill either specific customer requirements, market requirements, or both.
3. Improve sustainability data and constitute a first framework for evaluation.

## Why KNIME?

There are several advantages to undertaking this approach with KNIME software. Primarily, the process is scalable through the automation of KNIME workflows. This enables Würth and Fraunhofer IBP to remove manual work and enable effective collaboration as everyone can spend their time on more meaningful and creative tasks. Secondly, the model is easy to update due to the modular concept. Users can easily exchange modules, product list elements, and lines in the mapping algorithm without touching other parts of the model. Thirdly, because KNIME workflows are reusable and shareable, this approach can be transferred and applied to other products.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