

# Digital Product Passport for Recycling in the Solar Industry (DPP-RSI)

Degree programme : Master of Science in Engineering  
Specialisation : Business Engineering  
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The global photovoltaic market faces a dual challenge: China's dominant production position and the urgent need for sustainable end-of-life management in Europe. A Digital Product Passport offers an innovative solution to promote circularity and ensure this long-term sustainability. This marked the starting point for the research, conceptualization, programming, and development of a web tool designed to effectively address and mitigate current challenges.

## Problem

The photovoltaic (PV) industry in Europe faces two major challenges: China's dominance and inefficient transparency in the PV value chain. With over 80% of global PV production and costs as low as 50% of European and American production costs, China controls the PV market and has created dependencies for Europe. This undermines Europe's energy security and industrial competitiveness, posing a significant threat to its renewable-energy ambitions. Compounding this issue is a lack of transparency across the PV value chain, which involves manufacturers, installers, recyclers, and research organizations, which hinders transitions to a circular value chain.

## Research Methods

To address this challenge, a web-based tool was developed using a scientifically structured process. Theoretical research and practical applicability were ensured using the rigor cycle as the foundation. A comprehensive literature review of Digital Product Passports (DPPs) in other industries highlighted transferable practices and identified gaps specific to the PV sector. Key stakeholders participated in surveys and interviews, providing critical insights into their data needs and operational challenges. These findings informed the iterative prototyping process, starting with a localhost environment and evolving into a Docker-hosted solution. The use of Next.js, Prisma, TypeScript, SCSS ensured a best-practice web tool.

## Core Objectives and Features

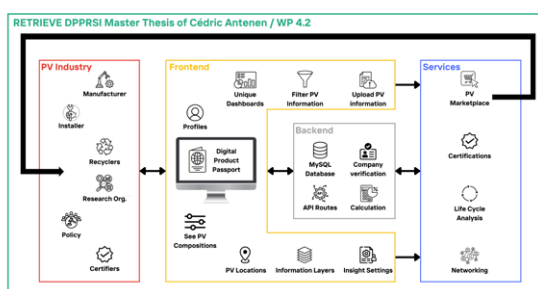
The web tool DPP-RSI was designed to address critical challenges in the photovoltaic value chain by combining clear objectives with robust functionality. It systematically documents the raw materials used in PV modules, thereby enabling enhanced transparency and traceability. To cater to the diverse needs of stakeholders such as manufacturers, installers, and recyclers, DPP-RSI offers tailored data access and usability. Its user-friendly interface bridges the gap between technical and nontechnical users, fostering inclusivity and accessibility. By integrating these objectives with advanced functionality, DPP-RSI enables data-driven decision-making, fosters collaboration across the value chain, and simplifies the processes of module reuse, refurbishment, and recycling.

## Outcome

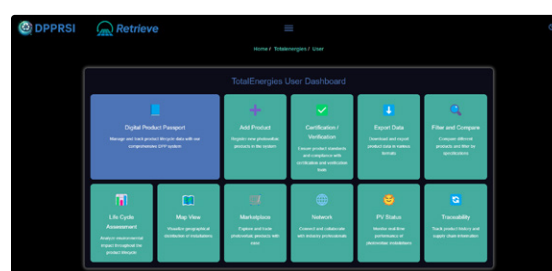
DPP-RSI provides a comprehensive solution for the sustainable management of PV module lifecycles. By centralizing and structuring critical data, the tool enhances resource efficiency, reduces waste, and promotes circular economy practices. It enables seamless collaboration among stakeholders, reducing Europe's reliance on external suppliers and supporting its transition to a more self-reliant renewable energy sector. Ultimately, the DPP-RSI not only strengthens Europe's photovoltaic industry, but also contributes to global environmental protection and the advancement of a sustainable future.



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Digital product passport architecture: PV industry connected with frontend, backend, and services



User Dashboard with all programmed services of <https://retrievedpp.winglabs.ch/>