

## Development of an Asset Database to Enhance the Circular Business Models for the European Solar Industry: A Design Science Research Approach

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**Abstract :** The expansion of solar energy as a means to address the climate crisis is undisputed, but the increasing number of new photovoltaic (PV) modules being put on the market is simultaneously leading to increased challenges in terms of managing the growing waste stream. Many of the discarded modules are still fully functional but are often damaged by improper handling after disassembly or not properly tested to be considered for a second life. In addition, the collection rate for dismantled PV modules in several European countries is only a fraction of previous projections, partly due to the increased number of illegal exports. The underlying problem for those market imperfections is an insufficient data exchange between the different actors along the PV value chain, as well as the limited traceability of PV panels during their lifetime. As part of the Horizon 2020 project CIRCUSOL, an asset database prototype was developed to tackle the described problems. In an iterative process applying the design science research methodology, different business models, as well as the technical implementation of the database, were established and evaluated. To explore the requirements of different stakeholders for the development of the database, surveys and in-depth interviews were conducted with various representatives of the solar industry. The proposed database prototype maps the entire value chain of PV modules, beginning with the digital product passport, which provides information about materials and components contained in every module. Product-related information can then be expanded with performance data of existing installations. This information forms the basis for the application of data analysis methods to forecast the appropriate end-of-life strategy, as well as the circular economy potential of PV modules, already before they arrive at the recycling facility. The database prototype could already be enriched with data from different data sources along the value chain. From a business model perspective, the database offers opportunities both in the area of reuse as well as with regard to the certification of sustainable modules. Here, participating actors have the opportunity to differentiate their business and exploit new revenue streams. Future research can apply this approach to further industry and product sectors, validate the database prototype in a practical context, and can serve as a basis for standardization efforts to strengthen the circular economy.

**Keywords :** business model, circular economy, database, design science research, solar industry

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