Newsletter 8

R3-Mydas ensures the sustainability of the new remanufacturing process in the energy sector

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R3-Mydas enables and accelerates the transition of the manufacturing industry toward more sustainable and circular value chains. To ensure the sustainability of the results, a Safe and Sustainable by Design (SSbD) assessment of the new circular value chains is expected in the three demo cases considered in the project: oil & gas, electric vehicles and wind energy sector.

To develop the study regarding sustainability for all the value chains (VC) along the R3-Mydas Project, a preliminary Life Cycle Analysis (LCA) has been proposed.

The objective of this study is to assess the remanufacturing or repurposing of each Demo-case based on the data collected throughout the project. The results will be compared with those of the current process for each case study within this Project. LCA methodologies included in the SSbD framework were used.

The LCA measures the different impacts of a product, process or system throughout all the phases that are included in the scope. The goal of the assessment is to collect and analyse the system's inputs and outputs to identify potential l impacts and to establish strategies of reduction.

Demo case 1: oil & gas components

In the oil and gas industry, crankshafts are essential components in engines and pumps, providing power to various systems involved in drilling, extraction, and transportation. During these operations, crankshafts are exposed to demanding conditions, like high mechanical loads and aggressive environments, accelerating the wear process.

Any form of damage to the crankshaft, particularly wear, can lead to costly repairs, reduced operational efficiency, and unplanned downtimes. Therefore, in this demo case of the project, the objective is to improve the remanufacturing process, making it more precise, cost-effective, and environmentally sustainable. This will be achieved by using advanced technology to scan the worn-out areas of the damaged crankshaft and create a 3D model. Then, the needed clad layer will be designed and, ultimately, precisely deposited by using the laser cladding technique. This process is explained in detail in Deliverable D2.1.

Accordingly, the value chain for this demo case is the one shown in Figure 1. It is structured in two different parts:

- The classic linear pathway (shown in **black colour**), represents the full sequence of producing a new crankshaft from raw materials, followed by its disposal at the End-of-Life phase.
- On the other hand, there are the circular economy strategies (**shown in green**) proposed for turning the classic process into a more sustainable one. These R-cycles are

reuse, remanufacturing and recycling, depending on the state of the deteriorated crankshaft.

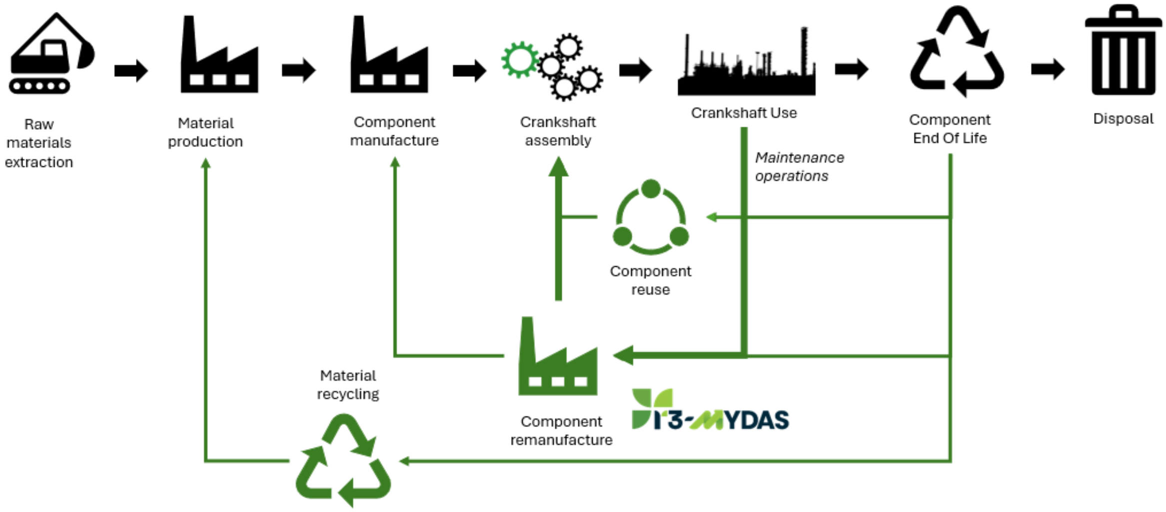

Figure 1. New value chain for demo case 1: oil & gas components.

In this LCA study, an "AS-IS scrap scenario" in which the component is scrapped and the material recycled was compared with an "AS-IS repair scenario" in which the component is remanufactured using a laser cladding process. In the AS-IS repair scenario, the component is given a second life, and the manufacture of a new crankshaft is avoided.

Results and conclusions of the sustainability analysis

This section presents the main results of the preliminary sustainability analysis for the oil and gas demo case, including both LCA and Life Cycle Costing (LCC) outcomes. It compares the AS-IS scrap and AS-IS repair scenarios, highlighting key environmental and economic findings, as well as the main conclusions derived from this analysis.

As shown in Figure 2, the AS-IS repair scenario demonstrates better environmental performance, achieving a carbon footprint reduction of more than 25%. However, the hotspot analysis highlights the significant impact of cobalt in the alloy used for additive manufacturing (AM), which contributes over 10% of the total carbon footprint. Nevertheless, the crankshaft manufacturing process remains more environmentally harmful than additive manufacturing in terms of environmental footprint.

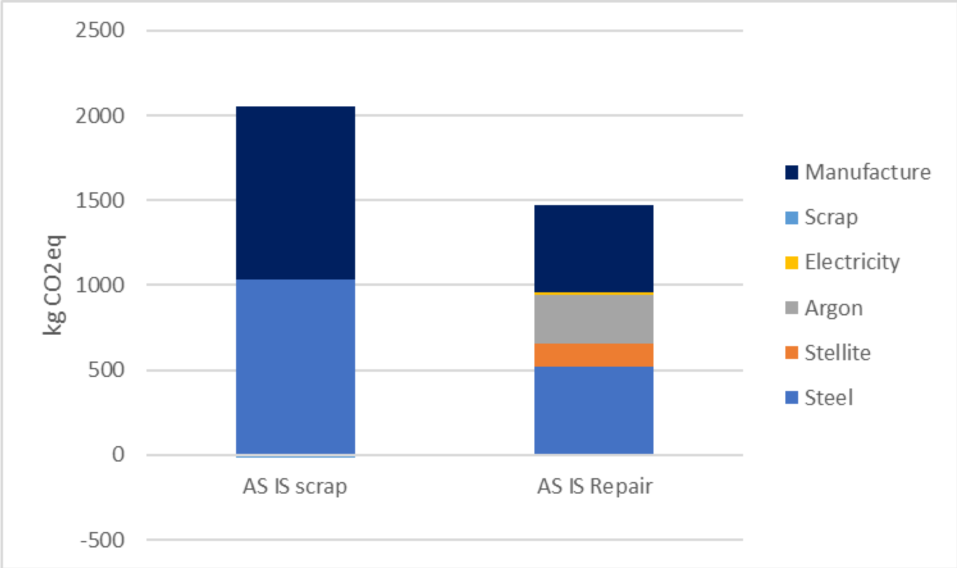

Figure 2. Comparison AS IS scrap and AS IS repair scenarios, carbon footprint.

Figure *3* compares AS-IS scrap and AS-IS repair scenarios, considering the environmental cost, which represent almost 50% of the total cost in each case. In addition to environmental cost, labour and steel are the primary costs in both scenarios, which are lower in AS-IS repair scenario.

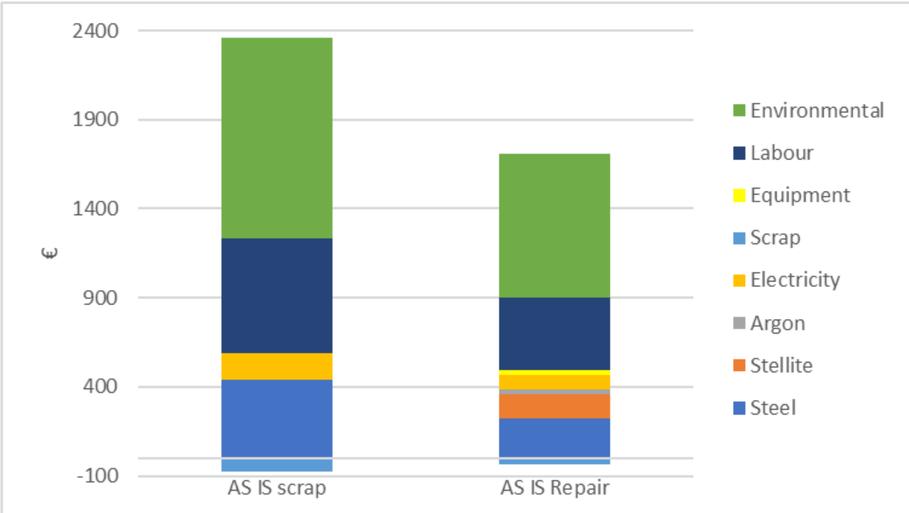

Figure 3. LCC results comparison for AS IS scrap and AS IS repair scenarios.

The results of the initial analysis demonstrate that new circular scenarios are more sustainable than the current linear ones. The reuse, repair and remanufacturing options considered in each demo case appear to offer clear advantages in terms of both environmental and economic sustainability. However, some technical gaps need to be addressed to increase the size of the repair/remanufacturing market, and this is something that R3-Mydas will focus on.

Some general recommendations can be derived from this initial sustainability analysis. In Demo-case 1 AS-IS repair scenario, the main impact is cobalt used as a raw material in the repair process. It would be advantageous to check the technical feasibility of other steel alloys with similar properties to reduce the environmental impact of repair processes. Furthermore, a more efficient process will decrease energy and raw materials consumption and increase sustainability in terms of environmental and cost. R3-Mydas developments could help to achieve this technical feasibility due to new possibilities in the laser cladding process.

More information and results in D5.4, available on R3-Mydas web.

