

ADAPTIVE LAW AND REMANUFACTURE IN THE CIRCULAR ECONOMY

To remanufacture is to restore used products or components to a performance standard which equals or exceeds that of newly produced ones. Remanufacture prolongs lifecycles, reduces demand for materials, lowers emissions, and creates jobs and skills, yet it is fairly uncommon in practice. Technical barriers are to blame in part, but here we focus on the role of governance structures such as laws, liability regimes, and product regulations. At present, the structures in question are intended for a linear make-use-discard economy, and their chief concern is with the first life of products – little provision is made for repair, refurbishment, remanufacture, or re-entry into the market. Two concepts from EU law and scholarship are meant to disrupt this make-use-discard paradigm: Safety and Sustainability by Design (SSbD) and the right to repair.

Safety and Sustainability by Design and the Right to Repair

SSbD actuates the legal principles of precaution and prevention by amalgamating two concepts: Safe by Design (SbD) and Sustainable by Design (SuBD) (Reins & Wijns, 2025). The first, SbD, is about anticipating hazards to human health and the environment and “designing them out” across the lifecycle of the product. First proposed in the mid-20th century and later formalised in initiatives such as the U.S. “Prevention through Design” (Schulte et al., 2008), SbD has been applied in sectors as varied as construction, consumer goods, aviation, and nanotechnology. The other component of SSbD, SuBD, imprints considerations of environmental, social, and economic sustainability into the early stages of design. SuBD aligns with various trends in contemporary EU policy, including eco-design and circularity by design, as reflected in the

Circular Economy Action Plan (European Commission, 2020) and the Eco-design for Sustainable Products Regulation, which came into effect in 2024.

As far as remanufacture is concerned, SSbD gives full play to the objectives of the Union in the domains of safety and circularity. First, repair, refurbishment, and remanufacture are likely to be more viable when products are both safe and sustainable from the outset. Second, modularity and avoiding hazardous substances conduce to longer lifecycles. The right to repair complements SSbD by ensuring that products which are designed to last will last in fact. Owners and their representatives are accordingly equipped with the right to access tools, spare parts, software, and technical documentation in order to repair products. While it is commonly associated with consumer goods such as household appliances, electronics, and vehicles, this right is no less relevant to industrial equipment, high-value components, and complex machinery.

A robust right-to-repair framework rectifies information asymmetries by requiring manufacturers to make pertinent information available to legitimate providers of repairs (Terry, 2019). Furthermore, spare parts must remain accessible for the intended life of the product, while contractual terms and technological measures that obstruct lawful repair, such as software locks, are inconsistent with the right and therefore ought to be banned. The right to repair also supports economic decentralisation by enabling independent repair networks and small and medium-sized enterprises to flourish.

The right to repair operates in tandem with SSbD: design choices make repairs safe and sustainable, while legal rights ensure that repairers may claim to the resources which they need. This synergy is particularly important for remanufacture because disassembly, part replacement, and testing require both a high degree of technical compatibility and unfettered access to technical resources.

The Need for an Adaptive Law

Whatever their merits, SSbD and the right to repair cannot bring about a circular economy on their own. Manufacturing technologies, material sciences, and sustainability priorities change quickly, and the applicable regulatory frameworks aimed at protecting the environment should develop in step (Quintavalla and

Yalnazov, 2025). An adaptive legal approach to SSbD and remanufacture would focus on desired parameters, such as durability, reparability, and environmental performance, rather than staid technical prescriptions. Regular review and collaborative governance are thus of the essence. The various stakeholders which will people the circular economy, such as manufacturers, consumers, and waste-management entities, may have different needs, which a rigid right to repair whose form and substance are set in stone may well fail to meet. The Add-reAM Project, in which both of us are involved, is about this problem. We will first analyse SSbD principles and the right to repair in the context of remanufacture. We will then examine the legal, technical, and policy links between these principles, identify points of overlap and tension, and assess various proposals for reform. Our goal will be to develop a dynamic regulatory roadmap for remanufacture policy that

is not a static compliance checklist but a forward-looking governance tool that is designed to evolve with technology, society, environmental protection and the market.

Conclusion

Traditional manufacturing in Europe, including in the Netherlands, is resource intensive, wasteful, and harmful, and it induces consumers to prefer replacing to repairing. Recycling helps a little, but its outputs are often degraded, and it requires a non-negligible outlay of energy. With national and EU policy now gearing for the ascent of a genuinely circular economy and with additive manufacturing having matured sufficiently to make a real difference (Inayathullah & Buddala, 2025), the time has come to close the knowledge gaps that remain.

The future of remanufacture will be shaped as much by law and policy as by technological innovation. Embedding SSbD and the right to repair into adaptive regulation will allow remanufacture to be scaled across industries. In the last analysis, the three concepts which we adumbrated here reinforce one another: SSbD ensures that products are physically and environmentally suited for multiple lifecycles, the right to repair guarantees that the tools, knowledge, and parts that are needed for those reincarnations are accessible, and adaptive lawmaking generates flexible regulation which develops in synchrony with technology and society. ■



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