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3s2 Monitoring and modelling the transition from linear to circular production chain in the bio-economy

Agent-based modelling of technological innovation systems: the shift towards circular bioeconomy in the organic waste treatment sector

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Waste is an essential part of the circular economy and bio-waste especially has a lot of potential to be valorised further. Consequently, the waste treatment sector requires new technology and business models to deal with waste in a legitimate manner. Since there are a lot of technical studies that often overlook the context and systemic studies that overlook firm-level needs, we argue that there is a need for a systemic approach to analyse technology innovation in the (bio-)waste treatment sector that centres around waste treatment company decision making. Therefore, we built an agent-based model based on data obtained from 10 waste treatment companies and technology experts. The model explores the mechanisms of innovation diffusion for Volatile Fatty Acid Platform technology that can be integrated into current anaerobic digestion plants. With this technology, waste treatment companies can produce volatile fatty acids that can be further processed into, for example, bioplastics, single cell oils or omega-3 fatty acids. This research looks at knowledge exchange between firms, subsidy schemes, potential for market growth of the aforementioned end-products and the potential to increase yields. We found that an optimal combination of social pressure (from other firms as well as broader movements in society), technical feasibility (type of end-product, yields) and economic feasibility (economies of scale, financial support) is required to achieve high levels of technology diffusion. When combining these outcomes with technological innovation systems literature, we found that it is particularly important for the technology to produce marketable end-products or to elicit enough entrepreneurial activity to further create markets. Governments should stimulate market formation and guide the search of technologies into a relevant direction. The circular economy provides a setting for legitimacy of the type of technology considered in our model, but also places the manageability of bio-waste in perspective: a prime objective should always remain to reduce the amount of waste produced where possible.

Keywords: biowaste treatment, innovation adoption, agent-based modelling, technological innovation systems