Using agent-based modelling to explore circular economy behaviours in Scotland

Abstract. Scotland has ambitious targets to achieve net zero carbon emissions by 2045, including a vision to move towards a Circular Economy (CE) [1]. CE involves keeping resources in use for as long as possible, extracting maximum value while in use and then recovering and regenerating products and materials at the end of their life cycle [2]. However, many hesitate to implement CE interventions because of uncertainties of their effectiveness. Agent-based modelling (ABM) is a useful tool to help reduce uncertainties by testing the effectiveness of interventions before actual implementation. Existing models have focused on industrial and technical production-side issues [3,4], neglecting everyday consumption and waste-related behaviours among individuals, households, and organizations. This study aims to explore CE strategies through empirical agent-based modelling of behaviours. As a debut, an ABM will be developed based on the Individual, Social and Material (ISM) framework [5]. In the context of CE, the behaviours could include minimizing resource use, reusing items, repairing, refurbishing, remanufacturing, and recycling remaining materials. The ISM framework will also serve as a guide for analyzing household and individual CE behaviours, employing a combination of nationally representative surveys and individual case studies. Furthermore, the framework will be employed to investigate organizational behaviours through key informant interviews and expert roundtables. In both instances, the study will greatly benefit from the utilization of secondary data. The initial emphasis will focus on three priority items: mattresses, furniture, and household electrical appliances, because they are good examples of problem products critical to comprehending circular behaviours as part of our daily lives. The result of the study will be used to develop intervention scenarios and ABMs of these items. The models will be used to validate our conceptual ABM and evaluate feasibility of the scenarios. Stakeholders will be integrated throughout the lifespan of the study to ensure adoption of a more feasible intervention options. In this regard, the study is invaluable to promote CE behavioural change amongst individuals, households, and organizations. From a scientific perspective, this study provides a valuable collection of first-hand information on CE behaviours, formalizes our conceptual framework, and lays the foundation for the development of an abstract ABM that can be used to explore CE behaviours in Scotland and other regions.

References

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