

Embedding circular economy goals in a smart grid cooperative model

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Extended abstract

Renewable energy generation has been acknowledged to contribute to the Sustainable Development Goals (SDGs) by reducing greenhouse gas emissions and reducing energy dependence on fossil fuels (Strielkowski et al., 2021). Moreover, the Covid-19 crisis, the war in Ukraine, and geopolitical tensions in the Middle East show the vulnerability of the global economy to systemic shocks, urging policymakers and firms to investigate alternatives to reduce our energy dependence on other countries and fossil fuels, towards increasing resilience of our businesses and communities.

The successful proliferation of renewables, however, causes an upcoming waste problem. For solar photovoltaics alone, 60-78 million tons of cumulative waste are anticipated by 2050 globally (IRENA and IEA-PVPS, 2016). Moreover, for some components of renewables, we are dependent on critical raw materials that originate from a very limited number of countries, increasing our geopolitical dependence and vulnerability (European Commission, 2023; Vakulchuk et al., 2020). Therefore, it is relevant to study circular economy strategies for renewables, including high-quality recycling (Chowdhury et al., 2020), remanufacturing (Deng et al., 2021), repurposing (Chen et al., 2023), as well as new business models that

aim at improved maintenance, repair, and reuse of renewable energy sources (Van Opstal and Smeets, 2023), or at sufficiency strategies (Temiz and Dincer, 2023).

To achieve a sustainable circular economy, scholars increasingly point at the importance of creating a circular society as a boundary condition (Calisto Friant et al., 2023; Jaeger-Erben et al., 2021). This concept of a circular society encompasses distributional, participatory, and procedural justice. To make a circular economy work, we should ensure participation of all members of society, enhancing resilience of both communities and businesses. During the last 180 years, cooperatives have been proven to be an organizational form that is able to tackle societal problems while strengthening resilience of its members and their communities (Novkovic, 2022). In the last few decades, citizen energy cooperatives (RESCOOPS) played an important role in increasing social acceptance and attracting financial means for investments in renewables (Huybrechts and Mertens, 2014). Nevertheless, research on the role of cooperatives in a circular transition remains scarce (Ziegler et al., 2023). More specifically, it is not clear why and how cooperative members, who are both using, owning, and governing their cooperatives, would embed circularity goals over a long period of time.

Smart grids have been proposed as a solution for local, digitally enabled renewable energy provision in communities, like those enabled by cooperatives. In this paper, we assess how cooperatives can be designed to embed circularity goals in the governance of a smart grid. A smart grid can be defined as “an electricity network that can intelligently integrate the actions of all users connected to it, in order to efficiently deliver sustainable, economic, and secure electricity supplies” (European Commission, 2006). Smart grids are a complex sociotechnical network, combining novel technologies, behavioural aspects of its users, and different sources of energy generation, storage, and distribution (Wolsink, 2012). Smart grids may increase community resilience, by reducing the risk of power outages, ensuring access to renewable energy for different groups in a community, or even developing services for marginalised community members and civil society organisations (Das et al., 2020; Hotaling et al., 2021; Tarasova and Rohrer, 2023).

Research on the social aspects of smart grids has been identified to be lagging to knowledge development of its technical aspects, resulting in major research gaps on energy democracy and the participation of silent and marginalised actors (Kojonsaari and Palm, 2023). Moreover, to the best of our knowledge, no research has been published earlier on governance aspects of circular economy strategies in smart grids. Therefore, we aim to answer the following research questions:

- RQ 1: What are suitable circular economy strategies for a smart grid? What are barriers and enablers to foster circular outcomes?
- RQ 2: How can a cooperative embed circularity goals in the governance of a smart grid, while safeguarding a profitable business model and enhancing community resilience?

To investigate this, we conduct 30+ interviews with relevant stakeholders of a smart grid project in Zwevegem (Belgium) which incorporates mixed user profiles (including SMEs, associations, and social housing) and multiple technical and regulatory challenges. Stakeholder respondents include owners and inhabitants of the site, local municipalities and public-sector organisations, service suppliers and energy consultants, research institutes, regulatory bodies, citizen energy cooperatives, local and regional civil society organisations, and representatives of projects that gained experience with circular economy strategies in renewables.

Preliminary results on the circular economy strategies involved include rethink strategies by applying alternative technologies that reduce the need for natural resources (e.g., changing to a DC backbone for energy distribution reduces the need for inverters), as well as improved repair and reuse strategies. However, reuse markets for renewable energy generation have been shown to be incomplete and insufficiently mature for deployment in the smart grid. During the process of this project, it became clear that developing and governing the smart grid required identifying an intrapreneur with sufficient degrees of freedom to operate and negotiate in a regulatory rich environment. The envisioned cooperative, designed to govern the smart grid and embed circularity goals, is at high risk of a mission drift in the very short term if its founding members do not embed circularity goals in its governance design.

We discuss managerial and policy implications of our findings, giving attention to practical barriers, enablers, and pitfalls. Moreover, we present and discuss design guidelines for the development of cooperatives that are aimed to govern circular smart grid projects that foster resilience of businesses and the communities they are embedded in.

Keywords

Circular business model, Community resilience, Smart grid, Cooperatives, Governance

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