

# Navigational Agency of Cooperatives Deploying Technology for Circular Economies

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## Abstract

The cooperative identity offers a normative yardstick for transformative change. It implies the democratic control of technology in transitions for just and sustainable circular economies but does not explicitly deal with technology. Since the choice and development of technology is embedded in socio-technical systems, the autonomous choice and cooperative embedding of technology is therefore in question. We explore this challenge as a question of navigational agency, or the capacity of cooperatives to choose and reform practices, and the technologies they involve, in their deployment of circularity strategies. We propose a novel typology of five stances of cooperatives deploying technology for circular economies: adopting technology, recoding technology and asserting alternative spaces as ideal types on a continuum from exported to self-made technology, complemented by political stances of advocacy and conversion to cooperatives. The typology advances the theoretical exploration of a complex, currently understudied topic, while also practically clarifying expectations regarding cooperatives and their capacity to deploy circularity strategies for transformative change.

**Keywords** Cooperatives · Technology · Circular Economy · Cooperative Identity · Agency · Socio-Technical Systems

## 1. Introduction

A growing body of research points to the limitations of the dominant circular economy discourse and its emphasis on technological innovation for green market creation (Calisto Friant et al., 2020). This circular green economy approach faces feasibility issues due to rebound effects in the continued growth logic of capitalist economies and a lack of consideration for the needs of consumers, workers and citizens in their individual and group diversity (Schröder et al., 2020; Ziegler et al., 2023a; Pansera et al., 2024). In response, researchers have focused on the social dimension of the circular economy (Moreau et al., 2017), and both research and policy are increasingly paying attention to organizations that embed circular strategies in the values and principles of the social and solidarity economy. These include cooperatives (Ziegler et al., 2025), work-integration social enterprises (Van Opstal et al., 2024) and the more inclusive and just sustainability transitions they would enable if supported by policy (OECD, 2022).

Given the prevailing “technocentric circular economy” (Calisto Friant et al., 2020), this article explores the relationship between a central organizational type of the social and solidarity economy, the cooperative, and its relation to choice and development of technologies in transitions to more circular economies. Cooperatives are “people-centered enterprises owned, controlled and run by and for their members to realize their economic, social and cultural needs and aspirations” (ICA, n.d.). The cooperative movement has defined a cooperative identity with values and principles that provides them with a “normative yardstick for transformative change”

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in the direction of just and sustainable economies (Novkovic, 2022). However, this identity does not explicitly deal with technology. It thus risks treating technology implicitly as a tool that can simply be used based on the values and principles of its users. And yet, technology is part of complex socio-technical systems (Geels & Schot, 2010). Due to this systemic character, the autonomous choice and use of technology is in question. As we will show, research so far has not theorized this challenge at the intersection of circular economy and cooperatives. Since the more general circular economy research places cooperatives in relation to reformist and transformative approaches focused on social and environmental innovation and a change in practices (Vézina, 2016; Calisto Friant et al. 2020; Gutberlet, 2023; Ziegler et al., 2023a; Rousselière et al. 2024), we chose a practice-based approach to explore the navigational agency of cooperatives in socio-technical systems. We theorize this agency as the capacity of cooperatives to choose and reform practices, and the technologies they involve, in their deployment of circularity strategies. Thus, we ask: *what is the navigational agency of cooperatives in the choice and development of technologies for circularity in socio-technical systems?*

Our exploration of this question enables us to make two contributions. Our contribution to theory is the first typology of cooperatives deploying technology for circular economies: adopting technology, recoding technology and asserting alternative spaces as ideal types on a continuum from exported to self-made technology, complemented by political stances of advocacy and conversion to cooperatives. The typology clarifies organizational choices, the tensions and barriers they imply for advancing circularity and cooperative goals, and how empirical research could advance this complex, currently understudied topic. Our contribution to practice is to clarify expectations regarding cooperatives and their capacity to deploy circularity strategies. We link the cooperative values of autonomy and democratic deliberations to technology choices, and how these are embedded in the multi-level governance of organizations and meta-organizations.

## 2. Method

At the heart of our theory is an abductively developed, novel typology. Before introducing our approach in this section, we first explain our preparatory literature review, which showed that there was no prior theory of cooperative choice of circular technologies, and thereby leading to our abductive, theory-developing approach.

Our preparatory literature review is based on a Boolean search strategy combining a keyword search on cooperatives and associated terms with circular economy and associated terms (see Appendix 1). The search was conducted in English and in French on major platforms such as Web of Science in English and Érudit in French with the support of a librarian in 2023 (see Appendix 1). In 2024, 154 articles were identified and added to PortailCoop, a public, digital library on cooperatives (PortailCoop, n.d.).

We reviewed the abstracts of these articles and used keyword search for theory contributions on the use of technology for circular economy by cooperatives. Since this yielded no results, we turned to the broader construct of socio-technical change to situate our research within this wider topic. Since the general literature highlights the tension between system reproduction and agency possibilities, we then identified research that is conceptually adjacent and thematically relevant to our study to limit the scope of our study. Since the circular economy research on cooperatives emphasizes the importance of social innovation and change in social practices, we chose a practice-based approach to further explore this tension. At this point, we arrived at conceptual closure, since we had identified a distinct approach within the general theme that allowed us to study abductively possible types, while adding further theoretical constructs did not seem to contribute to our approach.

Sections 3 and 4 introduce the literature and prepare our own, novel theory contribution at the intersection of the circular economy and cooperatives. Section 5 presents a theory-based typology to explain this complex phenomenon (Cornelissen, 2017). We aim at a typology that is comprehensive and offers novel insights (Delbridge & Fiss, 2013). While we focus on ideal-type identification, we also offer suggestions for subsequent empirical research. We illustrate our types with mini-cases. To identify illustrative cases, we used the first international survey on cooperatives and the circular economy and preparatory research panels with researchers and cooperators (Ziegler et al., 2025). The data of the chosen cases comes from previous qualitative research, following the methodological proposal of Chabaud and Germain (2006). In addition, we draw on grey literature produced by the respective cooperatives to illustrate how they concretize the cooperative identity when presenting their missions and actions, and on cooperative research insights already available on stance-specific

issues. Where the grey literature on our illustrative cases was in languages other than English, we translated the original texts to English.

While cooperatives follow diverse approaches to technology across sectors, geographies, and sizes, we sought to highlight the coexistence of several heuristic models. This method carries the risk of overlooking certain elements of knowledge and specificities (the principle of focus); it favors a principle of relevance to ensure the proposed typology has a heuristic value; that is, the cases studied were chosen for their heuristic value (Labrousse, 2006). Using our analytical framework and following abductive reasoning (Labrousse, 2006), we identified practices in cooperatives that deploy circular technologies and illustrate different forms of agency in relation to technology. These cases are thus neither inductive nor representative of the cooperative movement in a quantitative manner. Our typology aims at novelty because of the comprehensive bringing together of stances and their relation.

Section 6 critically discusses this typology. While our abductive approach is not based on prior generative axes, we discuss our results in axes that we inferred *ex-post*, thereby surfacing relations between stances, tensions, and limitations.

### 3. Cooperatives, circular economy and socio-technical systems

“A cooperative is an autonomous association of persons united voluntarily to meet their common economic, social and cultural needs and aspirations through a jointly owned and democratically controlled enterprise” (ICA, n.d.). Cooperatives follow the values of “self-help, self-responsibility, democracy, equality, equity, and solidarity” (ICA, n.d.). These are made organizationally relevant by seven principles: 1) voluntary and open membership, 2) democratic member control, 3) member economic participation, 4) autonomy and independence, 5) education, training and information, 6) cooperation among cooperatives (intercooperation), and 7) concern for the community. This definition, values and principles are referred to as the “cooperative identity” (ICA, n.d.). It is widely used by cooperatives and their federations, which are present in all regions of the world with over three million cooperatives worldwide (ICA, n.d.).

Their identity makes cooperatives unique democratic organizations, driven by their members’ needs and controlled by their members (Novkovic, 2008). As a societal project, the cooperative identity informs a socio-political utopia aimed at emancipation through the self-determination of productive activities (Desroche, 1976; Draperi, 2012). Therefore, cooperatives are widely recognized as a social innovation prefiguring democratic practices in markets (Novkovic, 2008; Richez-Battesti et al., 2012) and contributing to environmental innovation (Rousselière et al., 2024, Guerreschi & Zecca, 2025).

However, this normative identity evolves in complex, often countervailing contexts. Cooperative research has focused on the duality of cooperatives as both democratic organizations and enterprises. As enterprises, they must survive in competitive, capitalist environments that put pressure on cooperatives because of the rules, expectations and role models of this environment (DiMaggio & Powell, 1983). The literature speaks of cooperative degeneration (Spear, 2011), as organizations become market-driven rather than responding to the aspirations and needs of their members.

According to principle seven of the cooperative identity, “cooperatives work for the sustainable development of their communities through policies approved by their members” (ICA, n.d.). Since the circular economy is a way to operationalize sustainability for organizations (Geissdoerfer et al., 2017), this principle provides the entry point for the circular economy. In the absence of an internationally agreed definition of the contested concept of a circular economy (Kirchherr et al., 2023; Figge et al., 2023), we rely on an approach that emerged from a stakeholder process involving social economy actors. This approach defines circular economy as a “production, exchange and consumption system aiming to optimize resource use in every stage in the life cycle of a product or service through a circular approach, reduce the environmental footprint and contribute to the well-being of individuals and communities” (Jagou, 2021). The definition highlights both the systemic nature and the social and environmental purposes associated with circularity.

These purposes and how to achieve them are contested matters, yielding a variety of discourses. The dominant discourse of the “technocentric circular economy” (Calisto Friant et al., 2020) aims at sustainable human progress with an emphasis on technological innovation. Technology is seen as a driver of decoupling economy development from environment pressures within capitalist economies. This yields a dominant circular green economy discourse (Ziegler et al. 2023a). Meanwhile, a “fortress circular economy” (Calisto

Friant et al., 2020) aims at resource security via top-down implementation, the national pursuit of migration controls and resource security policies. By contrast “reformist circular society” (Calisto Friant et al., 2020) aims at economic prosperity and human well-being within planetary boundaries but with a focus on the reform of capitalism. Reformism adds a focus on social innovation in the circular economy. Beyond technological novelty, social innovation refers to intentional changes in social practices (Howaldt et al. 2017). Due to their social innovations in democratic organizing, cooperatives are recognized as creating a reformist space, potentially enabling a move from a circular economy to a circular society (Ziegler et al., 2023a). They offer organizational models for a society that shares not only resources but also wealth, power and knowledge through models of common ownership and association. Cooperatives can aim even further at a “transformational circular society” (Calisto Friant et al., 2020), which aims for conviviality and frugal abundance achieved via local production. This calls for world views of a “renewed and harmonious connection with the Earth and their communities” (Calisto Friant et al., 2020). Overall, there is an increase in cooperatives pursuing circularity, with such organizations being relatively active in regenerative sectors drawing on renewable sources (in agriculture, fishery, and renewable energy) and relatively absent from heavy industries (Ziegler et al., 2025).

There is also a growing literature on circular economy and cooperatives with over 150 articles identified by 2024 (PortailCoop, n.d.). However, our review of this literature did not yield a conceptualization of technology at the intersection of circular economy and cooperatives. It did lead to partly related topics. In relation to the digital transformation and the idea of platform cooperativism (Scholz, 2023), cooperatives can bring democratic models to digital platforms to leverage circularity strategies. While platform cooperativism is a topic in itself, it points to cooperatives such as CoopCycle (presented below) that develop technology in an explicit and deliberate manner. Moreover, such examples suggest that the cooperative approach, with its creation of federations and alliances, can use meta-organizing to advance their goals (Cousin & Audebrand, 2023). Similarly, in the domain of climate adaptation, extant research shows that producer cooperatives help farmers with the technology adoption required for climate change adaptation (Zhang et al., 2020). By their identity, cooperatives should be well positioned to cooperate and promote a “socialisation of knowledge” and “alliances” enabling them to develop inclusive innovation for development in socio-technical systems of innovation (Becerra & Thomas, 2017). However, research also strikes a cautionary note, pointing out in relation to platform cooperativism that successful examples of platform cooperatives are rare, and that they face numerous challenges. Therefore, putting into doubt their transformative potential (Bunders et al., 2022). Likewise, producer cooperatives might support farmers in response to climate change; however, that they do so with the goal of a regenerative, circular economy (rather than promoting “linear” technologies of increased use of pesticides and fertilizers) cannot be taken for granted given prevailing, unsustainable agricultural systems (Díaz et al., 2019) as well as low circularity rates worldwide (Circle Economy, 2025).

Since we could not find a conceptualization of technology, circular economy and cooperatives, we zoomed out to the more general literature on socio-technical change for sustainability. In their seminal contribution, Rip and Kemp (1998, p. 338) define a technological regime as “the rule-set or grammar embedded in a complex of engineering practices, production process technologies, product characteristics, skills and procedures, ways of handling relevant artifacts and persons, ways of defining problems—all of them embedded in institutions and infrastructures” (Rip & Kemp, 1998, p. 338). The concept of socio-technical regimes (Geels & Schot, 2010) widens the scope of relevant social groups to include users, policy makers, and special interest groups. Socio-technical regimes are stabilized by various lock-in mechanisms (Geels & Schot, 2010). Large socio-technical regimes around technological artifacts such as automobiles are global, consisting of actors linked and intertwined in value chains. Established actors tend to benefit from the stability and continuity of the regime. Developing the Polanyian concept of embeddedness as dependencies between firms in a business network of product development and production process development, Andersson et al. (2001) argue that active links between firms related to technology are a “decisive factor behind the firms’ ability to absorb new technology from each other.” These have a positive impact on their market performance. In short, the literature on sustainability and technology emphasize the systemic character of technology, which rather than serving as a “tool” is part of a socio-economic system exhibiting path-dependencies in the interest of incumbent players.

However, the stability and benefits of technological embeddedness are not set in stone. “Regime rationalities are by no means stable and monolithic, but subject to contestation and power battles by interested actors and therefore continuously socially constructed” (Fuenfschilling & Binz, 2018). This point is evidenced in rival circular economy discourses. For example, in response to the dependencies created by socio-technical systems, a critical, low-tech position has emerged (Bihouix, 2020). It asserts the priority of certain values

(strong sustainability, autonomy, conviviality) and with it the priority of the ends over the means. As we will see, this has been endorsed by some cooperatives. As a value-driven, normative approach, this example takes us back to the agency possibilities of a normatively defined identity given the pervasive influence of global socio-technical regimes. So how can cooperatives navigate towards more reformist or even transformational models of circular economy? Due to the reformist and transformational emphasis on social innovation in social practices, the next section develops a practice-approach for the exploration of this question.

## 4. A practice-approach to cooperative agency and circular economy

Practice theory is useful for analyzing the relationships between agency and structure, and changes in socio-technical systems (Shove et al., 2012). Tools and technology are an important part of practices because they involve using knowledge and material things in a particular way for a particular purpose (Reckwitz, 2002). Practices create routinized relationships between agents and objects, thereby reproducing socio-technical systems. Shove et al. (2012) distinguish three dimensions in the analysis of practices: meanings, competencies, and materials. *Meanings* refer to symbolic meanings, ideas and aspirations, as well as the social role that people adopt when skillfully using and coping with materials and tools; *competencies* refer to skills, know-how and techniques; *materials* refer to things, technologies, tangible entities and stuff from which objects are made (Shove et al., 2012). Products have no value until they are integrated (or re-produced) into competencies and meanings (Shove & Pantzar, 2005), including the larger socio-technical contexts in which they are embedded. A spectrum ranging from individual to collective understanding of social roles emerges for the analysis of practices and innovation (Welch & Warde, 2015; Welch & Yates, 2018; Spinoza et al., 1997; Ziegler, 2020, pp. 92–97).

A central motivation for creating cooperatives is to meet the needs and aspirations of their members (ICA, n.d.). This purpose provides a central source of *meaning*. Understanding needs, requires *competencies* to provide the respective products and services. Moreover, meeting needs, such as for housing and food, is linked to *materials* and technologies used to transform, maintain, and repair the respective materials. A distinct aspect of cooperative organizing is to approach the meeting of needs as not just a technical matter, but as a political question that should involve the need recipient. This yields the democratic governance at the centre of the cooperative model. Thus, meeting needs, and doing so as a matter of democratic organizing, generates meaning in the most general sense in our context. It is captured by the principles and values of the cooperative identity (ICA, n.d.).

However, it would be misleading to think of cooperatives *as organizations* as the exclusive focus of our exploration of agency. *Individual members* as owners with equal status and voice are at the ethical heart of the cooperative identity. Moreover, the cooperative identity also includes the principle of cooperation with other cooperatives (ICA, n.d.). This leads to the creation of federations, or the *meta-organizational* level of organizations whose members are organizations. The result is a need for a three-level, interrelated conception of individual, organizational and meta-organizational agency. Subsections 4.1. to 4.3. will present such a conception based on a practice approach of meaning, competencies, and materials, and further synthesize the extant literature.

### 4.1. Individual level

Navigational agency at the level of individual cooperative members is the capacity to choose practices and deal with conflicts between and within them. It is the capacity to enter new practices/exit old ones, and to use one's voice to reform existing practices in loyalty to the cooperative identity (Claassen, 2017; Ziegler 2020, p. 21). This definition recognizes the values of democratic agency and the equal voice of members at the core of the cooperative identity, as well as the voluntary adhesion of members. Coop members have a dual role understanding with "voice" complementing their roles as workers and consumers. Owing to voice, the choice and development of technology are in principle open to discussion and contestation. Moreover, since the rationale for creating a cooperative is to respond to shared needs and aspirations, such discussions have a collective, and shared ground institutionalized via the notion of collective ownership.

Cooperatives can foster the navigational agency of their members in multiple ways. Through the creation of a cooperative some *materials become available* for use and benefits; for example, the creation of a renewable energy cooperative enables citizens to choose this source of energy. Via the creation of a cooperative, *competencies* can be acquired and fostered. For example, if the renewable energy cooperative has not only “investor” members but also active members involved in the creation and maintenance of communal energy production as “prosumers.” Similarly, a cooperative can provide a place to repair and design artifacts. The choice of adhesion in such cooperatives enables the practical living of, and loyalty to, the values and principles of the cooperative identity (*meaning*).

## 4.2. Organizational level

Navigational agency at the organizational level refers to the cooperative’s capacity to enter and exit organizational models, and reform existing ones based on cooperative values and principles. Navigational agency, therefore, includes the choice and development of tools and technologies, including their appropriation and rejection. Owing to the democratic embedding of technology in the cooperative organization model, technology must be open to deliberation and contestations by members.

Given the techno-economic directionality of the current circular economy discourse, the cooperative identity is potentially transformative. It can facilitate the creation of new cooperatives, reform of existing ones, and the conversion of private enterprises into cooperatives. To continue our renewable energy example, consider the case of an electricity cooperative established in the early 20<sup>th</sup> century based on coal as a source of energy; but now the members decide to move toward renewable energy provision (Raymond, 2022). In addition, they can improve the circularity of the materials used in existing renewable energy models (Van Opstal et al., 2025). Community members might take over an existing, non-renewable energy provider and convert it into a renewable energy coop, a more general phenomenon of conversion to cooperative, specifically observed in moments of crises (Vieta, 2020).

All cooperatives *prima facie* seek an approach to technology embedded in democratic governance and thus introduce democratic governance competencies along with a focus on materials inspired by circularity strategies. Cooperatives pursuing circularity strategies for example report that democratic governance enables improved problem and need perception, and helps legitimize decisions (Ziegler et al. 2025, p. 8). Due to the above-noted absence of an explicit role of technology in the cooperative identity (level of *meaning*), the choice of technology and contestation of technology call for further exploration and cannot be taken for granted given the constraints and path-dependencies of socio-technical systems.

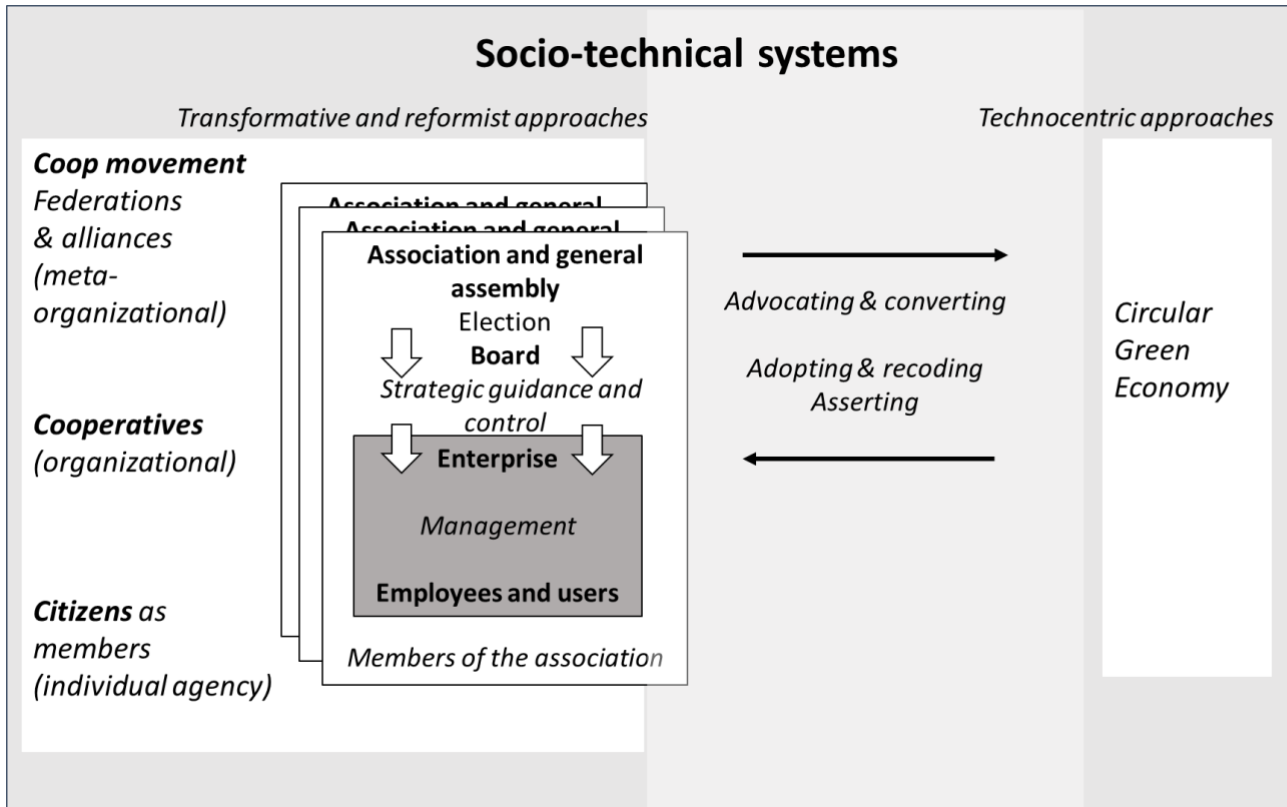
## 4.3. Meta-organizational level

Navigational agency at the meta-organizational level is the capacity to advocate for a set of practices, deal with conflicts between and within them, and to reform existing practices, including educational measures to explain new goals and foster competencies (e.g. principle 5 of the cooperative identity, ICA, n.d.). According to the European School, members of meta-organizations are themselves organizations, whereas according to the North American tradition of research on meta-organizations, they can also include individuals as members (Miller et al., 2025). We adopt the latter, more inclusive tradition since it is practiced by some coop meta-organizations, while agreeing with the European school that the focus remains on organizations. The principle of cooperation with cooperatives (also called intercooperation) in the cooperative identity gives rise to distinct meta-organizations. For example, inter-sectoral federations unite the interests of their members, typically on a territory, to define members’ interests and foster cooperative education (Lévesque, 2016). In between the organizational and meta-organizational, there are often looser, and ephemeral forms of intercooperation. In addition, there are alliances and networks that bring together a diversity of actors, not only cooperatives, but members of the social economy more generally, along a value chain etc. Research suggests that membership in networks can promote acquisition of new technical know-how and a sense of empowerment in relation to technology (Von Jacobi et al. 2019, p. 263).

Historically, cooperative federations have fostered the emergence of cooperative movements (Lévesque, 2016). To continue with our energy coop example, we can think of provincial, national, and supranational energy coop federations, such as REScoop in Europe, which supports its members in the adoption and use of

renewable energy (improving *competencies* and helping with the choice of *materials*). They also lobby for policies (REScoop, 2025) that support a cooperative approach (*meaning*).

In summary of these three levels, Figure 1 offers an overview of our proposed model of the navigational agency of cooperatives within socio-technical systems. On the left side, there is our conception of cooperative agency with its three levels (individual, organizational, and meta-organizational) around the cooperative governance model of democratic decision-making enabling and controlling economic decisions including the choice of technologies. This cooperative sphere is situated within a larger socio-technical system. Given the prevailing technocentric circular economy, we are specifically interested in the navigational capacity of cooperatives to embed circularity into their governance approach. To this end, the next section turns to a novel typology of stances that cooperatives can take, indicated as a bi-directional dynamic between cooperatives and the green economy in Figure 1.



**Figure 1.** Cooperative agency in socio-technical systems

## 5. Typology

This section presents the stances that cooperatives can take when deploying technology for circular economies. The goal of the typology is to simplify a complex phenomenon, and on this basis contribute to the theory and practice of cooperatives as technology users and developers in social change processes toward a circular economy. We draw on our practice-based approach to agency of cooperatives in socio-technical systems to explore agency possibilities and illustrate this for each case with an illustrative case serving our heuristic and not representative purposes.

### 5.1. Adoption of technology

Given the prevailing techno-economic systems and the fact that cooperatives tend not to be technology producers but rather small- and medium-sized organizations, our first stance is *adoption* of technology by cooperatives. Cooperatives use technology for the circular economy, but they do not develop it themselves.

Research shows that membership in a federation can help farmers to adopt technology for climate change adaptation (Wossen et al., 2017; Manda et al., 2020; Zhang et al., 2020) and enable mutualized use of machinery (Ziegler et al., 2023b). The interaction between agency levels (Figure 1) is for example in evidence, when producer cooperatives empower farmers by educating them and making available tools and technologies. An empirical survey of circular cooperatives suggests that the adoption stance is widespread: 49% of respondents reported that they depended on other organizations for technology, with 91% from non-coop providers (Ziegler et. al 2025, p. 10).

- **Illustrative case: Coop Warwick**

Coop Warwick started working in 2021 as the first agricultural cooperative in Québec (Canada) to use organic waste from farmers to produce renewable natural gas via biomethanization and the remaining digestate as a fertilizer for farming. The *meaning* communicated with the project focuses on three main objectives and processes: 1) an emission-reducing and reliable circular economy business model (reusing the waste reduces emissions from agriculture, and revalorizes waste as energy and fertilizer); 2) the regional embedding of the project in an area with many dairy cooperatives and proximity to a natural gas grid; and 3) the governance of coop Warwick based on the participation of the farmers as members and an equitable sharing of benefits among members.

*Competencies* for creating the cooperative were based on meta-organizational support. The project was piloted by Coop Carbone, a multi-stakeholder cooperative created with the support of a large credit union and a large producer cooperative in 2014. Its aim is to “support the fight against climate change and to contribute collectively to the efforts and target projects so that we can accelerate and achieve a solidary, prosperous and green recovery” (Coop Carbone, 2024). Coop Carbone is committed to delivering the project and replicating it in other regions. The *technology* of the project is adopted from Montreal-based private technology companies AST and Dominion and Grimm, a manufacturer of anaerobic digestion systems developed by the German company Lipp, of which Dominion and Grimm are the Eastern Canadian manufacturing agents. An analysis of the cooperative identified a lack of expertise in this biomethanization process as a challenge, necessitating costly support from consultants from abroad (Duroselle, 2024). Still, communications of this project by Coop Carbone focus on the reliability of the technology as one already used across the world, and on social acceptability (such as reduction of odors for people living in the surroundings).

The key *materials* for Coop Warwick are from the above-mentioned private partners for the creation of the *biomethanization* complex, and from the farmer members for the organic waste. The project also relies on two key infrastructures: roads for the delivery of organic waste and digestate and access to a pipeline for the natural gas produced by coop Warwick.

In summary, technology in this stance is used rather than developed in house, and the stance can be characterized in this sense as passive. Nevertheless, technology selection leaves many options open, and cooperatives and meta-organizations play an important enabling role as our example shows. However, technological embeddedness also implies that adoption is not neutral and can enforce mainstream ideas about technology and its organization on cooperatives, or what Young calls “quasi-coercive isomorphism” (Young, 2021). The risk of importing ideas and practices that countervail a cooperative approach is even stronger given that technology is not generally problematized in the cooperative identity. Moreover, the dependence on non-coop providers in the survey suggests a need for alliances beyond coop-to-coop intercooperation. Specifically, larger cooperatives might face supply issues if they seek to create circular value chains (e.g., absence of downstream or upstream partners, or partners that can deliver in sufficient quantities) (GICS, 2023). We propose further research on the risks of adopting technology along with non-coop ideas and meanings about technology, its use and associated competencies.

## 5.2. Asserting an alternative place

*Asserting an alternative place* is a second stance with an explicit conception of technology and choice based on low-tech tools (Bihouix, 2020). It is based on a value commitment to strong sustainability, autonomy, conviviality, and (re)appropriation of tools by users.

Since the goal is to keep tools under the control of users, low-tech is attractive in light of the cooperative identity and its emphasis on member control (ICA, n.d.). In this stance, the cooperative can create space for its users to experiment with less consumerist lifestyles and share skills of making and repairing tools.

- **Illustrative case: The Atelier Paysan**

The multi-stakeholder and farmer technology cooperative The Atelier Paysan was created in 2009 in France. It brings together 150 individuals and organizations, and this around a formulation of *meaning* that is made explicit in relation to technology. In their manifesto titled *Take Back the Land from the Machines* (2021), The Atelier Paysan presents a critical analysis of what it describes as a productivist, industrial, technicist, and export-oriented agricultural system, which contributes to the destruction of farming communities, ecosystems, regional planning, rural employment, health, and food supply. According to the manifesto, the use of high-tech, agricultural machinery makes farmers dependent on engineers, bankers, and digital technology. Agricultural machinery is viewed as an ideology rooted in techno-solutionism and technological lock-ins. The cooperative's project is political and aims at social transformation: "The widespread adoption of peasant agroecology, for a radical and necessary change in the agricultural and food model" (Atelier Paysan, 2024). Their purpose is to "collectively regain technical sovereignty and autonomy through the reappropriation of knowledge and know-how, in opposition to technologies that dispossess" farmers (Atelier Paysan, 2024). The cooperative places the development of low-tech tools in the context of the commons, giving free access to its self-construction guides (for example, arboriculture, which includes instructions on how to build a green manure seeder or a three-point hitch frame, complete with diagrams and user feedback from various regions).

Following the triple perspective of low-tech, commons, and popular education, The Atelier Paysan seeks to nurture *competencies* with a focus on empowering farmers in their work through cooperation and the design of tools adapted to their needs and aspirations, over which they have control. Adopting a low-tech approach, The Atelier Paysan emphasizes the potential of individuals to learn do-it-yourself practices and create the tools they need with the help of self-made manuals and training workshops. For example, they offer tutorial licenses under Creative Commons (CC). Since they aim for a social transformation of the agricultural system, the cooperative goes beyond designing and building tools. This underscores the importance of popular education in changing practices and mindsets by organizing workshops and debates, engaging in collective mobilizations, and conducting advocacy work aimed at constructing arguments to shift power dynamics. In line with the principles of popular education, no specific prior skills are required; instead, the focus is on acquiring new know-how and skills. However, the cooperative acknowledges the challenges of acting alone, and the danger of purist approaches that are not accessible to farmers (Poullot, 2025). Organizing with other organizations is necessary to contribute to social transformation.

For its *materials*, the cooperative remains dependent on the use of iron materials—which originate from mining and often destructive environmental processes—but it strives to reuse second-hand materials. To this end, the cooperative supports farmers in making technical choices regarding the tools they use, aiming for strong agroecology through a bottom-up, innovative, and subversive design approach for machinery and buildings (Poullot, 2025).

In summary, this stance exemplifies a critical approach to technology resonating with cooperative values of autonomy and democratic control. At the same time, the opposition of this approach to the current mainstream, implies a marginal position of this stance. This suggests further research on the likely struggles of cooperatives maintaining and diffusing competencies of making and repairing tools when pursuing this stance.

For this stance to have the desired transformative impact beyond local niches, new meta-organizations and alliances or support from existing ones are needed for the wider diffusion of such ideas in the cooperative movement. For this reason, low-tech circular coop consultants, such as cooperatives offering consultancy services for other cooperatives or social economy organizations more generally (ALTE, 2024; Ziegler et al., 2023b), might play an important role in the wider diffusion of such ideas.

### 5.3. Recoding

This stance develops an active position on technology through practices of reclaiming and recoding technology, securing it as a commons, and including members in technology development.

This stance is of interest given the importance of data for circular economy transformation (GICS, 2023; Blackburn et al., 2022). The last few years have seen an increase in research on platform cooperatives (Scholz, 2023) and data cooperatives (Bühler et al., 2023). This research stresses the role of meta-organization for technology ownership and the development of data (Cousin & Audebrand, 2023).

- **Illustrative Case: CoopCycle**

CoopCycle is a delivery cooperative that emerged as a countermovement to the competitive, capitalist model of digital platforms. Founded in France in 2017, the network has expanded to 12 countries and now includes over 70 cooperatives. The platform enables food delivery and general courier services by bicycle. It is a “federation of bike logistics messengers, making services for themselves and others” (CoopCycle, 2024).

CoopCycle offers a new way to decentralize power on digital platforms. The *meaning* focuses on an increase in the agency of cyclists as autonomous service providers and resistance to capitalist platforms exploiting workers of the gig economy. “We don’t ask for jobs handed out from a gig economy corporations, we make our own” (CoopCycle, 2024). Their empowerment also pertains to the co-design of the platform, which provides the possibility of choice in the development and use of technology. The cooperative identity principles two (democratic member control), four (autonomy and independence) and five (education and training) are specifically in evidence, as CoopCycle is committed to strong democratic governance and solidarity, worker autonomy, and co-creation in technological development.

Digital *competencies* are crucial for the creation and development of this cooperative. The idea and search for an alternative platform were initiated by a software developer. Once the coop reached a certain level of stability, the development and technological skills were professionalized, as this task was transferred from volunteers to more specialized people: “a coordinator and platform developers to replace the work of the initial volunteers” (Fortuny-Sicart et al., 2024, p. 6). There is also an element of technological hacking, in the sense that this cooperative has used (hacked) pre-existing software (Fortuny-Sicart et al., 2024, p. 13) and adapted it to the needs of its members.

The *materials* refer to on the one hand a digital platform for the autonomous organization of delivery services. On the other hand, CoopCycle highlights its contribution to a decarbonized economy, since its services provision relies on cyclists for delivery, including services provision for the carbon-intensive last kilometer in urban deliveries. “We work with local institutions and government bodies to implement cycle-logistics plans and decarbonize urban centers” (CoopCycle, 2024).

In summary, recoding actively appropriates technology and embeds it in democratic governance (such as users owning the code), making decisions on how it is used, what the priorities for further development are, and so forth. We illustrated this with the use of a digitally enabled delivery service, but underscore that such technology appropriation is not limited to digital technology. However, since mainstream use continues throughout (e.g. in our example capitalist service platform providers), cooperatives struggle with a comparative disadvantage in access to capital and might use, but not own, the technologies (Bunders et al., 2022). Thus, this stance suggests further research on cooperatives getting outcompeted when taking this stance, as well as mechanisms that protect recoding.

The last three stances directly focused on the relationships with technology. However, in the spirit of a socio-technical systems analysis, there is also a need to identify complementary political stances, as the next subsections will show.

## 5.4. Conversion to coop ownership

Business conversion to cooperatives is a distinct political stance that shifts the focus to ownership of technology. This stance focuses on member ownership of the means of production as the key to agency.

In research on cooperatives, conversion to coop ownership ranges from militant stances and occupation of factories to non-conflictual hand-over processes (Vieta, 2020; Vieta et al., 2024). Since most businesses are in private hands, the retirement of private owners from the baby-boomer generation is a potentially supporting tendency (Ziegler et al., 2023a). Conversion depends strongly on a supportive ecosystem supporting workers and owners in the process (Vieta et al., 2024), for example coop meta-organizations providing accompaniment in conversion processes. The discussion of cooperative ownership tends not to focus on coop ownership as a strategic option for the choice and development of technologies for the circular economy and is *in this respect* not in conflict with the prevailing technological regime. However, this does not mean that there are no other political conflicts, nor that coop ownership does not have inherent tendencies towards a more circular economy, as our illustrative case will show.

- **Illustrative case: Unión Solidaria de Trabajadores (UST)**

On what was once the largest sanitary disposal center in South America, the cooperative UST was formed as former workers of the center took care of the post-closure maintenance of the site (UST, 2024). “It was its workers, in no small part, that converted the massive Villa Domingo Disposal Centre, once a polluted 400-hectare landfill, into the sprawling ‘ecological green belt’ that now contains more than 40,000 trees (planted by the SYUSA/UST workers over the years), new lakes, and vast green spaces hugging the Rio de la Plata and spanning the waterfront of the neighborhoods of Villa Domingo and Wilde” (Vieta 2020, p. 62). The workers transformed a multinational company into a self-managed cooperative aimed at providing jobs and community development.

The *meaning* of the initiative is derived from the recuperation of the abandoned plant with its waste and polluted landfills, turning them into a green oasis. However, UST not only generates meaning with its ecological improvement, but also offers meaning to workers as they can employ their skills in this green and social project, as members of a cooperative. Moreover, the cooperative uses a part of its surplus “to repay” the neighboring communities for their support in the recuperation process (via “community actions” such as creation of homes, and an agroecological sustainable development centre” (UST, 2024). In other words, it is an integrated process of territorial recuperation, or as the UST puts it: “We know that another world is possible, that work, union, solidarity and collective construction are the most valuable tools” (UST, 2024). In this recuperation process, and the political struggle in the early stage of the takeover (including roadblocks and protest marches), the UST specifically highlights the importance of the (supportive) community of the neighborhood.

About a third of the members of the cooperative are former employees, who bring their skills and knowledge *competencies* into the cooperative (Vieta, 2020). These include skills linked to “blacksmithing, carpentry, masonry and plumbing” (UST, 2024), but within the process, the enlargement of competencies was vital. As the members pointed out, they had to educate themselves to gain the necessary knowledge on modern waste management and landfill conversion to make the transformation of the site possible (Vieta, 2020).

As far as *materials* are concerned, UST members must deal with polluted landfills and the material infrastructure left on-site. In the process, we see a rethinking of part of this material (e.g., efforts to introduce agroecological principles in land use).

In summary, the conversion to coop stance resonates with the basic value of common ownership in the cooperative approach. Moreover, since cooperatives deploying circularity strategies seem to prevail in the bioeconomy rather than industrial sectors (Ziegler et al. 2025), this stance potentially extends the sectoral scope, notably in moments of crisis (Vieta, 2020). We could not find research linking conversion to strategic decisions about circular economy strategies and choice of technology. However, the local embedding and sense of place of cooperatives are stressed in circular economy research (Ziegler et al., 2023a; de Bernardi et al., 2024). Thus, with the circular economy emerging as a policy concept globally, we propose that research on conversion to coop could be further deepened by examining synergies and tensions between conversion and the choice of strategies for circularity.

## 5.5. Political advocacy

This stance complements the prior stances with the role of cooperatives as political actors calling for a transition to just and sustainable circular economies also in the choice and deployment of technologies.

Actors raising their voices for communities and the environment is in line with principle seven of the cooperative identity and its support of sustainability and concern for communities. Coop research on advocacy highlights the political embedding of technology, and its relation to social movements (such as for peace, decolonialization, Janelle & Ziegler, forthcoming). In addition, research emphasizes the role of social economy eco-systems with their networks and meta-organizations for advocacy and representation (Lévesque, 2016).

- **Illustrative case: Commown**

The multi-stakeholder cooperative Commown was created in 2018 by four engineers in France to offer long-term rentals, that is, without the option of purchase, of responsible electronics and digital technology, mainly phones, computers, and headphones. Their offer also includes access to spare parts, a repair service, and help with changing parts via a wiki. The *meaning* of this organization is political and ecological and is rooted in the social economy. It aims at a paradigm shift towards less extraction, decent work, and reduced consumption of technological products (Ballon & Coquerel, 2025; Ballon & Coquerel, forthcoming).

The Commown founders have *competencies*, at the level of master's and doctoral degrees, in engineering or chemistry. The cooperative participates in the training of students in the critical and alternative perspectives on the use of responsible electronic devices advanced by Commown. Through their wiki and blog, the cooperative promotes the development of knowledge and skills for maintaining and repairing electronic devices to ensure the longest possible life for the electronic devices it rents out. In addition, their activist stance requires political *competencies*. Their political ambition translates into lobbying and advocacy work with public institutions, elected representatives and tech companies. One person oversees this work on a full-time basis. Commown has worked with the NGO *Les Amis de la Terre* on a law to improve the reparability and/or reconditioning of electronic devices with a reparability index (Montagut, 2025, p.6). Beyond political advocacy, this work also draws on communication competencies to reach the larger public. Commown is heavily involved in the Licoornes collective, a consortium of cooperatives committed to socio-ecological transition, and in the Fairtech collective behind the free of obsolescence label. Commown contributes a counter-narrative to the technophile discourse; for example, a comic book has been distributed on social networks recounting the adventures of a protagonist in 2064, who has no smartphone in a dystopian society controlled by technology (Commown, 2024).

*The materials* of Commown are phones (such as Fairphone), computers and headphones, selected for their reparability. The cooperative aims at transforming users' relationship with technology: to reinforce their control over the machine and reduce programmed obsolescence, including paying attention to the conditions under which the material is produced (e.g. conditions under which minerals are extracted).

In summary, the advocacy stance highlights the political work needed if technology for a circular economy is governed by democratically organized organizations and responds to citizens' needs and aspirations. Therefore, we propose further research on the complementary role of advocacy in promoting transformative goals of the cooperative identity *in countervailing ideological and political contexts*.

However, an advocacy stance risks losing sight of the dual aspect of cooperatives as also enterprises providing economic services, and the time and resources for developing viable economic models as Scholz notes reflecting on platform cooperativism (Scholz, 2023). The next section therefore turns to a critical discussion of the relation of stances, along with limitations of our method.

## 6. The relation of stances and limitations of the typology



**Figure 2.** Typology of stances

This section revisits the complementarity between stances along two dimensions and then turns to a critical discussion of the implications for research and practice.

We can present our typology of stances in terms of two complementary dimensions (Figure 2): a continuum from externally adopted technology to self-made technology in the upper part of Figure 2; and a continuum of low to high conflict with the prevailing technological regime in the lower part. The upper part provides a space for stances with respect to technology choices as such, presented on a continuum from technology adopted from external supplier to auto-produced technology. The lower part provides a space for the consideration of such choices within regimes that generally call for political advocacy so that cooperatives can make such choices. We present this as a continuum from low political conflict in the case of technology adoption to high political conflict in the case of alternative places for making technology (as for example in low-tech scenarios).

In this part, we also note a coop distinct option of “conversion to coop”, as a basic political economy stance when ownership of production changes to the cooperative model. Since we only observed it in relation to the adoption of technology, we place it on the left side of the continuum. We now revisit the stances, their relations and limits one by one.

Considering the prevailing, techno-centric green economy, an entry point for cooperatives is technology adoption. Cooperatives can purchase technologies provided by non-coop providers and adopt them for their purposes. For example, making tools available in cooperative repair spaces or biomethanization technology for agricultural producers in our Coop Warwick example. Since technology in this stance is not problematized, and remains embedded in larger networks, we can expect isomorphic pressures on cooperatives taking this stance. Technology carries imprints of the “formative environments in which they gestate” (Stirling, 2024), with features such as secrecy, hierarchical authority, and centralization creating a tension with more transparent, democratic and distributed decision-making of cooperatives. While this impact might be most directly observable in the management of cooperative enterprises, Young (2021) points to the risk of meta-organizations serving as a conduit for such coop-external values and norms. An uncritical technology adoption stance risks supporting isomorphic pressures that undermine the distinct qualities of cooperatives and their identity (as observed in the general literature on cooperatives, also beyond technology).

It is therefore noteworthy that, at least in some sectors, notably the digital technology sector, cooperatives take an explicit stance with respect to technology, or what we call recoding. The reshaping of technology is explicitly based on cooperative principles and values. These results contribute to making technology available as commons, co-developed, and co-owned by members. However, such recoding will tend to take place in an overall techno-centric green economy environment, and we would expect circular coops to face similar challenges as platform cooperatives: capital costs and infrastructure remaining in private ownership (Bunders et al., 2022).

Due to the systemic character of technology, and the small and medium size of many cooperatives, adoption, and recoding likely need to be complemented by a political stance of advocacy, if the goal of a transformative yardstick is to be advanced. Federations and alliances, and thus the meta-organizational level, frequently mandated with political advocacy, play an important role in supporting and advancing cooperative agency in efforts of adoption and recoding (Cousin & Audebrand, 2023). However, beyond specific sectors (such as delivery), we could not find coordinated meta-organizational efforts of cooperative federations to support circular economy technology development. We would also expect the increase in political conflict with the prevailing technological regime to reappear in the political advocacy work of meta-organizations. For example, meta-organizations might be torn between support for technology adoption, which is more inserted in the prevailing system and might therefore correspond to members with more funding options for the meta-organization, and support for more reformist or transformational stances toward technology.

An explicitly transformative technology stance is associated with low-tech and degrowth (Bihouix, 2020), captured here as asserting an alternative place. It involves resistance to prevailing techno-centric systems, and an attempt, notably in agriculture, to carve out spaces for the use of tools based on values. This stance provides a laboratory for the cooperative movement, and there are examples of cooperatives providing consultation services, such as Alte Coop, which promotes the diffusion of such ideas to cooperatives, the economy and society. Just as the transformative circular economy discourse more generally (Calisto Friant et al., 2020), this stance appears to be a niche even within the cooperative movement. The interstitial character of such efforts, with their emphasis on values and principles, risks the exhaustion of members, and demands sacrifices (Pel et al., 2023). To foster the goals of this stance, political advocacy plays an important complementary role.

Finally, we identified a special case of recuperation and conversion to cooperative ownership (Vieta, 2020). Such recuperation efforts have the potential to extend cooperatives values and principles across sectors, and research shows its pertinence in times of crises (Vieta, 2020). Research also shows that conversion is promoted by supporting ecosystems (Vieta et al., 2024), where the meta-organizational level of alliances and federations plays a supporting role. However, we could not find evidence of dedicated circular economy conversion programs.

We now turn to a discussion of the limitations of our typology and suggestions for further research to address these limitations in sections 6.1 to 6.3.

## 6.1. Cooperatives, technology and circularity – extending the dialogue

Our typology simplifies the complex reality of cooperative practices. This can obscure situations, in which cooperatives simultaneously adopt multiple stances or shift between them over time. It is a theory-based typology and cannot claim representativeness of illustrative cases. Moreover, the typology draws on both a European and American corpus of scholarship in English and French, as well as illustrative cases from these regions, and is accordingly limited by its scope of literature considerations as well as biased by the respective support conditions (with Québec in Canada for example being known for having an active cooperative and social economy eco-system). However, cooperation and a less destructive relationship with the planet are global topics. There is a need for dialogue between imaginaries of technologies in the global South and North (Maldonado-Mariscal & Hölsgens, 2024). Concepts such as *tecnologia social* (Pozzebón et al., 2021) and *Buen Vivir* open space for this dialogue by pointing out that the specific imaginary of technology within this concept in Latin America is strongly linked to the collective use and benefit of technology and to the creation of open knowledge as a common good (Maldonado-Mariscal & Hölsgens, 2024). More dialogue can contribute to the ongoing discussion of technology in relation to the cooperative identity. Is concern for the community only a matter of sustainable development and preserving “resources for us”, or also of a different, more reciprocal, ecological embedding with lessons from indigenous-led cooperators (Awashish, 2022)? And while this paper was inspired by social innovation and a focus on practices, it would also be possible to extend the dialogue in relation to eco-innovation (Kemp, 2010, Mazzanti & Zecca, 2023) and what drives the implementation of circular economy innovation strategies in “green cooperatives” (Guerreschi & Zecca, 2025).

Beyond meaning and the rethinking of cognitive models, an intriguing technology-specific potential for such dialogue is suggested by research on knowledge commons and technoficing (Qureshi et al., 2022). This research focused on small-scale farmers in India, and their need to have knowledge of new agricultural practices, notably in times of rapidly changing socio-environmental conditions. “Technoficing” refers to a selection of technology that focuses on the needs of the users rather than “on what advanced technologies can achieve” (Qureshi et al., 2022, p. 16). It pertains to both the practices identified and the way they are shared, such as through low-cost videos. The research identified a process of identification of local knowledge, which is often not recognized or perceived as “of the past,” of solicitation of farmers to share their knowledge, of knowledge encoding (in this case via video shooting) and of examination (focus on practices that require minimal capital investments, local resources, and are easy to implement). This process was organized by a not-for-profit intermediary organization. The research suggests an interesting dialogue potential with low-tech approaches, yet here originating with the practices of small-scale farmers in India. It also indicates the potential for coop meta-organizations in the identification and appropriate sharing of knowledge. With this, we would like to turn to practical implications.

## 6.2. Foresight and meta-organizational planning

Our typology shows the limitations and risks of cooperative agency within socio-technical systems. Therefore, foresight approaches that project the cooperative identity as a future desideratum in the choice and development of technologies for the circular economy could be considered. Foresight refers to processes and methods that enable reflection on the future along with strategies and trajectories leading towards anticipated or desirable futures by backcasting (Popper, 2008). Extant coop research has engaged with foresight, notably in relation to the digital transition (Glenn, 2013). Circular economy research has provided foresight studies as well (RRECQ, 2025). However, we are not aware of foresight studies at the intersection of cooperatives and circular economy. The typology of stances would provide a starting point for strategic foresight work with cooperatives on transition pathways inspired by the cooperative identity.

Such work could strengthen cooperative meta-organizations, which in the form of sectoral and inter-sectoral federations exercise a distinct yet ambivalent cooperative agency (Lévesque, 2016; Young, 2021). Extant circular economy research suggests that foresight exercises could be useful to add or deepen meta-organizational activities such as setting material agendas, facilitating new relationships among organizations, and facilitating digital platforms (Miller et al., 2025) in their respective regional or national contexts. For example, coop federations can identify sectors of cooperative strength and associated material flows (as in agriculture). They can use member events and communities of practices to facilitate relationships; they might specifically draw on the recent movement of platform cooperativism (Scholz, 2023) to explore opportunities of platforms focused on the exchange and reuse of materials and tools (Blackburn et al., 2022); and they might

use existing accompaniment for new cooperatives (such as for legal and marketing matters) to promote circular coop options (Ziegler et al., 2025).

Foresight activities would also enable meta-organizations and cooperatives to identify skills and training needs within a sector or across the cooperative movement beyond short-term interests and concerns. A research project on social economy organizations and the green transition in France identified communication and awareness raising skills, skills to understand complex interactions, and the relationship between social economy operation and green transitions as key priorities (Micheaux et al, 2024). This research noted that many of these skills are covered by existing courses but are not necessarily offered in a way that is accessible to members of social economy organizations.

### 6.3. From meta-organizing to a meso-critical space?

We close with a suggestion for further theoretical work linking agency to space. French regulation theory offers an analytical framework to study the capacity of cooperatives to constitute socio-economic subsystems, which differentiate themselves and become autonomous, in relative terms, from the dominant capitalist system (Bodet et al. 2026).

Historically, worker and multi-stakeholder cooperatives have developed new organizational structures and learning processes, promoting the democratization of work and consumption through practical in-act critiques of dominant governance modes. Associations of cooperatives support social innovation in terms of democratization, new rules and conventions, and modifications of regulations and legislation (Ballon & Celle, 2023). Extant research on the creation of “meso-critical spaces” in France and elsewhere (Bodet & Lamarche, 2020) could shed light on the capacity of cooperatives to develop technological stances in relation to an integrated, territorial organization consistent with a social and circular economy, to take on roles as sectoral architects (Cousin & Audebrand, 2026) and to construct prefigurative discourses that critique prevailing socio-technical systems (Bodet et al. 2026).

## 7. Conclusion

So, what about the navigational agency of cooperatives in the choice and development of technologies for circularity in socio-technical systems? The coop identity provides a transformative yardstick for change (Novkovic, 2022). Cooperatives aspire to offer democratically governed technology. They test and deploy technologies to meet needs and aspirations, and in intercooperation they seek to advance socio-economic change, thereby enriching the plurality of pathways towards transitions to just and sustainable economies. However, research also highlights a prevailing technocentric discourse (Calisto Friant et al., 2020) and the systemic nature of technology embedded in prevailing practices, putting into doubt autonomous choice and transformative agency. This paper therefore proposed a typology of five stances that cooperatives can take in relation to technology.

Future research could use this typology through qualitative and quantitative studies to test our stances and proposals for further research. It could explore why cooperatives choose stances or change stances over time, the socio-economic impact of these stances, and compare those with those of private and public enterprises. It could promote North-South dialogues re-examining technology in the light of alternative meanings and practices.

Our central contribution to practice is to problematize the question of technology, which we argued remains largely implicit in discussions of the cooperative identity. Due to the systemic nature of technology, our contribution can help clarify expectations and agency possibilities. Given the distance between cooperative values and the prevailing socio-technical contexts, cooperatives and their members should anticipate risks. Since reformist circular cooperatives occupy a niche in current circular economies, with transformative low-tech a niche within the niche, we suggest that foresight approaches might enable the exploration of transition pathways linking the transformative cooperative identity, as a desideratum to progress towards, to starting points from existing socio-technical systems.

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## Declarations

**Competing Interests** The authors declare no competing interests.

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## Appendix 1: Literature review

The key word research strategy employed a Boolean search combining circular economy and associated terms with cooperatives and associated terms. Terms were chosen in preparatory research to identify key words used by researchers. The key words were used in both English and French.

This yielded the following key word search strategy that we used in different variations depending on the platform:

*("économie circulaire" OR "circular economy" OR "économie verte" OR "green economy" OR "responsabilité sociale" OR "social responsibility" OR "investissement responsable" OR "responsible investment" OR (recycl\* AND "waste management") OR (recycl\* AND "gestion des déchets") OR "justice sociale" OR "social justice" OR "entrepreneuriat social" OR "social entrepreneurship" OR "développement durable" OR "sustainable development" OR "protection de l'environnement" OR "environmental protection" OR "environment protection" OR "responsabilité environnementale" OR "environmental responsibility" OR écoconception OR ecodesign OR eco-design OR "consommation et approvisionnement responsable" OR "responsible consumption and procurement" OR "optimisation des opérations" OR "optimization of operations" OR "réduction des ressources" OR "resource reduction" OR "économie collaborative" OR "collaborative economy" OR "économie de partage" OR "sharing economy" OR "économie de fonctionnalité" OR "economy of functionality" OR revente OR réparation OR valorisation OR "écologie industrielle" OR "industrial ecology") AND (cooperative\* OR "coop" OR "coops" OR "co-op" OR "co-ops" OR "co-operative" OR "co-operatives" OR mutuelle\* OR "mutual association" OR "mutual associations" OR "mutual company" OR "mutual companies" OR "mutual corporation" OR "mutual corporations" OR "mutual society" OR "mutual organization" OR "mutual organizations" OR "mutual organisation" OR "mutual organisations" OR "credit union" OR "économie sociale et solidaire" OR "social and solidarity economy" OR "entreprise collective" OR "entreprises collectives" OR "collective entreprise" OR "collective enterprises" OR "entreprise d'insertion" OR "integration entreprise" OR "entreprises d'insertion" OR "integration entreprises").*

The literature search included peer-reviewed data banks such as Web of Science. To improve the inclusiveness of results, we also included larger search engines such as Google Scholar. The following databases were used:

- Web of Science
- Emerald Insight
- ScienceDirect
- Wiley Online
- ABI/Inform Collection
- Érudit
- Business Source Complete
- ProQuest Central
- Google Scholar

The data-based search was conducted by Sandrine Julien in 2023, a librarian working for the digital library on cooperatives, the PortailCoop. Following the convention of PortailCoop, which seeks to include all research on cooperatives, we did not have a time limit for excluding research before a certain time. Following a verification of results by the lead author, articles were imported to PortailCoop, a digital library that enables a keyword search of all materials on the platform.