Entrepreneurial strategies for transformative change: An application to grassroots movements for sustainable urban water systems

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1. Introduction

The sustainability transitions and innovation literature increasingly acknowledge the potential of local agency in driving transformative change through social and technological innovation (e.g., Van Oers et al., 2018; Seyfang and Longhurst, 2016). Given the required capacity for facilitating collective action and initiating local transition processes, so-called grassroots movements can act as such change agents (Seyfang and Smith, 2007; Smith et al., 2014). Grassroots movements composed of committed individuals and collective actors, can respond to unmet local interests or values such as sustainable development, and provide protected spaces for local knowledge to drive novel, bottom-up solutions (Smith et al., 2014; Seyfang and Smith, 2007).

So far, research on grassroots movements in the context of sustainability transitions has predominantly focused on investigating how movements are created and how they impact the setting up of, e.g., energy cooperatives (Bomberg and McEwen, 2012; Magnani and Osti, 2016), alternative food networks (Kump and Fikar, 2021; Gernert et al., 2018), local waste management schemes (Weber et al., 2018), or sustainable consumption (Grabs et al., 2016) and low carbon communities (Middlemiss and Parrish, 2010). This research has highlighted why some grassroots movements are particularly successful in configuring urban infrastructure systems (Wolfram, 2016). However, how actors involved in grassroots movements develop and implement new ideas, technologies or practices have gotten limited attention in the literature on sustainability transitions and grassroots movements (Kump and Fikar, 2021; Barnes et al., 2018; Gorissen et al., 2018), not least in the context of transitioning urban water systems.

We contribute to the literature on sustainability transitions and grassroots movements by providing a novel conceptual framework for investigating the activities of actors engaged in grassroots movements and by interpreting them as (combinations of) different entrepreneurial strategies. We specifically add insights to the role of individual and collective agency, which is often neglected in the sustainability transitions literature (Koistinen et al., 2018). To address agency in our analysis, we draw on the institutional entrepreneurship literature, combining the entrepreneurial strategies concepts by Battilana et al. (2009) and Hung and Whittington (2011). According to our framework, actors engaged in grassroots movements challenge the institutionalized status quo by articulating their ideas of a social or technical innovation (*framing*), amassing the necessary resources (*aggregating*), activating allies and collaborators (*mobilizing*) and coordinating external relations to diffuse new ideas and practices (*networking*). Therefore, we investigate how actors engaged in grassroots movements use combinations of *framing*, *aggregating*, *mobilizing* and *networking* activities to initiate successful bottom-up projects and thereby contribute to achieve transformative change. In doing so, we enrich the extant literature on entrepreneurial strategies, using inductive coding to derive additional activities of strategies from our empirical analysis, providing fine-grained insights into how the strategies of grassroots movements function together.

We address these questions by analyzing the case of *Coopérative Equilibre* (henceforth *Equilibre*), a housing cooperative and part of a grassroots movement for sustainable urban water systems in Switzerland. As a crucial and exceptionally successful example of a bottom-up process for transitioning water infrastructures in the urban

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area of Geneva, we trace how *Equilibre* managed to implement non-grid wastewater reuse and source separation technologies at multiple housing projects. The integration of such technologies into conventional water infrastructures can increase the resilience and flexibility for coping with growing urbanization, climate change and related extreme events (Dunn et al., 2017; Larsen et al., 2013). Moreover, by reusing valuable resources, the technologies are able to close urban water loops, creating an overall more sustainable urban water system (Oral et al., 2020). In spite of the technologies' advantages and availability, public authorities in Switzerland - as well as in most high- and middle-income countries - continue relying on centralized management and large-scale infrastructures for the provision of water services (Eggimann et al., 2018; Kiparsky et al., 2013). Grassroots movements can thus play an important role in promoting transformative change toward sustainable development (Purtik et al., 2016).

2. Conceptual framework: grassroots movements and entrepreneurial strategies

Grassroots movements are collaborative undertakings, characterized by a high degree of participatory decision-making and flat hierarchies, using local knowledge to drive novel, bottom-up solutions around a shared cause (Smith et al., 2014; Seyfang and Smith, 2007; Oteman et al., 2017; Gernert et al., 2018). Research has shown that bottom-up processes involving the interests and ideas of local actors are increasingly relevant for sustainability transitions as they provide a space for social and technological innovation (Wolfram, 2018; Huang, 2019). Successful bottom-up solutions fostered by grassroots movements can generate important learnings and demonstration effects for further projects and thereby contribute to transformative change towards sustainable development (Seyfang and Smith, 2007; Oteman et al., 2017; Gernert et al., 2018). This way, grassroots movements impact the wider society by inspiring others to replicate the innovative ideas and practices (Grabs et al., 2016; Kump and Fikar, 2021).

The successful implementation of social and technological innovations, however, also depends on how actors engaged in grassroots movements manage to create and diffuse societal change. The sustainability transitions literature on grassroots movements has identified multiple potential strategies that can be used for understanding actors' activities. For instance, Grabs et al. (2016) mention that grassroots initiatives are *providing narratives*, *spreading ideas* or *maintaining good relations with external actors*. Oteman et al. (2017) highlight *forming coalitions and collaborations* and *lobbying* as important strategies. Gernert et al. (2018) identify similar activities (*construction of shared visions*, *diffusion of knowledge* or *building bridges between actors*) and additionally mention *attracting and retaining participants*, *mobilizing resources* and *networking with the wider society*. Reeves et al. (2014) highlight the importance of network activities such as *organizing public meetings*, *inviting members of local organizations* and *submitting a press release to local media outlets*. Innovation research identifies similar activities of grassroots movements, such as e.g. *framing as a process for meaning production* and *mobilization for transforming the spaces of innovation* (Fressoli et al., 2014), *learning processes to gain skills and knowledge* (Hossian, 2016; Ornetzeder and Rohracher, 2013; Bradbury and Middlemiss, 2015), *capacity building to involve communities for new practices* and *the*

development of supportive networks (Singh et al., 2020), which are important for scaling up innovations (Hossian, 2016; Wierenga, 2020). Despite mentioning single activities, neither sustainability transitions nor innovation studies provide a framework for systematically describing the activities of actors in grassroots movements.

However, the described activities could qualify actors engaged in grassroots movements as institutional entrepreneurs, who use entrepreneurial strategies to initiate changes that diverge from the institutional status quo of established rules, norms and practices and actively mobilize resources for the implementation of these changes (Battilana et al., 2009).[1] Contrary to institutional entrepreneurs, the initiation of institutional change is not a prerequisite for being a grassroots movement. Bottom-up solutions might be introduced to enhance the quality of life of the communities in which grassroots movements are embedded without any scaling effect (Gernert et al., 2018; van Lunenburg et al., 2020). Nonetheless, due to the conceptual overlap between grassroots movements and institutional entrepreneurs, entrepreneurial strategies can serve as a useful concept for systematically describing and deepening the understanding of the actors' activities within grassroots movements. We therefore expand on the strategies of actors engaged in grassroots movements discussed by the sustainability transitions and innovation literature by additionally drawing on the institutional entrepreneurship literature, including both the innovation and institutional theory strand. We propose to cross-fertilize both research fields by combining the *Framing, Aggregating and Networking* (F.A.N.) framework (Hung and Whittington, 2011) applied in innovation studies with the institutional theory-induced two-step model of institutional entrepreneurship strategies by Battilana et al. (2009). Although both concepts mention the development and articulation of *framing* strategies, they differ in terms of the other strategies. Hung and Whittington (2011) propose the strategies of *aggregating* resources and *networking* with external actors, while Battilana et al. (2009) acknowledge the aggregation of resources only as part of the *mobilizing* strategy for recruiting allies and collaborators. As we find examples for all four entrepreneurial strategies in the sustainability transitions and innovation literature on grassroots movements (see Table 1), added value is created by combining both entrepreneurial strategy concepts within a novel framework. We take the *framing* strategy from both concepts, the *aggregating*, and *networking* strategy from Hung and Whittington (2011) and the *mobilizing* strategy from Battilana et al. (2009), using the strategies as main categories for our framework. To specify the activities for each strategy, the institutional entrepreneurship literature is combined with the sustainability transitions and innovation literature on grassroots movements, which we outline below.

2.1. Entrepreneurial strategies: framing, aggregating, mobilizing and networking

2.1.1. Framing strategy: creating meaning

Grassroots movements typically need to first provide an idea or narrative of necessary change (Grabs et al., 2016) to initiate the re-interpretation of the (local) environment (Hung and Whittington, 2011). According to the institutional entrepreneurship literature, such a narrative can be communicated by using diagnostic, prognostic or motivational framing, which can be expressed through literary devices,

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[1] Due to their social objectives, grassroots movements are not comparable with commercial entrepreneurs. However, there seems to be some similarities between grassroots movements and social entrepreneurs (such as the intention to address social challenges), which has led to efforts to combine both concepts (e.g. Becker et al., 2017; van Lunenburg et al., 2020). Nonetheless, we exclude the social entrepreneurs literature due to the lack of a clear definition (van Lunenburg et al., 2020) or systematic framework for analyzing strategies and due to the concept's stronger economic focus compared to institutional entrepreneurs.

Table 1

Grassroots movement activities mentioned in the sustainability transitions and innovation literature and their categorization as entrepreneurial activities.

Activities mentioned in the sustainability transitions and innovation literature	Entrepreneurial Strategy
• *Providing narratives, spreading ideas (Grabs et al., 2016)* • *Constructing shared visions (Gernert et al., 2018)* • *Framing as a process for meaning production (Fressoli et al., 2014)*	Framing
• *Mobilizing resources (Gernert et al., 2018)* • *Learning processes to gain skills and knowledge (Hossian, 2016; Ornetzeder and Rohracher, 2013; Bradbury and Middlemiss, 2015)* • *Building capacities to involve communities for new practices (Singh et al. 2020)*	Aggregating
• *Forming coalitions and collaborations (Oteman et al., 2017)* • *Attracting and retaining participants (Gernert et al., 2018)* • *Organizing public meetings (Reeves et al., 2014)*	Mobilizing
• *Maintaining good relations with external actors (Grabs et al., 2016)* • *Lobbying (Oteman et al., 2017)* • *Diffusing knowledge (Gernert et al., 2018)* • *Building bridges between actors (Gernert et al., 2018)* • *Networking with the wider society (Gernert et al., 2018)* • *Inviting members of local organizations (Reeves et al., 2014)* • *Submitting a press release to local media outlets (Reeves et al., 2014)* • *Developing supportive networks (Singh et al. 2020)*	Networking

e.g., rhetorical means, symbolic language, metaphors and analogies (Battilana et al., 2009; Rasmussen et al., 2017). A number of authors describe interactions between activities associated with diagnostic and prognostic framing: diagnostic framing relies on the activity of delegitimizing the existing institutions by highlighting their failings. Prognostic framing builds upon diagnostic framing by legitimizing the proposed changes, presenting them as advancement of the institutionalized status quo (Suddaby and Greenwood, 2005; Fligstein, 2001; Rao et al., 2000). While these two framing activities are oriented to change opinions, motivational framing is more action-focused, relating to activities of mobilizing others by providing convincing reasons for supporting a vision (Rasmussen et al., 2017).

2.1.2. Aggregating strategy: aggregating resources

To induce the support of the relevant actors, grassroots movements need to access resources (Gernert et al., 2018; Hossian, 2016), such as material, symbolic or organizational resources (Battilana et al., 2009; DiMaggio, 1988; Hardy and Maguire, 2008). Aggregating financial means may be necessary, as financial resources can cover additional or negative costs resulting from the proposed changes or to convince actors in the first place (Greenwood et al., 2002). Besides aggregating financial means, using resources related to actors' social position have been found to play an important role in initiating as well as promoting change (Battilana et al., 2009). For instance, with the resource of knowledge, grassroots movements broker or even leverage collaboration among diverse actors, which according to the institutional entrepreneurship literature generates collective action for change (Battilana et al., 2009; Maguire et al., 2004).

2.1.3. Mobilizing strategy: activating allies and collaborators

Transformative change also requires the support of others, meaning that a key activity for grassroots movements, just like institutional entrepreneurs, is to mobilize participants, allies and collaborators (Reeves et al., 2014; Battilana et al., 2009). Maguire et al. (2004) stress the importance of connecting the proposed ideas to the activities and interests of others, ultimately creating a collective identity (Rao et al., 2000). Pushing for novel ideas and practices "outside the mainstream" necessitates actors to gain support from diverse actors (Van Oers et al.,

2018; Geels, 2010). To do so, grassroots movements need to build bridges between different identities (Oteman et al., 2017; Gernert et al., 2018), potentially creating consensus through reorganizing preferences and aligning interests among actors (Maguire et al., 2004; Hardy and Maguire, 2008).

2.1.4. Networking strategy: coordinating external relations

To make an impact on the broader society, an important activity for grassroots movements could be to coordinate external relations and create "community momentum" (Kirwan et al., 2013; Hossian, 2016; Grabs et al., 2016). For institutional entrepreneurs, networking involves brokerage and lobbying activities outside their own context to diffuse new ideas and practices (Burt, 2005; Fligstein, 2001). Through outreach and education activities, such as e.g., organizing public meetings and participatory forums for involving citizens (Weber et al., 2018), inviting members of local organizations and submitting press releases to local media outlets, (Reeves et al., 2014), grassroots movements diffuse new ideas and practices and empower other citizens. This is an important step for upscaling and transcending the local context (Gernert et al., 2018; Hoppe et al., 2015). Table 2 summarizes the four strategies and related activities.

2.2. Combinations of strategies and interaction with local context

Entrepreneurial strategies can build upon each other by being applied in a non-linear order or in an overlapping manner (Jolly and Raven, 2015; Hung and Whittington, 2011). The strategies can combine in synergistic but also conflictual ways. For instance, the *mobilizing* strategy might profit from particular *framing* activities: through using "collective action frames", which are shared sets of action-oriented beliefs that motivate actors to defy the institutionalized codes in support of proposed changes, inter-actor relations can be initiated and sustained (Benford and Snow, 2000; Fligstein, 2001; Dorado, 2005).

Another example for a potential interaction between strategies might be observable in the case of limited access to resources, e.g., expertise knowledge (Kooij et al., 2018). Grassroots movements could gain resources through *networking* activities with e.g., universities, technology developers and local authorities, highlighting the link to the *aggregating* strategy (Seyfang and Longhurst, 2016). Connecting and experimenting with other innovators and resourceful actors also facilitates acquiring e. g., ideas and legitimacy (Burt, 2005; Fligstein, 2001). However, *aggregating* such resources through *networking* might in return necessitate a convincing *framing* strategy (Hung and Whittington, 2011; Gorissen et al., 2018).

Besides interactions between the entrepreneurial strategies, the different strategies might also interact with the local context. Grassroots movements are embedded in and affected by the local context, in terms of an institutional framework that might impact a movement's choice of strategies and its overall success (Oteman et al., 2017; Smith et al., 2014; Håkansson, 2018). For example, depending on the position in a community, it might be easier for certain actors to mobilize others and promote their discourse (Phillips et al., 2004; Fligstein, 2001), affecting *mobilizing* but also *aggregating* efforts. Especially trust and legitimacy from local actors are needed resources for mediating different interests (Gernert et al., 2018), motivating others (Reeves et al., 2014) and

Table 2

Entrepreneurial strategies and the expected activities.

Strategy	Expected activities
Framing	• *Delegitimizing the status quo* • *Justifying new practices* • *Motivating support*
Aggregating	• *Amassing financial means* • *Using resources from social position*
Mobilizing	• *Activating allies and collaborators*
Networking	• *Coordinating external relations*

negotiating support for new ideas (overcoming "liability of newness") (Fligstein, 2001; DiMaggio, 1988; Maguire et al., 2004; Geels, 2010; Van Oers et al., 2018). Moreover, *framing* activities have to connect to some degree to familiar designs, frameworks or discourses to legitimatize and ensure the "institutional fit" of the proposed ideas, upholding some level of conformity with established interpretations and worldviews (Oteman et al., 2017; Dacin et al., 2002; Glynn and Abzug, 2002). Consequently, grassroots movements need to relate to local narratives, cultural frames and identities in their activities (Wolfram, 2016).

Fig. 1 illustrates the interplay between the grassroots movements' ideas and envisioned practices, the strategies and the desired outcome in the form of implementing the proposed solutions. These solutions can then provide input into transformative change for the broader society, as others can learn from these ideas and practices.

3. Research design and method

To study how the strategies of actors engaged in grassroots movements unfold, interact or adapt to local context, we focus on a group of project managers working for the Swiss housing cooperative *Equilibre*. As part of a grassroots movement, *Equilibre* promotes alternative ideas and practices (e.g., shared economy or sustainable management of resources such as energy and water) through its housing projects and provides essential resources as well as context for civic engagement (Fine and Harrington, 2004; Seyfang and Smith, 2007).

3.1. Case study approach and empirical setting

We choose a case study approach due to the complexity of sustainability transitions, where the context affects the case in a real-world situation with many uncontrollable variables (Yin, 2014). As the case study approach enables analytic generalization rather than statistical, the sampling is theoretical (Eisenhardt and Graebner, 2007), where the case is selected because it can illuminate a specific phenomenon, in our case, on the bottom-up process of social and technological innovation through actors engaged in grassroots movements. Through an initial exploratory interview campaign with 13 different actors engaged in the grassroots movement (e.g. with consultants, housing cooperatives, researcher and public servants) pushing for the development and implementation of decentralized water technologies, we identified *Equilibre* as a crucial case (Bennett, 2008). *Equilibre* has been one of the first housing projects to install unconventional wastewater technologies in Switzerland. The case is also a success, as *Equilibre* managed to install non-grid wastewater reuse and source separation technologies in multiple housing projects and attempts to diffuse them by sharing knowledge and experience with actors across Switzerland (e.g., other housing cooperatives, municipalities or interested individuals). There is no other case that has been as successful in implementing and diffusing non-grid wastewater reuse and source separation technologies (Coppens, 2018). Through the analysis of this case, we identify combinations of strategies that matter for actors engaged in grassroots movements to successfully enable change. More precisely, we can say something about which strategies - that our conceptual framework claims to matter - are not necessary for the case to be successful. However, we are unable to exclude that other cases could still be successful, although some of the strategies we observe to matter are absent. Our analysis of the successful case of *Equilibre* have more of a theory-building character rather than hypothesis-testing and suggest more precise hypotheses based on the application of our conceptual framework on the empirical case.

We need to be careful with the generalization of our results also because our case is influenced by specific context conditions, besides the combinations of strategies used by actors engaged in the grassroots movement. The Swiss wastewater sector is dominated by large-scale infrastructure solutions with a centralized management, and is therefore generally unsupportive of new and decentralized technologies, which is reflected in the enforced connection to the centralized sewerage

system (Eggimann et al., 2018). Additionally, Switzerland lacks national laws and norms guiding municipalities and regional governments on how to handle urban projects intending to use unconventional (non- or small-grid) wastewater technologies (ibid.). This also means that in the federal context of Switzerland municipalities and sub-state governments have quite some freedom in how to organize their wastewater systems, and that there is potentially an important decision space for trying out alternative approaches (Hanger-Kopp and Palka, 2022). Participation by different types of actors - including grassroots movements - is rather typical in Swiss local and regional governance (Ingold et al., 2010). The sub-state of Geneva is more environmentally friendly and advanced in terms of strategies and policies tackling sustainable development in comparison to other Swiss sub-states, as indicated e.g., by the Green Party winning the most mandates and its candidate receiving the most votes in Geneva during the last election for the lower and upper house of the Swiss parliament in 2019. The political identification with the Green party highlights the ascribed importance of environmental issues for the people of Geneva, which also shows in their voting behavior in national referenda on environmental issues (e.g. the "green economy"- (No. 605), "fair food"- (No. 621) or the "nuclear-phase out"-initiative (No. 608)), receiving approval rates above the national average in general.[2]

Equilibre stands out as a particularly active actor for advancing sustainable ideas and practices such as e.g., using wastewater technologies for recovering valuable resources such as water and nutrients like nitrogen and phosphorus. The cooperative was founded in Geneva in 2005 by a group of eight families who envisioned an own housing project with high social and environmental standards (for more information on *Equilibre* see Appendix 1). The first project *Cressy* was finalized in 2011 and soon further projects followed such as *Soubeyran* (2012–2017) and *Les Vergers* (2012–2018). For all three projects, *Equilibre* realized its own socio-ecological ideas, implementing different non-grid wastewater technologies, such as compost dry toilets, vermicomposting filters or phyto-purification systems; and in the case of *Soubeyran*, this even included an ambitious wastewater concept in the form of a circulatory system (e.g., the locally purified water is stored in a 20,000-L rainwater tank, which feeds the toilets of the building) (further information on the technologies can be found in Appendix 2).

Especially the planning office of *Equilibre* (internally referred to as "bureau") had a pivotal role in choosing technological solutions for the wastewater of *Equilibre*'s housing projects. The planning office was founded in 2012/13 in an effort to professionalize *Equilibre* (before it was run on a voluntary basis), which was a requirement for winning the call for tender for the *Les Vergers* project. Currently, it employs six project managers,[3] who are also at the same time cooperative members and residents, that are responsible for project acquisition, development (including the proposition of technological solutions), implementation and supervision once projects are finalized. Moreover, they directly interact with future residents and authorities, facilitating participation and bridging different interests and expectations. In this capacity, the project managers realized their idea of using non-grid wastewater technologies at their housing projects.

3.2. Data collection and analysis

Constructing the case consisted of multiple steps: First, we collected data through documents (including statistics, legal documents and the

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[2] Further information on the referenda can be found here (only available in German, French or Italian): https://www.bk.admin.ch/bk/de/home/politische-rechte/volksabstimmungen.html [05/06/2020].

[3] The planning office also employs an accountant, who was not interviewed due to the lack of involvement in the housing projects' planning process. The projects managers are environmental engineers by training. In order to guarantee the interviewees' anonymity, we do not assign profession or gender, referring to the manager as *"he or she"*.
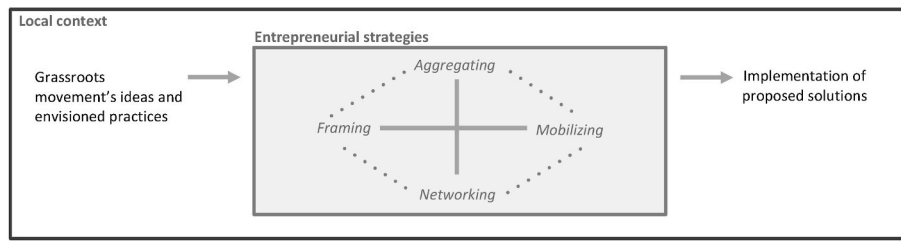
Fig. 1. Illustration of how grassroots movements' strategies translate the movements' vision for change to actual implementation (adapted from Battilana et al., 2009).

website of *Equilibre*) that provided us with information on the housing cooperative, grassroots movement and the influence of the local context such as the political system of Switzerland. In order to gain deeper insights on the actors engaged in grassroots movement, their activities and the local context within which they are embedded, we conducted interviews, for which we developed a semi-structured interview questionnaire based on our theoretical assumptions. To answer our research question, we followed a purposive sampling strategy (Yin, 2011), selecting interviewees which are 1) engaged in *Equilibre* and thus within the broader grassroots movement in Geneva and 2) directly responsible for choosing and implementing water technologies within *Equilibre*'s housing projects. We therefore interviewed all the actors involved in implementing Equilibre, which is the six project managers of Equilibre. There are no further employees or managers involved in the project. We conducted the interviews between November and December 2019 and between June and July 2020 (see Table 3). We refrained from interviewing other actors, such as public authorities or other cooperative members, as we wanted to understand the internal strategies of Equilibre from an emic perspective (Morey and Luthans, 1984).

Due to the planning office's horizontal organization and decision-making structure, the project managers are familiar with all the housing projects and therefore, all finished sub-projects – *Cressy*, *Les Vergers* and *Soubeyran* – were included in the analysis. Although usually two employees take over the lead for a project, the strategies for the projects are quite similar due to the regular consultations and close coordination within the planning office. Nonetheless, certain strategic elements were adapted due to different contexts, for instance, the *Cressy* project had a smaller number of residents and dwellings compared to *Les Vergers* or *Soubeyran*, which enabled a more extensive exchange with future residents. Any differences of the strategies are explicitly mentioned during the discussion of the findings in the next section.

While the first two interviews were conducted in person, the additional interviews had to take place via *Zoom* or phone due to Covid19. The questions were structured into seven thematic blocks, addressing the housing projects' development process, the motivation behind using non-grid wastewater reuse and source separation technologies as well as the interactions with residents and public authorities. The interviews

were particularly important for retracing the project managers' activities throughout the development process, especially in regard to the planning, approval and actual operation of the wastewater technologies. The interviews were conducted in German[4] and English, recorded and transcribed. We thus collected data on what the project managers did, which they did not necessarily perceive as entrepreneurial strategies. We then used the four entrepreneurial strategies as a conceptual framework to assess the project managers' actions.

In the second step, the interviews were coded in the QDA-software f4analyse (F4analyse, 2019). We used thematic coding and categorizing, which allowed us to code statements in the transcript that are linked to particular themes and clustered into categories (Gibbs, 2007). The main categories and corresponding themes were derived deductively from the literature, using Table 1 as basis. We then inductively identified and described the actual activities (codes) and linked them to the expected activities (themes) as part of the entrepreneurial strategies (categories). Additionally, we created new categories and themes to code statements on the local context and the actors' background and motivation (see Appendix 3).

In order to analyse the relationships between the categories and how they link the actors' ideas and envisioned practices to the actual implementation of the proposed solutions, we applied process-tracing in the last step (Beach and Pedersen, 2013; Bennett, 2008; George and Bennett, 2005). By reconstructing the qualitative case study through the interviews, we focused on the process between the observable variables, in our case the different activities, interpreted as strategies (independent variable) and the actual implementation of the proposed solutions (dependent variable), taking into account the local context. Using the theory-testing approach of process-tracing, we applied our conceptual framework (Fig. 1) to an empirical case, in order to refine the approach and specify the categories (Beach and Pedersen, 2013).

4. Analysis

In the following we show how *Equilibre's* project managers succeeded to implement non-grid wastewater reuse and source separation technologies in all of the cooperative's housing projects. As early users and producers of these technologies, the project managers could use the lack of regulations and norms regarding such technologies, providing them with the space to negotiate meanings and practices, implement novel ideas and to pursue changes. They did so by creating lighthouse projects that could potentially inspire others to realize similar projects:

> 'With the alternative toilet systems, in the beginning a lot of people thought that is was completely crazy to do what we did -and now we get councils of little towns, which come to see if it possible to make the same thing in their town' [Interviewee 4].

Typical for a grassroots movement, *Equilibre's* project managers also

Table 3
Interviews conducted with Equilibre's project managers.

Interviewee	Location	Date	Duration
Interviewee 1	Soubeyran (Geneva)	2019/11/22	1 h 06 min
Interviewee 2	Soubeyran (Geneva)	2019/11/22	1 h 48 min
Interviewee 3	Via telephone	2020/06/26	55 min
Interviewee 4	Via Zoom	2020/06/29	57 min
Interviewee 5	Via Zoom	2020/07/10	59 min
Interviewee 6	Via telephone	2020/07/12	57 min

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[4] In the case of the German interviews only the most relevant statements, which contained information on the assumed observable manifestations, were translated into English by the author.

intended to initiate a larger societal transition:

> 'At *Equilibre*, we are very keen to share what we do … We really want to become an actor of the transition for new economy, new society, reducing the consumption of energy and waste' [Interviewee 3].

4.1. Entrepreneurial strategies in the case of equilibre

Table 3 summarizes our findings, structured along the four strategies. We find that most of the entrepreneurial strategies occurred as described in Section 2.1. However, not all activities were applied to the same extent and additionally, some additional activities were identified, such as aggregating knowledge through interpersonal relationships with scientific institutes (cf. Table 4). Moreover, we identified certain interactions between the strategies and found the local context to have impacted the strategy choice (see Section 4.2 and 4.3).

4.1.1. Framing strategy

Grassroots movements as well as other change agents usually problematize and delegitimize the status quo as a prerequisite for justifying the introduction of alternatives or innovations. However, *Equilibre*'s project managers largely refrained from criticizing the established sociotechnical system and from excessively using motivational framing. The project managers only indirectly criticized the ongoing reliance on large-scale wastewater infrastructures by highlighting the benefits of non-grid technologies compared to the established infrastructures. For instance, using the "locality" frame, the project managers underlined how non-grid wastewater technologies support a more local economy by keeping water on-site and re-circulating it (according to Interviewee 1). In line with this, the project managers used the "nexus" frame to motivate support for non-grid wastewater reuse and source separation technologies by linking them to other issues such as nutrient recovery and nutrition. This was identified as an important issue for the residents, which was then linked to nutrient recovery using alternative technologies:

> 'Food clearly came up as an issue … which in the end includes the reuse of excrements' [Interviewee 1].

Linking non-grid wastewater technologies to the residents' matter of the heart potentially fostered their implementation.

Moreover, they portrayed *Equilibre*'s housing projects as "experiments" or "living labs", which potentially increased the stakeholders' acceptance, as it does not sound too radical or extreme. Experiments are intended to generate knowledge and framing a project as such stresses its usefulness for society, while also suggesting its reversibility e.g. in case of a technical malfunction. According to multiple interviewees (Interviewee 1 and 2), the impression of "reversibility" seemed particularly important for convincing future residents and authorities of non-grid wastewater technologies, which was ensured by upholding e.g. the obligation to connect. For this reason, the toilets that were equipped with a *cacarousel*[5] in the *Les Vergers* project also have an installation for a regular connection in place (according to Interviewee 2).

Another justification frame is "people's will", which justifies the installation of non-grid wastewater technologies with the future residents' wish to use them. For instance, one interviewee elaborated on that by saying:

> 'Just imagine we would have dictated that to them. If then something goes wrong, they would come back to us [asking] 'what did you do there?'. If they [residents] are included and contribute ideas, then it is really their system [alternative wastewater system] and not ours' [Interviewee 2].

The project managers present themselves as enactors of the

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[5] *Cacarousel* is a toilet with an individual vermicomposting system in-situ.

Table 4
Process-tracing results of the entrepreneurial strategies in the case of *Equilibre*.

Strategy	Expected activities	Actual activities
Framing	● *Delegitimizing the status quo*	*Delegitimizing frames:* - "Locality": Presenting the conventional approach as less holistic than on-site treatment of wastewater
	● *Justifying new practices*	Justifying frames: - "Living labs"/"Experiments": Signaling no radical transformation; goal is the generation of knowledge - "Reversibility": Ensuring the return to conventional approach remains possible; higher acceptance by residents and authorities - "People's will": Presenting the intention of using alternative wastewater technologies as the future residents' wish
	● *Motivating support*	Motivational frames: - "Nexus": Linking alternative wastewater technologies to other issues e.g. urban farming
Aggregating	● *Amassing financial means*	Financial means: - Acquiring smaller subsidies from foundations and municipalities - Covering costs through a credit with loan guarantees by the sub-state of Geneva (up to 95%)
	● *Using resources from social position*	Resources from social position: - Securing legitimacy and trust from future residents *Knowledge*: - Activating knowledge through universities, technology developers
Mobilizing	● *Activating allies and collaborators*	*Exchanging with members of the housing cooperative:* - Involving members and future residents by organizing open forums; used for issue prioritization - Engaging members and future residents to work on particular issues by organizing working groups - Informing and mobilizing residents by organizing regular information evenings and use of online platform
Networking	● *Coordinating external relations*	Networking with public servants: - Less necessary; interactions with public servants already during call for tender *Networking with universities* - Collaborating with scientific institutions e.g. Swiss Federal Institute for Technology in Zurich (ETH) and in Lausanne (EPFL), University of Geneva *Networking with technology developers* - Collaborating with developers of alternative wastewater technologies *Giving guided tours (e.g. public servants; schools) and interviews:* - Diffusing new ideas and practices - Recruiting new members and residents outside the own context

residents' will, which on the one hand diverts responsibility to the residents and on the other hand awards the managers with additional legitimacy for their entrepreneurial activities.

4.1.2. Aggregating strategy

Equilibre's project managers mainly aggregated knowledge and financial means for realizing their ideas. Although the aggregation of financial means may matter for other grassroots movements, we find that this only played a subsidiary role for the project managers. The costs were largely covered by bank credits with loan guarantees by the sub-

state of Geneva:

'What we have in Geneva is an incredible advantage: the state gives us guarantees for credits, credits up to 95%' [Interviewee 1].

Securing the financing for the non-grid wastewater technologies was also not an obstacle (according to Interviewee 3 and 6), as the extra costs resulting from the installation of such technological solutions (compared to regular connection costs) did not make a large difference for the overall costs of *Equilibre*'s housing projects. Nonetheless, the project managers aggregated some smaller subsidies from private foundations, municipalities and additionally, they were awarded some prize money by the sub-state of Geneva.

Aggregating knowledge was essential for convincing the future residents and authorities of non-grid wastewater reuse and source separation technologies. This was challenging due to the lack of knowledge and guidelines, especially regarding nutrient recovery and fertilizer production:

'It [implementation of nutrient recovery and fertilizer production] lacks knowledge, not only here but in general' [Interviewee 2].

Consequently, *Equilibre*'s project managers aggregated the necessary knowledge themselves by cooperating with their personal network, consisting of universities, technology developers and other grassroots movements.

Besides trust, the project managers perceived legitimacy as an important resource. To secure it, they involved the residents as soon as possible in the planning process:

'And when we have a rough plan, we go to the authorities and present that. But we already start to consult the residents and to do some preliminary decisions, because they are actually the ones that have to use that [the technologies] later' [Interviewee 2].

The legitimacy derived from the future residents' support of the project managers' ideas, reassured authorities of the resident's acceptance of unconventional technologies, but also gave *Equilibre* a better negotiation position.

4.1.3. Mobilizing strategy

Equilibre's project managers used the *mobilizing* strategy especially through activities such as meetings with members and future residents for initiating and sustaining collective action. By doing so, they make the link between the future inhabitants, the architect, the sub-state of Geneva, the administration and council of the cooperative (according to Interviewee 4).

The project managers organized working groups focusing on particular issues, where interested members or future residents could participate and contribute their ideas. For the *Les Vergers* project, the entrepreneurs organized almost every two months information evenings, where all the working groups presented what they have worked on and what they plan on working on (according to Interviewee 2). Some of the working groups have continued their meetings even after the projects were finalized. Usually, the project managers stay in contact with the residents (e.g. providing training or guidance), who ideally adopt a permanent active role by taking on responsibility and ownership, confirming the importance of sustaining collective action:

'We want to facilitate and encourage participation, and we really ask people to take part in some way. They don't have to come to every meeting, they don't have to be always there on every subject. But we except from people to take part in the project [development] first and then take part in the collective life in the buildings. So, it is really … I would say self-management by the people' [Interviewee 3].

4.1.4. Networking strategy

The project managers connected with different external actors for implementing their envisioned unconventional wastewater

technologies. For instance, *Equilibre* coordinated with multiple scientific institutions for running together research projects on the implemented technologies, such as the Swiss Federal Institute for Technology in Zurich (ETH) and in Lausanne (EPFL) or the University of Geneva (mentioned by Interviewee 1), and also activated their wider network, working together with the developers of such systems.

Networking with public servants played a less important role, as they already had the necessary backing from relevant actors. Even the interactions with the water department, which has to authorize the use of non-grid wastewater technologies, were unproblematic due to the relationship of trust between project managers and the public administration:

'Everything that has to do with water … actually is not such a problem … We actually talk [directly] with the director of the water department. He knows us well' [Interviewee 2].

According to Interviewee 2, the authorities even foster the development of a "cooperative culture", as they see in cooperatives the potential to re-vitalize neighborhoods, a wish that is sometimes even officially stated in the call for tenders and the respective scope statement:

'The scope statement really stated that they are searching for cooperatives, who animate the district' [Interviewee 2].

Therefore, housing cooperatives are increasingly involved in the district planning, becoming an essential part of the Geneva's spatial development concept. However, there were also specific issues such as e. g., composting or nutrient recovery, which faced more political resistance due to the lack of rules and guidelines, complicating the mobilization of certain public servants:

'No one knows [the rules], it is like a legal grey area. That means that somehow it depends … on the person that receives your dossier' [Interviewee 2].

This shows potential for policy change i.e., to ensure policy coherence beyond the goodwill of single public servants.

Another *networking* activity was the provision of guided visits to the housing projects, an offer that has been taken up by schools and authorities. This way, the project managers were able to have an impact outside the cooperative e.g., spreading their ideas, potentially inspiring other people to realize similar projects (Interviewee 4), which was also facilitated using media:

'Now for two years, every year we appear multiple times on TV, in the newspaper. There is always more, it is really exponential' [Interviewee 2].

4.2. Interactions between strategies

Equilibre's project managers applied different strategies in a non-linear order to realize their idea to use non-grid wastewater reuse and source separation technologies at *Equilibre*'s housing projects. Some of the strategies overlapped, benefitting from each other by producing synergistic effects between them. As examples, we elaborate on three key interactions that we observed between the strategies (see Fig. 2).

4.2.1. Interaction I: mobilizing - aggregating - framing - networking - mobilizing

Meetings with members and future residents represent an activity that links to all four strategies, providing evidence for interactions and for the non-linear application of the strategies. Besides using the meetings for the mobilization of actors, the project managers tried to aggregate support for their ideas (*aggregating* activity) by ensuring coherence between what the residents value and want, and the project managers' wish to introduce non-grid wastewater technologies (DiMaggio and Powell, 1983). Moreover, the meetings were also an
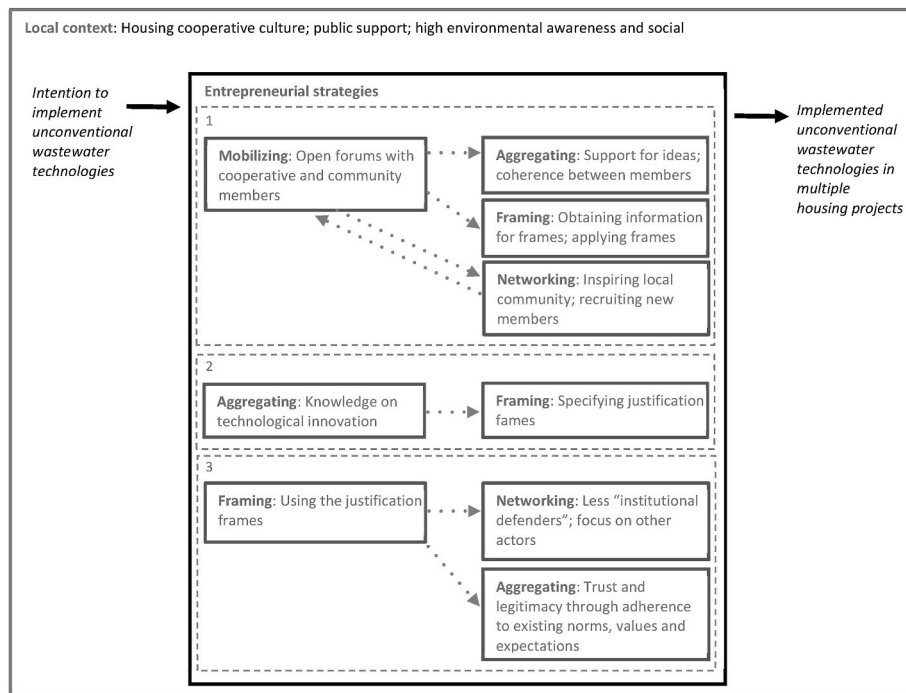
Fig. 2. Illustration of interplay between the entrepreneurial strategies in the case of *Equilibre* (own illustration).

opportunity to obtain useful information for the *framing* strategy, as members were asked to determine the issues that are important to them, allowing the specification or adjustment of the strategy. Additionally, the meetings also provided a platform for testing or applying the *framing* strategy. Through organizing open forums, *Equilibre* was also able to network with the local community, which is essential for inspiring others to replicate such projects (Grabs et al., 2016), but also for recruiting and retaining new members, which is beneficial for the *mobilizing* strategy. Consequently, the other strategies profited from the *mobilizing* activity of meetings with members and future residents.

4.2.2. Interaction II: framing - aggregating

There was also an interaction between the *aggregating* and *framing* strategies, as the latter profited from the aggregation of knowledge. This interaction was especially important due to the lack of official guidelines and experience with non-grid wastewater reuse and source separation technologies that apply water recirculation or nutrient recovery in (sub-)urban areas. For instance, the generated knowledge on the advantages of such technological solutions helped to specify the justification frames. It might have even impacted the success of the *mobilizing* and *networking* strategies, as it installed trust (Sotarauta and Mustikkamäki, 2015). Hence, the application possibilities of the aggregated knowledge demonstrate how the outcome of one strategy can be used as input for other strategies, again suggesting the non-linear application and interaction between the strategies.

4.3. Interaction III: framing - networking

Another example for an interaction is how the *networking* strategy was impacted by the focus on justification frames in the *framing* strategy. As already mentioned, *Equilibre*'s project managers used primarily justification frames, connecting with the prevailing designs, logics and discourses of the established socio-technical system (Dacin et al., 2002; Glynn and Abzug, 2002). This less confrontational approach impacted the *aggregating* strategy, creating legitimacy through adherence to existing norms, values and expectations (Bergek et al., 2008). Consequently, public authorities did not need to feel threatened, fearing the hollowing out of the state or consequences for the established power

distribution (Edelenbos, 2005). Thus, the public authorities remained open for new ideas and refraining from acting as "institutional de-fenders" (DiMaggio, 1988; Levy and Scully, 2007).

4.4. Interaction between the entrepreneurial strategies and the local context

In our analysis we find the grassroots movements' strategies profited from the local context. The movement's ideas were met with a largely positive attitude by the relevant stakeholders, indicating some fit be-tween the new ideas and the institutional system, which is referred to as "institutional fit" (Oteman et al., 2017). The local context enabled a non-confrontational approach regarding the articulation of new ideas and practices and therefore, *Equilibre*'s project managers refrained from delegitimizing the institutionalized status quo and from using action-inducing framing. For instance, framing non-grid wastewater technologies as compatible with the centralistic logic of the established wastewater infrastructure generated comprehensibility and resonance with the values and identities of stakeholders (Suddaby and Greenwood, 2005). One strong value in this context seems to be the people's overall strong environmental awareness in the sub-state of Geneva (according to Interviewee 3). Consequently, due to the general acceptance of sus-tainable projects and through the project managers of *Equilibre* under-standing the "pre-existing place-based conditions" (Håkansson, 2018), the cooperative faced less opposition for their proposed changes. This local context or regional specificities interacted with the strategy choice and impacted the project's success.

Despite the lack of a regulatory framework that supports the implementation of unconventional water technologies, the sub-state authorities of Geneva were (and still are) supportive of *Equilibre* and its intention to use non-grid wastewater reuse and source separation technologies. As part of a grassroots movement, *Equilibre* profited especially from being a housing cooperative. Due to the existence of a "housing cooperative culture" in Geneva (as stated by Interviewee 3 & 6), the project managers faced favorable conditions for their ideas, requiring less networking work with public authorities, and instead focusing their efforts on other actors. This level of political support cannot necessarily be found in other Swiss sub-states. For instance, in

the sub-state of Zurich, a similar grassroots movement that pushed for alternative water systems being used in new buildings did not receive political backing by the local authorities, which emphasizes the importance of the interaction of grassroots movements with formal politics (e.g., Weber et al., 2018). In contrast, *Equilibre*'s new ideas and practices are incrementally impacting the sustainability policy of Geneva, as local authorities stimulate such movements by providing financial support and temporary useable spaces (Wolf et al., 2018). An explanation could be that the authorities' see the need for active citizens to "own" sustainable development (Young, 1997), acknowledging the role of housing cooperatives in generating momentum for bottom-up transition toward more sustainable societies (Gernert et al., 2018; Purtik et al., 2016). However, as *Equilibre* and other actors that are part of the grassroots movement still receive exemptions for each single project, policymakers could enhance coherence through broader policy changes in order to use the full potential of such "catalytic agency" ().

5. Conclusions

This article provides an in-depth analysis of how a grassroots movement can use entrepreneurial strategies to implement socio-technological innovations, shaping local communities and potentially the broader society. Our results show how the housing cooperative *Coopérative Equilibre* in Geneva (Switzerland) acted as part of a grassroots movement pushing for change by implementing non-grid wastewater reuse and source separation technologies. Most importantly, and in contrast to existing literature (Suddaby and Greenwood, 2005; Rasmussen et al., 2017), we find that in our case, the actors largely refrained from criticizing the status quo and from excessively using motivational framing. While existing literature would suggest that diagnostic and motivational framings are needed, our combined analysis of different strategies suggests that there are situations where such activities are not needed. The local context of a "housing cooperative"-culture and a strong environmental consciousness prevalent in the sub-state of Geneva might be a context where both diagnostic and motivational framings are less needed. We also find that the ability to aggregate knowledge and the social position of the project managers were critical for their success, which is in line with the literature (Battilana et al., 2009; Maguire et al., 2004).

We contribute to the literature on sustainability transitions and grassroots movements by providing a novel conceptual framework for investigating the activities and strategies of actors involved in grassroots movements for developing and implementing new ideas and practices. We specifically contribute with a systematic investigation through the application of institutional entrepreneurship literature and by proposing a framework combining the concepts of entrepreneurial strategies by Battilana et al. (2009) and Hung & Whittington (2011). The framework formulates what strategies (main categories) and activities (corresponding themes) we expect to identify during the analysis. Through thematic coding and categorizing (Gibbs, 2007), we then complemented the framework, inductively identifying and describing the actual activities (codes) and thereby refining the strategies of actors engaged in grassroots movements. We accordingly were able to provide a more fine-grained insight into how strategies (and the activities therein) function together, while being impacted by the local context, showing how entrepreneurial strategies translate the actors' ideas for change to actual implementation by providing exemplary empirical evidence for the interactions between the strategies (see Fig. 2). We thus contribute to the literature showing that the iterative use of *framing, aggregating, mobilizing* and *networking* strategies and their interactions with the local context enable social and technological innovation (Wolfram, 2018; Huang, 2019). In doing so, we shed light onto the role of individual agency, which is often lacking in transitions research (Koistinen et al., 2018). The iterative use of these strategies might unfold differently in varying contexts. However, the idea that the process is non-linear and that the interactive use of the strategies is conducive for supporting

bottom-up change can be applied beyond the investigated case study.

The research design also has limitations. While *Equilibre* serves as a crucial case, being the most successful movement in the Swiss wastewater sector, the findings might be very specific to the local context. This is particularly due to the strong within-case inferences of process-tracing and the general spatial-temporal dependency of entrepreneurial strategies (Baumol, 1990). Housing cooperatives might face different challenges depending on their location. Yet, understanding the context and its impact on choosing and applying strategies provides in-depth insights about how these can work synergistically (or not) and what contexts are more or less supportive of bottom-up transitions. By interviewing only *Equilibre*'s project managers who used the entrepreneurial strategies, the dataset is limited, lacking insights on how these strategies are perceived by other actors (public administration, housing cooperative members etc.) or their reactions to these strategies.

This article offers several directions for follow-up research. For instance, the research could be expanded by tracing similar projects in other regions of Switzerland and in other countries, providing evidence for the generalizability of the interactions between strategies and with the context beyond this case study. For instance, there are already other projects implementing non- or small-grid wastewater technologies in other Swiss regions such as the *Stöckacker Süd* in the sub-state of Bern or the tiny-house *Tilla* in the sub-state of Zurich, showing that there is already some diffusion of such technological solutions beyond *Equilibre*. Moreover, it would be interesting to include how other involved actors, e.g., public servants, residents, perceive the movement's activities. The activities of grassroots movements might further depend on whether their local projects aim at implementing a task that was thus far organized by public actors (as by the municipality in our case) or by private actors (see, e.g., Weber et al., 2019).

In this article, we did not study the link between the successful local implementation of a project and the scaling-up of these ideas and practices, and we cannot exclude there are local projects without any impact on the broader dynamics of sustainability transitions. Indeed, there is no guarantee that the local dynamics of innovation within these bottom-up projects actually leads to societal change in the form of broader sustainability transitions. From a policymaking perspective, this bottom-up implementation without a broader policy change could lead to fragmented structures that might empower non-state actors (such as grassroots movements) while hollowing out the government's responsibilities (Gillard et al., 2017). Yet, there are also potential synergies between the formal role of the government and local grassroots movements' activities for achieving sustainable urban transformations (e.g., Weber et al., 2018). The link between bottom-up processes and societal change merits further analysis.

By investigating the activities of *Equilibre*'s project managers, this article contributes to a better understanding of how actors engaged in grassroots movements apply entrepreneurial strategies to affect or create change such as implementing novel or alternative technologies, highlighting especially the potential of housing cooperatives in this regard. This way, incremental change of socio-technical systems can be initiated in a bottom-up manner even in sectors that might exhibit strong socio-technical lock-ins such as in the case of wastewater. This is key for the initiation phase of transition processes, which then is important for the expansion and consolidation phases, and ultimately for the scaling up of local innovations (Koehrsen et al., 2019).

CRediT authorship contribution statement

Katrin Pakizer: Conceptualization, Investigation, Methodology, Project administration, Resources, Software, Writing – original draft. **Manuel Fischer:** Writing – review & editing. **Eva Lieberherr:** Supervision, Conceptualization, Writing – review & editing.

Declaration of competing interest

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Data availability

The authors do not have permission to share data.

Appendix

1. Case study: Equilibre

The selected case study for this in-depth analysis is the case of *Equilibre*, a housing cooperative in Geneva, which was founded in 2005 by a group of eight families who envisioned an own housing project with high social and environmental standards. The cooperative was formalized in the form of an ethical charter[6] and an official registration in the commercial register.[7] In 2007, the FPLC (*Fondation pour la Promotion du Logement bon Marché et de l'Habitat Coopératif*), which is a public foundation promoting low-cost and cooperative housing, proposed to three cooperatives, including *Equilibre*, the allocation of a plot of land at Cressy in the commune of Confignon, which is located in the suburbs of Geneva. The state-owned land is leased for 99 years and the cooperatives were allowed to build three-story buildings with the obligation to enact the Habitation Mixte (HM)[8] housing standard. Apart from the administrative and economic constraints, *Equilibre* enacted its own vision for their building, such as bioclimatic architecture, own electricity production using photovoltaic panels, car-sharing and an innovative water management concept based on the premise to prevent the wasteful use of water including wastewater. This first project of *Equilibre* was finalized in 2011 and soon further projects followed such as *Soubeyran* (2012–2017) and *Les Vergers* (2012–2018). A chronological overview of *Equilibre's* finalized projects is provided in Fig. 3. Additional four projects are in the planning in order to provide enough housing to its 274 member households (with around 700 people in total).
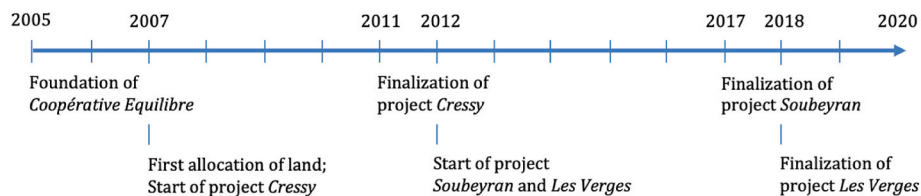

Fig. 3. Timeline of the finalized Coopérative Equilibre projects

Among *Equilibre*'s housing projects, in particular *Soubeyran* stands out, as it is the first project in Switzerland to use non-grid wastewater reuse and source separation technologies, such as large vermicomposting systems[9] for a multi-household building, in an urban area (located within the city of Geneva) (Coppens, 2018). Together with another cooperative, *Equilibre* received a plot of land in the district of Servette, where it built a five-story building with 38 accommodations bound to the Habitation Bon Marché (HBM)[10] housing standard. As with the previous project, the cooperative was again able to realize its own socio-ecological ideas, including an ambitious wastewater concept in the form of a circulatory system.

2. Unconventional water technologies used by Equilibre

Equilibre experiments with different non-grid wastewater reuse and source separation technologies that allow a more sustainable water management. For instance, for the housing project *Cressy*, *Equilibre* used compost dry toilets, which allow the treatment of brown water without discharging it to the sewer. Additionally, a phyto-purification system treats the greywater before it is discharged together with the rainwater into a separate sewer system, which was a unique concept for a rental building in Switzerland at that time. In *Soubeyran*, the wastewater system consists a vermicomposting system with a series of filters for purifying grey- and blackwater, which after its purification is then transferred together with rainwater to a 26,000-L retention tank (Coppens, 2018). The collected water is used for feeding the toilets of the building, effectively creating a closed cycle, and for watering the gardens.[11] The resulting compost from the vermicomposting system can later be integrated into the soil and tests by the university École Polytechnique Fédérale de Lausanne (EPFL) show that it could potentially be used for bushes of fruit trees (Coppens, 2018). Besides

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[6] The charter was adopted in 2005 and modified in 2015 to include an article advocating for non-exclusion and tolerance. It has no legislative aim but represents an affirmation of values.

[7] The following information was retrieved from: https://www.cooperative-equilibre.ch.

[8] *Habitation mixte* refers to apartment building comprising a mix of subsidized dwellings (proportional to the income of the tenants) and dwellings without subsidies (République et canton de Gènève, 2018).

[9] The housing project Les Vergers also uses vermicomposting, however, as individual in-situ systems for each household.

[10] *Habitation Bon Marché* is a type of subsidized housing reserved for people with low incomes, whose rents are permanently controlled (République et canton de Gènève, 2018).

[11] The tank is equipped with an overflow pipe, connecting it to the public wastewater drainage system.

technologies for reusing wastewater, there are also water saving measures, for instance, the toilets in the housing project Soubeyran separate liquid and solid excretion and use less fresh water for flushing. While regular toilets use 13.6 L of water per flush, toilets at Soubeyran use 4 L for solid excretions and only 1 L for liquid excretions (Coppens, 2018). Additionally, showers, sinks, washing machines and dish washers are equipped with water saving devices for reducing water consumption.

The non-grid wastewater reuse and source separation technologies used by *Equilibre* are sustainable for multiple reasons. First, they treat wastewater onsite, thereby decreasing the risk of pollution and contamination of waterbodies by insufficiently treated wastewater and unburdening the centralized treatment plants, drainage system and overflows. As treating water centrally is costly and energy-intensive, municipalities also save resources, which particular pressing as the ageing infrastructures in Switzerland are in need of future investments (Maurer and Hoffmann, 2019). Second, wastewater reuse and source separation technologies also reduce the consumption of freshwater, which is a necessity to ensure water services also for future generations. Regarding climatic changes in Switzerland, the National Centre for Climate Services (NCCS) states that hot days are expected to cause the greatest increase in Geneva (together with Valais and southern Switzerland) (NCCS, 2018), which could lead to more water scarcity but also increased water demand. Technological solutions for wastewater reuse and source separation enable a more efficient treatment of resources and diversify water assets by closing urban water loops[12] (Furlong et al., 2016; Hoffmann et al., 2020; Leigh and Lee, 2020). The onsite recycling of water from sinks, baths or washing machines alone could decrease the amount of fresh water used and wastewater discharged by between 50 and 60%, reducing water production and sewage treatment costs at centralized wastewater treatment plants (Oral et al., 2020). Additionally, as these systems are installed individually and preclude the need for long pipes. The decentralized water technologies can be adapted more quickly than centralized technologies to changing socio-environmental conditions and prove to be more resilient to extreme events, such as earthquakes (Hoffmann et al., 2020).

3 Thematic coding

Categories	Themes	Codes
Framing	● *Delegitimizing the established practice*	Not holistic
		Not circular
	● *Justifying new practices*	Reversibility
		Living lab
		Residents' wish
	● *Motivating support*	Local economy
		Nexus
Aggregating	● Aggregating financial means	*Subsidies*
		Municipal financial support
		Bank credit
		Reduction of connection charges
	● Using resources from social position	*Acceptance*
		Knowledge
		Social cohesion
Mobilizing	● Mobilizing allies and collaborators	*Information exchange*
		Meetings with residents
Networking	● Coordinating external relations	*Collaboration*
		Visits
		Media
Local context	● Local culture	*Support for cooperatives*
		Climate consciousness
	● Regulations	*Planning process*
		Technical issues
		Development areas
Motivation	● Personal motivation	*Negative practice experience*
		Impact of studies
		Curiousness
		General interest in sustainability issues
		Cooperative
		Future habitant
Background	● Education	*Environmental engineering*
		Architecture
	● Memberships	*Another project*
		Another housing cooperative
		Associations
		Green party

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[12] Usually, fresh water entering a city follows a linear process, being used, treated and then discharged. "Closing the water loop" means that water remains within the city, as rain- and stormwater is captured and stored, while wastewater (including recovering valuable nutrients like nitrogen or phosphorus) is recycled and cycled back into the urban water system (Oral et al., 2020).

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