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CONTENTS

DESIGNING SYSTEMIC CHANGE FOR URBAN ECOSYSTEMS: A FRAMEWORK FOR ASSESSING SOCIAL INNOVATION

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Abstract
Developing systemic changes for decarbonization and adaptation to climate change at the urban level is a complex challenge which requires considering a systemic approach. Numerous cases, frameworks and theoretical models are described in the academic literature, starting to create a relevant body of evidence that designing social innovations at the urban level can change citizens' mindsets and behaviors toward more sustainable practices, at both social and ecological levels. Yet this rich and important body of knowledge is scattered across different fields and not yet systematized in a comprehensive framework that can provide actionable knowledge for social innovators, designers and policy makers aiming to design and assess social innovations. Based on a systematic multidisciplinary literature review, we develop a framework for the design and evaluation of social innovations in climate ecosystems, which comprise the consideration of key main categories of indicators: context, input, social innovation (SI) actions (capacity building, SI top-down/bottom-up initiatives and scaling) and outputs (short-term results, medium-term outcomes, long-term impacts). This framework has both theoretical and practical relevance as it can be utilized for managing complexity and for clustering social innovation initiatives and related indicators, which can be deployed for measuring the effectiveness of actions and policies in municipalities.

Author Keywords
Climate neutrality; framework; systemic design; city; classification; social innovation.

Introduction

Social innovation is emerging as a relevant category of innovation that can change people's behavior and mindsets (Gregg et al., 2020) and reconfigure socio-technical systems (Geels, 2020) for supporting climate neutrality. Such social innovations tackle problems in the society with a human-centered approach, prototyping new products and services that are social in the means and in the ends, and improving them through rapid experimentation cycles. The contribution of social innovation to climate neutrality, includes – but is not limited to – reducing consumption by establishing opportunities for sharing, repairing and reusing practices (Schanes et al., 2016), creating capacity building so that citizens and other stakeholders can solve environmental and social problems

(and create related jobs and economic opportunities) and build contexts and platforms to support change through the engagement and upskilling of networks of actors within communities (Diepenmaat et al., 2020; Gregg et al., 2020). The potential impact of deliberately designing the emergence and scaling of social innovations in cities for the wellbeing of communities seems particularly relevant (Hoppe & De Vries, 2019). Yet policy-makers might still find it challenging to understand how social innovation can contribute to decarbonization, specifically because of the challenge of measuring social innovation's impact. While several scientific articles have provided theoretical support and empirical evidence of the benefits of deploying social innovation for tackling climate changes, a comprehensive framework that organizes existing knowledge and indicators is still missing. Indicators of social innovation effectiveness, for climate change in particular, are scattered across papers, projects and disciplines. We propose to fill this important gap, performing a multidisciplinary literature review and organizing existing scientific knowledge into a comprehensive framework of dimensions that is theoretically grounded and practically useful.

The methodology is based on a systematic literature review of social innovation in the context of climate neutrality from the fields of sustainability, energy, climate change, management and public policy. The review was conducted by searching for relevant keywords in Google Scholar and includes the results of government-funded research projects. The search resulted in 267 papers that were processed and categorized according to their relevance for the identification of social innovation indicators (Unceta et al., 2016; Hewitt et al., 2019; Cantafio & Ryan, 2020; Lukesch et al., 2020; Andion et al., 2021; Baer et al., 2021; Sörgel et al., 2021).

The systematization of such a large body of literature led to the identification of an overview of approaches to the evaluation of social innovation in climate ecosystems, which comprises the consideration of key categories of indicators: context, input (or resources), social innovation actions (capacity building, top-down/bottom-up initiatives and scaling) and outputs (results, medium-term outcomes, long-term impacts). This general framework structure is based on the logic framework (Knowlton & Phillips, 2012): context, input, actions, outcomes, impacts. We expanded the logic framework categories to account for the specific dimensions of social innovation identified through the literature review, including also learning cycles for the development of a continuous prototyping mindset, which is a typical design competency relevant for developing adaptation and resilience (Stocco et al., 2021).

We make a contribution to theory by providing a systematization of literature from related fields, intersecting social innovation and climate change with a focus on potential assessment, thus providing a framework for design-led research for sustainability. From a pragmatic perspective, this paper provides a specific contribution by proposing a usable framework for researchers and policymakers aiming to select, design and measure the effectiveness of policies and actions that support the co-creation of social innovations with multiple stakeholders.

Literature Review: Social Innovation Contribution Toward Climate Neutrality

Methodology

With the aim of identifying scientific papers from diverse disciplines that address social innovation for climate neutrality and decarbonization, we searched scientific databases and key scientific journals. We started by performing keyword searches in Google Scholar with a broad set of keyword combinations in order to identify articles from related fields that might use different terminologies. Specifically, we performed multiples searches in the databases by combining one keyword related to social innovation (social innovation, social innovation action plan, social impact, social value, social innovation ecosystems, wellbeing, social impact assessment, social innovation metrics) and a keyword related to climate neutrality (decarbonization, environmental sustainability, climate change, climate neutrality, carbon neutrality, net zero, carbon footprint, ecology, circular economy). In a second phase, key journals related to the topic of interest were manually scanned, specifically the scientific journals *Nature Climate Change*, *Sustainable Cities and Societies* and *Sustainability* for the last three years. This search resulted in the identification of 267 articles from 2008 to 2022, which included two special issues: "Social innovation and the energy transition," published in the journal *Sustainability* in 2018, and "The dynamics of sustainable innovation journeys" published in *Technology Analysis & Strategic Management* in 2008.

All articles were processed by reading the abstract and keywords in order to understand if the paper contained a relevant contribution to answer our research question in the form of a theoretical model, a framework or indicators related to social innovation for decarbonization. When the contribution was not clear from the abstract, the entire article was processed. The analysis of the abstracts led to the identification of 31 articles from the fields of sustainability, energy, climate change, management and public policy. An additional 10 relevant papers were identified from the reference list of the 31 identified articles, which contained dimensions relevant for the research question. All 41 articles were read and analyzed, and their outcome systematized in the following sections: providing the motivations for considering social innovation in the context of climate change; theoretical models and frameworks; and development of a comprehensive framework to classify indicators.

Motivation: Why We Should Consider Social Innovation for Climate Neutrality

According to identified articles, there are multiple reasons for considering social innovation a relevant lever for decarbonization. We can group the motivation into five progressive categories: from the most basic and necessary levels of (a) acceptance and (b) behavior change to (c) the systemic consideration of socio-technical systems and (d) empowerment, which (e) influence wellbeing.

At the most basic level, it was outlined that if there is no acceptance by organizations (in particular, incumbent firms), local governments, citizens and the various actors, energy transitions will fail (Nakano et al., 2018; Gregg et al., 2020). Social innovations can provide a relevant contribution for climate neutrality by bringing behavioral change toward more sustainable practices (Schanes et al., 2016; Grottera et al., 2020; Loyarte-López et al., 2020; Mukai et al., 2022). Schanes et al. (2016) quotes Edenhofer et al. (2014, p. 20) that

> [t]he mitigation report of the Intergovernmental Panel on Climate Change (IPCC) states that behaviour, lifestyle, and culture have a considerable influence on energy use and associated emissions and that stabilizing or lowering consumption, transitioning towards a sharing economy and adopting other behavioural changes have a high mitigation potential. (p. 1033)

Thirdly, a relevant number of reviewed articles discussed how socio-technical systems can be disrupted by niche innovations that can reconfigure the system. In fact, "[s]uch transitions not only entail new technologies, but also changes in markets, user practices, policy and cultural discourses, and governing institutions" (Geels et al., 2008, p. 521). In a highly cited paper published in *Science*, Geels et al. (2017) discuss socio-technical transitions for decarbonization, offering an overall framework which takes into account technical and social aspects, including people's behavior and the relevance of framing the discourse based on the case reported by Rosenbloom et al. (2016) that discusses and analyzes solar electricity in Ontario through a "discursive approach to understanding multi-dimensional interactions within socio-technical transitions" (p. 1275) with a new analytic approach that connects discourses and storylines to transitions.

The most discussed reason for paying attention to social innovation when addressing carbon neutrality seems to be found in its ability to empower supporting actors to take action to tackle climate issues. Diepenmaat et al. (2020) published a theoretical paper with the eloquent tile "Why sustainable development requires societal innovation and cannot be achieved without this" in which they describe the business perspective on transitions and discusses societal innovation as a distinct innovation type by proposing an "innovation cube" and discussing the "need for broader partnerships for societal innovation based on multiple value creation" (p. 1270). They outline that sustainable development needs collective action for creating new systems, which in turn requires social innovation. Furthermore, citizens need to take up a new role for finding and sustaining new business models for a circular economy (Diepenmaat et al., 2020). Wuebben et al. (2020, p. 567) conducted a systematic review of "citizen science and citizen energy communities" for sustainable development goals (SDGs) and call for citizen science to supplement typical citizen participation formats in energy communities, as it engages citizens in research and increases their literacy regarding energy systems. Providing concrete examples through the case of Scotland's journey to decarbonization, Ostfeld and Reiner (2020) report on the effects of citizens' juries and focus groups. Agarwal et al. (2012), based on an analysis of climate adaptation policies in 47 least developed countries, provide key lessons for adapting such plans to local needs, such as increasing local autonomy, creating "mechanisms for information sharing among decision makers across sectors and levels of decision making; and (4) improve accountability of local decision makers to their constituents" (p. 565).

Finally, three recent papers focus on wellbeing, since it is (or should be) the final goal of all social and technological innovations. Engelbrecht (2018) highlights the need to consider wellbeing when assessing technological and social innovations because we cannot assume that innovations are desirable, per se. We should rather keep focused on the final desired societal outcome. Also, Hoppe and De Vries (2019) focus their work on wellbeing, arguing that "[i]n the context of energy transition, social innovation can be

defined as empowerment and social goals pertaining to the general wellbeing of communities" (p. 141). Creutzig et al. (2022) demonstrate that demand-side solutions for climate change mitigation are not only useful to support decarbonization but also to increase levels of wellbeing. Specifically, they propose a classification of three "mitigation potential of demand-side options: avoid, shift, improve" (p. 36) which seem relevant for classifying social innovations, in particular for the context of the circular economy.

Theories and Frameworks

Framing the Context of Energy Transitions

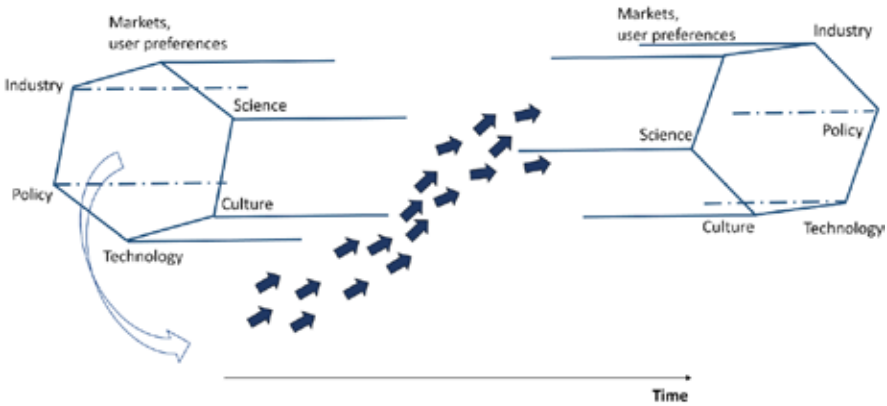
After establishing the key contribution that social innovation can provide for supporting the transition to carbon neutrality, we outlined the theoretical models, and frameworks emerged from the literature that can be relevant for social innovation assessment.

As the aim of the literature review is to develop a pragmatic framework for designing and assessing social innovation policies and initiatives that can contribute to climate neutrality, we review models and frameworks that have relevance in particular for local governments. We describe such models and frameworks, starting from the broad context of transitions to climate neutrality, then narrowing the focus to social innovation specificities.

In their paper published in *Science*, Geels et al. (2017) invite the public to go beyond individual elements and consider socio-technical systems, that is, the interlinked mix of regulations, markets, infrastructures, technologies and user practices, which in combination deliver value for society (Figure 1). They present the multi-level perspective (MLP) framework for understanding the complex causal mechanisms that characterize systems transitions for deep decarbonization. The authors map socio-technical system elements: (i) market and user preferences, (ii) science, (iii) culture, (iv) technology, (v) policy and (vi) industry. They explain how niche innovations can bring radical breakthroughs which trigger the adjustments of socio-technical systems. In the paper, the authors argue that the acceleration of transitions

> involves three mutually reinforcing processes: growing internal momentum of niche-innovations, weakening of existing systems [...], and growing exogenous pressures. The resulting socio-technical transitions go beyond the adoption of new technologies and include investment in new infrastructures, the establishment of new markets, the development of new social preferences and the adjustment of user practices." (Geels et al., 2017, p. 1244)

In particular, it is argued that to motivate citizens to change practices, beliefs, conventions, skills and purchase decisions, information about climate change threats and financial incentives should be complemented by positive discourses about the benefits of innovations for decarbonization. Business and citizen support for decarbonization can be built "through bottom-up learning processes, participatory governance and polycentric stakeholder" (Geels et al., 2017, p. 1245).



Simplified and adapted from: Geels et al., 2017

Figure 1. Socio-technical system elements.

In a more recent paper, the same author (Geels, 2020) further developed a "multi-dimensional model of agency through crossovers between social constructivism, evolutionary economics and neo-institutional theory" (p. 1). He reviewed the strengths and weaknesses of each of the three theoretical perspectives, highlighting their complementarity. Some of the identified strengths of social constructivism are, for example, the "interest in the shape and design of artefacts and patterns of use" and the "focus on cognitive processes." Among the weaknesses – or less elaborated topics – of the social constructivist approach, Geels (2020) identified the "idealist bias (limited attention for competition, markets, financial resources)" and "limited link to broader social sciences (due to dominance of micro-interactionism)" (p. 11). Regarding the second theoretical perspective, evolutionary economics, he identified among the strengths, the "deep understanding of 'material' processes (market competition, resources, performance, investment) and knowledge/capabilities," while among the weaknesses of the approach, we find the "limited understanding of institutions (as exogenous regulations)" and "limited interest in technical details (due to primary interest in economic implications of technology for firms/sectors)" (Geels, 2020, p. 11). Finally, the third theoretical perspective of neo-institutionalism has the strengths of showing "relational, processual understanding of institutions" and "recursive interactions between local practices and organizational fields" but the weaknesses of having a limited focus on "technology and 'material' dimensions" and "economic processes" (Geels, 2020, p. 11).

In "Why sustainable development requires societal innovation and cannot be achieved without this," Diepenmaat et al. (2020) review multi-disciplinary perspectives related to societal innovation for sustainable development, in particular the business literature on value creation, the literature on business model innovations, sustainability strategy and sustainability transitions, adding the "recursive perspective on innovation and society" (p. 2) applied to societal innovation. The authors are critical of the triple helix models "because these underestimate the importance of disinterest and conflicts of interests to be managed via multiple value creation on the basis of recursive multi-actor intentionality"

(Diepenmaat et al., 2020, p. 1). They propose the need to acknowledge that "actors require each other in realizing their own needs and wishes and may help each other in this respect. Contextual aspects enter via the improvement perspectives" (Diepenmaat et al., 2020, p. 13). Their work presents an historical discussion of modalities in which business addressed sustainability, and offers a systematic approach to innovation types. In particular, it provides a "co-evolutionary understanding of innovation-based transformations, based on a recursive relationship between innovations, improvement perspectives and socio-economic transformations, including the transformation of modernity" (Diepenmaat et al., 2020, p. 3).

In the paper, they specifically review societal innovation, framing it as a systemic type of innovation which requires design thinking and system building. They further argue that "Societal innovation involves social innovation in the form of cross-sector partnerships (resulting in new value chains) and possibly changes in ownership (energy cooperatives for renewable energy to heat and powerhouses)" (Diepenmaat et al., 2020, p. 16). The focus on design thinking is justified by the ability of the method to find configurations that are suitable for several actors (users, governments, finance). They base their argument on the work Ceschin and Gaziulusoy published in *Design Studies* in 2016 in which the authors visually presented the evolution of design for the field of sustainability, from the level of product design, to the level of product-service system, to the spatio-social level and finally to the socio-technical system level (p. 17). Thus, more recently, the focus of design broadened to include socio-technical system innovation, focusing on transforming systems by supporting the development of long-term visions and linking those visions to strategic decisions of design and innovation teams (Ceschin & Gaziulusoy, 2016, p. 31).

Creutzig et al. (2022) analyzed mitigation solutions in terms of effects on human wellbeing. Although such mitigation solutions are usually evaluated in terms of greenhouse gas (GHG) reduction, they systematically assessed the potential of demand-side solutions in terms of avoiding, shifting and improving consumption, and calculated the link to human well-being. With a methodology based on expert judgment and an analysis of extant literature, they evaluated "306 combinations of wellbeing outcomes and demand-side options" and found that "bridging socio-behavioural, infrastructural and technological domains, can reduce counterfactual sectoral emissions by 40-80% in end-use sectors." (Creutzig et al., 2022, p. 36). In terms of solution categories, they identify: (1) building: sufficiency, efficiency, lower carbon and renewable energy; (2) food: food waste, overconsumption, animal-free protein; (3) transport: teleworking and online education systems, non-motorized transport, shared mobility and BEVs; (4) urban: compact city, circular and shared economy, systems approach in urban policy and practice, nature-based solutions; (5) industry: using less material by design, product life extension, energy efficiency and circular economy (Creutzig et al., 2022).

Framing Social Innovation

According to Unceta et al. (2020, p. 908), social innovation (SI) "measurement and socioeconomic impact have been for a long time a required and challenging area of research inside SI studies, acknowledged by the research community, policymakers, social investment funds, practitioners, social entrepreneurs and social innovators themselves. However, there is still a lack of consensus on what are the major and determining methodological tools and indicators involved in its measurement and impact assess-

ment. Despite this difficult task, there are three approaches that can be identified in the academic field which seek to build a system of indicators for SI measurement: "the individualistic approach," "the organizational approach" and "the regional/national approach" (Unceta et al., 2016). In this paper, we focus mainly on the urban level, but take into account all levels of complexity.

In the special issue "Social innovation and the energy transition," published in the scientific journal *Sustainability* in 2018, 20 articles contributed to the topic from different academic disciplines. The editors (Hoppe & de Vries, 2018) categorize the contributions into key topics relevant to social innovation:

> (i) technological innovation leading to new market models, actor configurations, and institutional settings creating room for social innovation; (ii) new governance arrangements; (iii) community energy, its impact, implications, and social incentives and policy to empower it; (iv) new participative research approaches to test and learn from livings labs and best practices; (v) "green nudges" to stimulate behavioral change; and (vi), serious energy games. (p. 141)

In a recent literature review on "social innovation related to ecological crises," Haskell et al. (2021) analyzed the 40 most relevant articles related to the topic and found that only five of those articles explicitly aligned with strong sustainability. For the literature analysis, the authors deployed the framework developed by Howaldt et al. (2017), which combines innovation studies and theories of social change. The framework was developed within the E.U.-funded project SI-DRIVE; it has a focus on social practices oriented toward societal challenges and it has already been applied specifically to environmental challenges (Schartinger et al., 2017). The framework is composed of five dimensions that can guide stakeholders in facilitating social innovation development. The focus is on an audience of policy makers and actors within the civil society, with the aim of assessing the potential for diffusion when social innovations are imitated and diffused across contexts (Haskell et al., 2021). The five dimensions of the the framework (Figure 2; Howaldt et al., 2017) are: (1) concepts and understanding; (2) addressed societal needs and challenges; (3) resources, capabilities and constraints (capacity building, empowerment and conflict); (4) process dynamics (mechanisms of diffusions, imitation, social learning, relationship to social change); and (5) governance, networks, actors (functions, roles and new concepts). Based on data and insights from both the SI-DRIVE (reviewed above) and SIMPACT E.U.-funded research projects, Terstriep et al. (2020) reflect on social innovation ecosystems. Their results suggest that to establish a social innovation ecosystem, it needs

> 1) a mode of governance that integrates actors from civil society, and the social, economic and academic field; (2) social innovation hubs, labs and transfer centres as intermediaries that accelerate social innovation activities; and (3) the integration of different modes of innovation in transformational innovation strategies. (p. 881)

More specifically, within the analyzed SIMPACT project (Rizzo et al., 2020; Unceta et al., 2020), a practical framework is proposed (Dhondt et al., 2016; Castro-Spila et al., 2016) for policy makers and social innovators to forecast ex-ante the potential impact of social

innovation options. Such a framework is based on five steps: (1) determining the goals and socio-economic outcomes; (2) determining causal relationships between inputs, outputs and outcomes; (3) determining the role of stakeholders; (4) calculating the impact; and (5) the decision process.

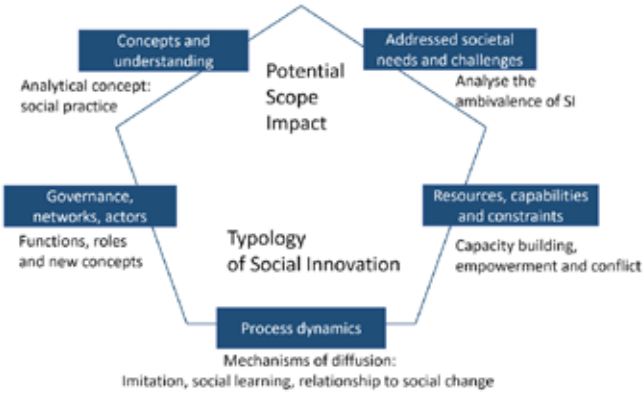


Figure 2. SI Drive framework adapted from Howaldt et al. (2017).

A comprehensive framework for evaluating social innovation initiatives has been developed by Secco and colleagues (Secco et al., 2019) and applied to a variety of contexts, from forest-dependent rural communities (Secco et al., 2019), to social farming, community energy and food cooperatives. The framework is the backbone of the E.U.-funded project SIMRA (Social Innovation for Marginalized Rural Areas) and has been utilized for the assessment of social innovations across Europe. It was derived from a literature review of over hundreds of existing frameworks (Secco et al., 2019) with the aim of developing a method and categories for evaluating social innovations. The resulting SIMRA framework builds in particular on the approach of the theory-of-change, detailing the causal mechanisms that led to changes, the base of any evaluation approach. More specifically, it outlines the intervention logic (logic model) that provides the causal link from inputs to activities, leading to outputs and culminating in outcomes and impacts, with the additional contribution of feedback and learning processes that loop back. The comprehensive SIMRA framework (Figure 3; Secco et al., 2017) includes an analysis of the context, and this takes into account nine main elements: (1) the trigger (that is, individual and collective needs); (2) the perceived context at international, national, regional and local levels; (3) the agents (ideas, values, willingness, reflexivity, capacity for change) which influence the context; and (4) the preparatory actions for collective benefit; which in turn affect (5a), the reconfiguring of the system. The (5b) reconfigured systems (new networks, new government arrangements and new attitudes), lead to (6) project activities with specific procedures and practices. Such social innovation activities produce (7) outputs in the form of identifiable products and services, which in turn produce (8) outcomes and impacts (positive or negative) on economic, social, environmental and governance/institutional aspects. Finally, (9) the learning processes provide feedback loops and

multiplier effects to inform the context and social innovation activities. In practical terms, these nine key aspects are assessed with a mixed quantitative-qualitative methodology (Secco et al., 2017) and a combination of expert and participatory-based evaluations (Secco et al., 2019).

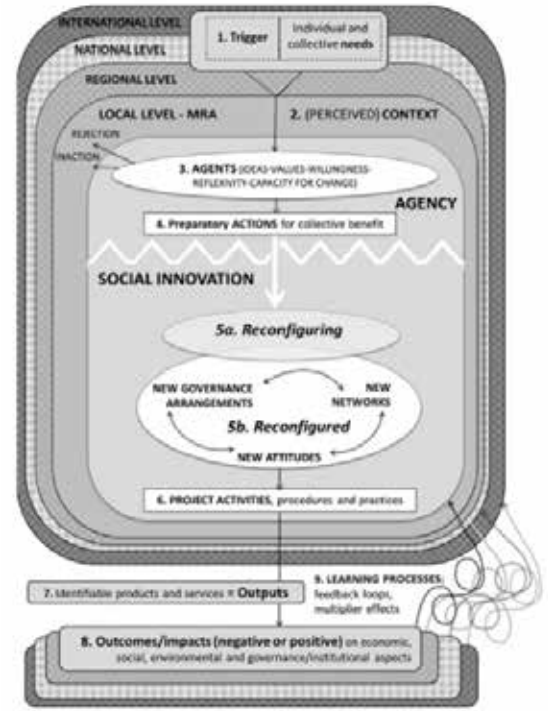


Figure 3. The SIMRA framework (source: Secco et al., 2017).

The Regional Social Innovation Index (RESINDEX) Model (Unceta et al., 2016) adds a further level to social innovation indicators, comparing the potential capacity to the realized capacity. The model was developed within a research project funded by Innobasque, the Basque Innovation Agency, and comprises a series of indicators grouped in three indexes: (1) capacity for potential innovation – composed of (1a) capacity for knowledge, (1b) capacity for learning, (1c) capacity for socialization, (1d) capacity for development, (1e) capacity for association; (2) realized capacity of social orientation index – composed of (2a) knowledge acquisition, (2b) development of social projects, (2c) impact of social projects, (2d) governance and (3) realized capacity of social innovation index – composed of (3a) knowledge acquisition, (3b) development of innovative social projects, (3c) impact of innovative social projects and (3d) governance.

In an analysis of social innovation ecosystems and sustainability in cities, Andion et al. (2022) proposed five dimensions that reinforce or hinder social innovation in cities, based on the case of the Brazilian city Florianópolis. The dimensions are categorized according

to the scale of analysis: macro, meso and micro level. At the macro level, they identify the "institutional" dimension; at the meso level, they identify the level of "SIE supply – network of support actors," "SIE demand – network of social innovation initiatives" and interaction and governance. At the micro level, they identify the dimension of "practice and consequences – social innovation initiatives and their actions in [the] public arena" (Andion et al., 2022, p. 1276).

Angelidou and Psaltoglou (2017) investigated social innovations for sustainable development at the urban level. They explored the characteristics of social innovation across "the three basic and distinct dimensions of social innovation, as they are put forward by a large body of literature: i. Content, ii. Process and iii. Empowerment" (p. 113). They analyzed the literature to categorize domains of social innovation for sustainable urban development clustered into content (principal subject, sustainability challenge, urban setting characteristics), process (organization type, innovation mechanism, and ICT component) and empowerment (type, beneficiaries, outcome). They further focused on the human agency level, providing a categorization of "four primary citizen profiles in social innovation for sustainable urban development: the 'citizen-sensor,' the 'sharing citizen,' the 'collaborative citizen' and the 'entrepreneurial citizen'" (Angelidou & Psaltoglou, 2017, p. 113).

Finally, Baer et al. (2021) developed a categorization of approaches to social innovation related to Positive Energy Districts by comparing three in-depth case studies in Norway. The three dimensions that emerged from the case studies are: (1) citizen involvement, (2) stakeholder interaction and (3) capacity building and education.

Toward a Multi-Disciplinary Systematic Framework of Social Innovation for Climate Change

All the dimensions identified in the above reviewed literature have been included in a comprehensive map and organized according to the well-established logic model (Knowlton & Phillips, 2012) as the underpinning structure (Figure 4).

Given the broad number of dimensions identified, in particular for the category of social innovation actions or initiatives, some of the original categories of the logic model have been expanded. In particular, the social innovation actions are organized into three subcategories: social innovation capacity building activities, (top-down/bottom-up) social innovation initiatives and scaling strategies. While we are aware that the sub-dimensions are not mutually exclusive, we find the clustering useful to organize the multitude of social innovation approaches and initiatives sourced from the literature review. Capacity building seems to emerge as a prerequisite for supporting the emergence and scaling of social innovation initiatives, thus indicating a pathway.

The categories related to the results are defined according to the newest labeling adopted by the European Commission (Horizon Europe Key Impact Pathways): results, output and impacts. Mapping the existing knowledge on the topic provided a complex and multi-faceted overview, indicating the variety of levels and perspectives adopted by researchers in diverse fields. The framework could thus provide guidance to researchers and practitioners to be aware of the many levels of complexity and the potential impact of deliberately designing the emergence and scaling of social innovations in cities for the wellbeing of communities (Hoppe & De Vries, 2019).

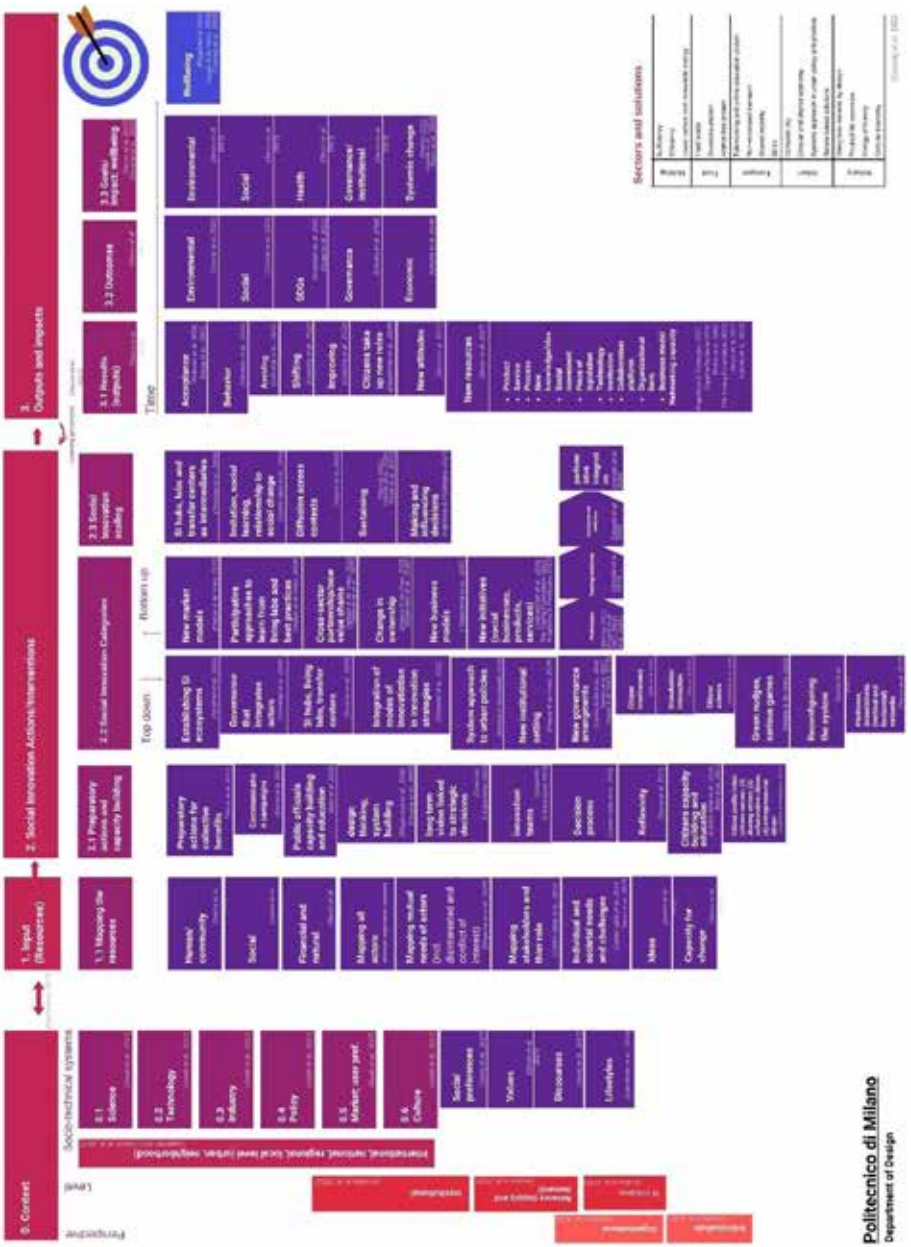


Figure 4. A comprehensive framework of social innovation for climate change (source: Knowlton & Phillips, 2012).

Implications and Conclusions

With the aim of developing a comprehensive framework for the assessment of social innovation initiatives for climate neutrality, we conducted an extensive multi-disciplinary literature review. We presented models and frameworks from extant literature, then aggregated and categorized the dimensions that emerged.

The resulting framework is theoretically based and comprehensive; it can be utilized to categorize social innovation initiatives and actions and related indicators for their assessment. Given the wealth of knowledge sourced in the literature review, it seemed that the time for a comprehensive framework had come for coping with the complexity of the challenge and for categorizing the hundreds of indicators scattered across several projects and papers. Our work contributes to theory by systematizing the available knowledge on the dimensions that influence social innovation specifically for climate neutrality. The comprehensive multi-disciplinary framework has practical implications for selecting, designing and assessing social innovation's impact toward a sustainable society. In future research, we aim to compare this theoretically-grounded framework with existing cases of social innovation for climate neutrality and with municipalities' needs (in particular with the city partners of the H-2020 NetZeroCities project), and then to categorize SI initiatives and related indicators (of results, outcomes and impacts). Such work would provide an actionable set of indicators for designers, policymakers and all stakeholders to design a solid SI policymaking and evaluation framework that can be general enough to be comparable across contexts and specific enough to adapt to local (urban) contexts.

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