sustainability

MDPI

Review

Toward a Comprehensive Framework of Social Innovation for Climate Neutrality: A Systematic Literature Review from Business/Production, Public Policy, Environmental Sciences, Energy, Sustainability and Related Fields

Sabrina Bresciani *, Francesca Rizzo and Alessandro Deserti

Department of Design, Politecnico di Milano, 20158 Milano, Italy
* Correspondence: sabrina.bresciani@polimi.it

Abstract: Social Innovation (SI) is considered a key lever for supporting climate action and decarbonization. In addition to the adoption of technological innovations, novel social practices can lead to the reconfiguration of socio-technical systems toward more democratic energy transitions and heightened civic participation for climate action. Several frameworks and cases of social innovation for climate neutrality are described in the academic literature; however, this rich body of knowledge is scattered across different fields and the actual relevance of social innovation for climate is rarely measured. A core challenge remains regarding the systematic assessment of social innovation's contribution to decarbonization. With the aim of developing a comprehensive framework for potentially assessing social innovations, the extant literature is mapped and the following key dimensions of social innovation for climate neutrality are derived: context, input (or resources), social innovation activities (capacity building, types of SI initiatives and scaling), and results (immediate outputs, medium-term outcomes, long-term impact toward wellbeing). The framework has both theoretical and practical relevance: it provides a structured pathway of social innovation mechanisms and related assessment categories, which can be deployed showing evidence of social innovation effects, gaining insights for actions' improvements, as well as informing policy-making.

Keywords: decarbonisation; climate neutrality; social practices; social innovation; social change; social behaviour; urban policies; assessment; pathway

Citation: Bresciani, S.; Rizzo, F.; Deserti, A. Toward a Comprehensive Framework of Social Innovation for Climate Neutrality: A Systematic Literature Review from Business/Production, Public Policy, Environmental Sciences, Energy, Sustainability and Related Fields. *Sustainability* **2022**, *14*, 13793. https://doi.org/10.3390/su142113793

Academic Editor: Brantley Liddle

Received: 31 July 2022
Accepted: 18 October 2022
Published: 24 October 2022

1. Introduction

There is growing consensus that climate neutrality cannot be achieved with technological solutions alone, but requires a focus on social aspects. Social acceptance is considered a significant factor affecting transition pathways [1], and societal innovation is argued to be a necessary lever of sustainable development [2] and energy transition processes [3].

Social innovation (SI) is emerging as a relevant category of innovation that can change people's behaviour and mindsets [4], and reconfigure socio-technical systems [5] to support climate neutrality and the European Green Deal (EGD). Such social innovations tackle problems in the society with a human-centred approach; prototyping novel products, services, spaces and practices that are social in terms of the means and the ends, and improving them through rapid experimentation cycles [6]. The contributions of social innovation to climate neutrality include—but are not limited to—reducing consumption by establishing opportunities for sharing, repairing and re-using practices [7], as well as creating networking and strengthening capacity building so that citizens and other stakeholders can solve environmental and social problems together (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 [2,4].

Social practices are interconnected [8]; therefore, they need to be considered alongside a systemic approach to facilitate change toward sustainable practices. To achieve system change rather than system optimization [9], all stakeholders, including citizens, non-for-profit, firms and institutions need to explore innovative social practices and collaboration patterns, such as with urban living labs [10], and mutually recognize their different purposes [11].

While there is a steadily growing body of empirical evidence illustrating the crucial role of social innovation for decarbonization, it remains challenging to evaluate the actual extent of social innovation contribution due to the lack of comprehensive instruments and tools for assessing SI outcomes and impact related to climate neutrality [12,13] and the need for transdisciplinary approaches [14]. Although several scientific articles have provided theoretical support and empirical evidence of the benefits of deploying social innovation to tackle climate changes, a comprehensive framework that organizes the existing knowledge and potential indicators of outcomes is still missing. Measures of social innovation effectiveness for climate action are scattered across papers, project and disciplines. A theoretically grounded and broadly applicable framework for SI assessment can provide a strategic instrument for social innovators, to support them in testing social innovation initiatives and gain insights into their effectiveness as well as areas that might need improvement. In addition, reporting results (in the context of climate action, and in general) has been shown to influence behaviour toward more sustainable practices [15]. Furthermore, it has been advanced that, in policy-making, "the lack of monitoring skills constitutes a barrier to green growth and sustainable development pathways in urban areas" [16] (p. 393).

We aim to fill this important gap by performing a multi-disciplinary literature review and organizing the existing scientific knowledge into a comprehensive framework of dimensions. The methodology is based on a systematic literature review of social innovation in the context of climate neutrality, which led to the identification of 267 papers. The systematization of such a large body of the literature resulted in an overview of key dimensions for the evaluation of social innovation in climate ecosystems, comprising categories of indicators.

We make a contribution to theory by providing a systematization of the literature from related fields, intersecting social innovation and climate change with a focus on potential assessment, thus presenting a framework that can be utilized to classify and select indicators. From a pragmatic perspective, the paper provides a specific contribution by proposing a usable framework for researchers and policymakers aiming to select, design and measure the effectiveness of grassroot social innovation initiatives and policies that support the co-creation of social innovations with multiple stakeholders. In addition, the visual mapping of the populated framework can serve as a boundary object [17] that citizens, policy makers and academics can utilize as a tool for structuring strategic conversations.

2. Methodology

2.1. Search Strategy and Selection Criteria

To identify scientific papers from multiple disciplines that conceptualize dimensions or indicators of social innovation effectiveness for climate neutrality, we carried out a systematic literature review following the protocol outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement [18,19], as outlined. A comprehensive search was conducted by following five main steps (Figure 1) in January 2022.

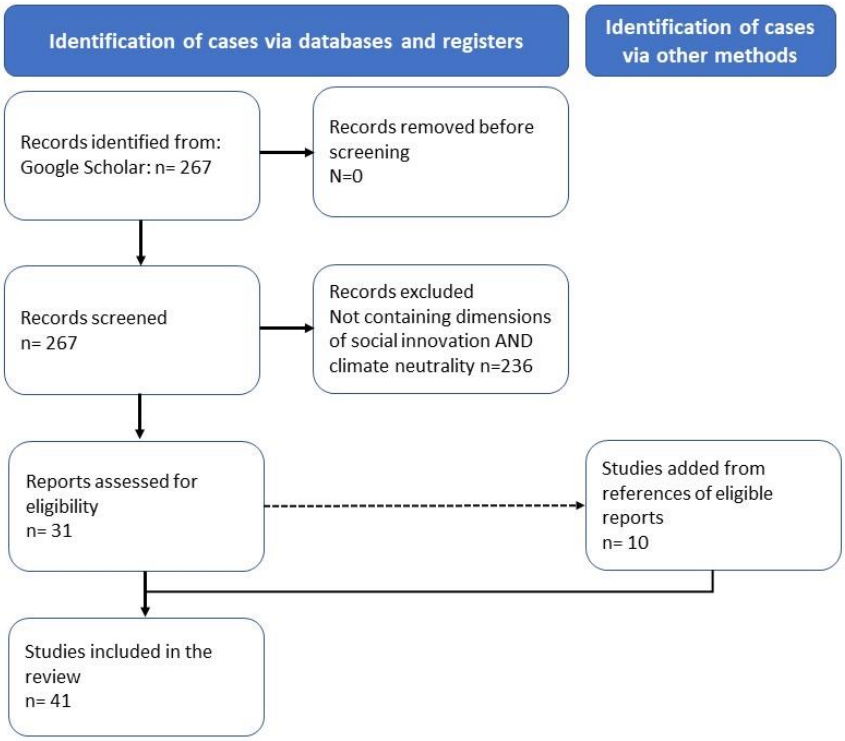

Figure 1. PRISMA flow diagram of the systematic review, based on [19].

Step 1: the Google Scholar database was searched from 2008 by combining a broad set of keywords, including one related to social innovation ("social innovation", or "social impact", or "social innovation ecosystems", or "social impact assessment", or "social innovation metrics" or "social innovation action plan") and one related to climate neutrality ("climate neutrality", or "decarbonization", "environmental sustainability", "climate change", "carbon neutrality", "net zero", "carbon footprint", "circular economy"), in order to identify articles from related fields that might use different terminologies. We restricted the search to articles, to the fields of Social Sciences, Environmental Sciences, Business and Management, Economics, Energy, and we further restricted the results to the English language. The choice of Google Scholar was motivated by the aim to identify a broad spectrum of contributions, in particular articles including applied research, which might not be found on other, more specific databases. The search resulted in the identification of 267 articles from 2008 to 2022, which included a Special Issue: "Social Innovation and the Energy Transition" published in the journal Sustainability in 2018.

Step 2: all articles were processed by reading the title, abstract and keywords to determine whether they contained a relevant contribution in the form of a theoretical model, a framework, criteria or indicators related to social innovation for decarbonization. Papers that only contained discussions or dimensions related to technical solutions or decarbonization was not included, as the aim of this literature review is to focus on social innovation related to climate neutrality. When the contribution of a paper in relation to the research question was not clear from the abstract, the entire article was processed to identify the presence of dimensions. The analysis conducted by the first author led to the identification of 31 articles which contained discussion of dimensions of social innovation. In order to avoid false negatives, we adopted a conservative and comprehensive approach by including all the articles that contained dimensions and categories at any level (micro, meso or macro), irrespective of the methodology, sample or geographic location.

Step 3: the 31 relevant articles were read by all authors and all the categories, dimensions, measures, indicators were extracted and collaboratively mapped according to semantic similarity. To provide a theoretically based overall structure for mapping the extracted criteria, the three authors jointly decided to deploy the logic model framework [20]

as is a solid, widely utilized and broadly applicable framework, also including learning cycles for the development of a continuous prototyping mindset—a typical and relevant competence for developing adaptation and resilience [21].

Step 4: by reading the selected articles, an additional (10) articles were added with a snowball procedure, adding key articles cited in the 31 papers identified in step 3 when relevant to understand the underlying framework or model, resulting in a total of 41 articles.

Step 5: the criteria extracted from the 41 articles were graphically mapped (collaboratively by all authors), by placing similar concepts together and providing a structure of criteria with categories and sub-categories.

2.2. Characterization of the Selected Papers

A summary of the resulting articles is provided in the following table (Table 1) in chronological order, from 2008 to 2022. The original papers identified in step 3 are all articles published in scientific journals, and all are indexed by Scopus. The 10 additional papers identified through the references of the articles are provided in the table in italicized font, and included the following: two books, two scientific articles, one technical report, and six project deliverables of EU-funded projects.

Table 1. Synthesis and characterization of the reviewed papers.

Year	Type	Journal/Publisher	Title	Author(s)
2008	Art.	Technology Analysis & Strategic Management	The dynamics of sustainable innovation journeys.	Geels, Hekkert & Jacobsson [22]
2010	*Book*	*London: Nesta*	*The open book of social innovation*	*Murray, Caulier-Grice, & Mulgan* [23]
2012	Art.	Wiley Interdisciplinary Reviews: Climate Change	Climate policy processes, local institutions, and adaptation actions: mechanisms of translation and influence	Agarwal, A., Perrin, N., Chhatre, A., Benson, C. S., & Kononen, M. [24]
2012	*Book*	*Sage*	*The logic model guidebook: Better strategies for great results*	*Knowlton & Phillips* [20]
2014	Art.	Technological Forecasting and Social Change	Social innovation: Moving the field forward. A conceptual framework	Cajaiba-Santana [25]
2014	*Report*	*IPCC working group report*	*Technical summary—In: Climate Change 2014: Mitigation of Climate Change*	*Edenhofer, Pichs-Madruga, Soknoa, Kadner, Minx, Brunner, Agrawala, Baiocchi, et al.* [26]
2016	Art.	Design Studies	Evolution of design for sustainability: From product design to design for system innovations and transitions	Ceschin & Gaziulusoy [27]
2016	*Project del.*	*SIMPACT project report*	*Evaluation Toolbox: Ex-Ante Impact Assessment and Value Network Analysis for SI.*	*Dhondt, S., van de Ven, H., Cressey, P., Kaderabkova, A., Luna, Á., Moghadam Saman, S., Castro Spila, J., Ziauberyte, R., van der Torre, W., & Terstriep, J.* [28]
2016	Art.	Sustainability	Cities and systemic change for sustainability: Prevailing epistemologies and an emerging research agenda	Wolfram & Frantzeskaki [14]
2016	Art.	Journal of Cleaner Production	Low carbon lifestyles: A framework to structure consumption strategies and options to reduce carbon footprints	Schanes, Giljum, & Hertwich [7]
2016	*Art*	*Innovation: The European Journal of Social Science Research*	*Social innovation indicators*	*Unceta, Castro-Spila & Garcia Fronti* [29]
2016	*Project del.*	*SIMPACT project*	*Social Innovation Evaluation Toolbox*	*Castro-Spila, Cressey, Shondt, Kaderabkova, Luna, Moghadam Saman, Terstriep, van de Ven, van de Torre, & Ziauberyte* [30]
2017	Art.	Science	Sociotechnical transitions for deep decarbonization	Geels, Sovacool, Schwanen, & Sorrell [22]
2017	*Project del.*	*Deliverable 4.2 of theSIMRA Project*	*Set of methods to assess SI implications at different levels.*	*Secco, Pisani, Burlando, Da Re, Gatto, Pettenella, Vassilopoulos, Akinsete, Koundouri, Lopolito & Prosperi* [31]

Table 1. *Cont.*

Year	Type	Journal/Publisher	Title	Author(s)
2017	*Project del.*	*Deliverable of the Project: "Social Innovation: Driving Force of Social Change" (SI-DRIVE).*	*Social innovation in environment and climate change: summary report.*	*Schartinger, D., Wepner, B., Andersson, T., Abbas, Q., Asenova, D., Damianova, Z., Zirngiebl, M.* [32]
2017	Art.	Sustainable cities and society	An empirical investigation of social innovation initiatives for sustainable urban development	Angelidou & Psaltoglou [33]
2017	*Project del.*	*Deliverable 1.6 of the Project: "Social Innovation: Driving Force of Social Change" (SI-DRIVE).*	*Towards a general theory and typology of social innovation.*	*Howaldt, Schröder, Butzin & Rehfeld* [34]
2018	Art.	Innovation: The European Journal of Social Science Research	The (social) innovation—subjective wellbeing nexus: subjective well-being impacts as an additional assessment metric of technological and social innovations	Engelbrecht [12]
2018	Art.	Sustainability	Comparative analysis on citizen's subjective responses related to their willingness to pay for renewable energy in Japan using latent variables.	Nakano, Miwa & Morikawa [35]
2018	Art.	Sustainability	Social innovation and the energy transition	Hoppe & de Vries [36]
2018	Art.	Innovation: The European Journal of Social Science Research	The (social) innovation—subjective wellbeing nexus: subjective well-being impacts as an additional assessment metric of technological and social innovations	Engelbrecht [12]
2019	Art.	Forest Policy and Economics	Towards a method of evaluating social innovation in forest-dependent rural communities: First suggestions from a science-stakeholder collaboration.	Secco, Pisani, Da Re, Rogelja, Burlando, Vicentini, . . . & Nijnjk [37]
2020	Art.	Regional Studies, Regional Science	Incorporating innovation metrics in urban indices: the Sustain-LED Index.	Cantafio & Ryan [38]
2020	Art.	Technological Forecasting and Social Change	Micro-foundations of the multi-level perspective on socio-technical transitions: developing a multi-dimensional model of agency through crossovers between social constructivism, evolutionary economics and neo-institutional theory.	Geels [5]
2020	Art.	Energies	Collective action and social innovation in the energy sector: A mobilization model perspective.	Gregg, Nyborg, Hansen, Schwanitz, Wierling, Zeiss, & Padovan [4]
2020	Art.	European Planning Studies	Social Innovation Regime: an integrated approach to measure social innovation.	Unceta, Luna, Castro & Wintjes [13]
2020	*Art.*	*International Journal of Knowledge-Based Development*	*Implementing social innovation in real contexts*	*Rizzo, Deserti, & Komatsu* [39]
2020	Art.	European Planning Studies	Favourable social innovation ecosystem(s)?—An explorative approach	Terstriep, Rehfeld, & Kleverbeck [40]
2020	Art.	Sustainability	Citizen science and citizen energy communities: a systematic review and potential alliances for SDGs	Wuebben, Romero-Luis, & Gertrudix [41]
2020	Art.	Sustainability	Why sustainable development requires societal innovation and cannot be achieved without this	Diepenmaat, Kemp, & Velter [2]
2020	Art	Sustainability	Methodology for carbon footprint calculation towards sustainable innovation in intangible assets	Loyarte-López, Barral & Morla [42]
2020	Art	Climate Policy	The role of lifestyle changes in low-emissions development strategies: an economy-wide assessment for Brazil	Grottera, Lèbre La Rovere, Wills & Pereira [43]
2020	Art	Energy Policy	Public views of Scotland's path to decarbonization: Evidence from citizens' juries and focus groups	Ostfeld & Reiner [44]

Table 1. *Cont.*

Year	Type	Journal/Publisher	Title	Author(s)
2022	Art.	Environment, Development and Sustainability	Social innovation ecosystems and sustainability in cities: a study in Florianópolis, Brazil	Andion, Alperstedt, Graeff & Ronconi [6]
2021	Art.	Sustainability	Approaches to Social Innovation in Positive Energy Districts (PEDs)—A Comparison of Norwegian Projects	Baer, Loewen, Cheng, Thomsen, Wyckmans, Temeljotov-Salaj, & Ahlers [45]
2021	Art.	Journal of Cleaner Production	Social innovation related to ecological crises: A systematic literature review and a research agenda for strong sustainability	Haskell, Bonnedahl, & Stål [46]
2021	Art.	Nature Climate Change	A sustainable development pathway for climate action within the UN 2030 Agenda	Sörgel, Kriegler, Weindl, Rauner, Dirnaichner, Ruhe, . . . , & Popp [47]
2022	Art.	Nature Climate Change	Demand-side solutions to climate change mitigation consistent with high levels of well-being	Creutzig, Niamir, Bai Callaghan, Cullen, Días-José, Figueroa, Grubler, Lamb, Leip, Masanet, Mata, Mattauch, Minx, Mirasgedis, Mulugetta, Nugroho, Pathak, Perkins, Roy, de la Rue du Can, Saheb, Some, Steg, Steinberger, & Ürge-Vorsatz [48]
2022	Art.	Energy Research & Social Science	What effect does feedback have on energy conservation? Comparing previous household usage, neighbourhood usage, and social norms in Japan.	Mukai, T., Nishio, K. I., Komatsu, H., & Sasaki, M. [49]

Most of the resulting papers were published in 2020 and 2021, indicating that the topic has been receiving heightened attention very recently. In terms of sectors, papers were published in the fields of (10) sustainability (of which 8 were in the journal "*Sustainability*"), (9) production or technology, (8) public policy, (6) energy or (8) other fields including social science.

The analysis is provided in the next Section and is structured in three main categories. Firstly (Section 3.1), the reasons why social innovation should be considered for sustaining the journey toward climate neutrality are grouped and discussed. Secondly (Section 3.2), the relevance of social innovation is framed within the discourse energy transition with the aim of identifying relevant dimensions—which mainly regarded contextual factors and system changes. Thirdly (Section 3.3), the application of social innovation to the specific context of climate neutrality and energy transition is outlined, building on the insights of several EU-funded projects, which provide both structure and specific elements to populate the framework.

3. Literature Review: Social Innovation in the Context of Climate Neutrality

3.1. Evidence of Relevance of Social Innovation for Climate Neutrality

According to the identified articles, there are multiple reasons for considering social innovation a relevant lever for decarbonization. We can group the motivations into five progressive categories: from the most basic and necessary levels of (a) acceptance (3 articles) and (b) behaviour change (4 articles), to (c) the systemic consideration of socio-technical systems (6 articles) and (d) empowerment (9 articles), which (e) influence wellbeing (4 articles).

At the most basic level, it was outlined that if there is no *acceptance* by citizens, organizations (incumbent firms in particular), local governments, and various actors, energy transitions will fail [4,35]. Social innovations can provide a relevant contribution to climate neutrality by shaping *behavioural change* toward more sustainable practices [7,42,43,49]. Schanes et al. [7] (p. 1033) report 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" [26] (p. 20).

Thirdly, a relevant number of the 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" [50] (p. 521). In a highly cited paper published in *Science*, Geels et al. [22] discuss socio-technical transitions for decarbonization, offering an overall framework that considers the technical and social aspects, including people's behaviour and the relevance of framing the discourse. Their argument is based on the case reported by Rosenbloom, Berton and Meadowcroft [51] (p. 1275) that discusses solar electricity in Ontario through a "discursive approach to understanding multi-dimensional interactions within socio-technical transitions" with a new analytic approach that connects discourses and storylines to transitions.

Among the reviewed articles, the most discussed reason for paying attention to social innovation when addressing carbon neutrality is found in its supporting actors' *empowerment* to take actions to tackle climate issues. Diepenmaat, Kemp and Velter [2] 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 of transitions and discuss societal innovation as a distinctive innovation type. They propose an "innovation cube" and advance the "need for broader partnerships for societal innovation based on multiple value creation" (p. 1270). They further 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 to find and sustain new business models for a circular economy [2]. Wuebben et al. [41] (p. 567) conducted a systematic review of "Citizen Science and Citizen Energy Communities" for Sustainable Development Goals (SDGs) and called 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 Scotland's journey to decarbonization, Ostfeld and Reiner [44] report on the effects of citizens' juries and focus groups. Agarwal et al. [24], 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 [. . .] improving accountability of local decision makers to their constituents" (p. 565).

Finally, four recent papers focus on wellbeing, as it is (or should be) the final goal of all social and technological innovations. Engelbrecht [12] highlights the need to consider wellbeing when assessing technological and social innovations because we cannot assume that innovations are desirable per se, and should remain focused on the final desired societal outcome. The work of Hoppe and De Vries [36] also 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). Cantafio and Ryan [38] develop the Sustain–LED index to measure the liveability of US metropolitan areas. Creutzig et al. [48] demonstrate that demand-side solutions for climate change mitigation are not only useful to support decarbonization but also to increase levels of well-being. Specifically, they propose a classification of three "mitigation potential of demand-side options: avoid, shift, improve" (p. 36), which seem relevant to classifying social innovations, particularly in the context of circular economy.

After establishing the key contributions that social innovation can provide for supporting the transition to carbon neutrality, we review the theoretical models and frameworks emerged from the literature that can be relevant for social innovation assessment. We describe papers starting from the broad context of transitions to climate neutrality in the next Section 3.2), then narrowing the focus to social innovation specificities in the following Section 3.3).

3.2. The Context

In a highly cited paper published in *Science*, Geels et al. [22] 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, when

combined, deliver value for society (Figure 2). They present the Multi-Level Perspective (MLP) framework for understanding the complex causal mechanisms that characterize systems transitions for deep decarbonization. They 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 (visualized by thick blue arrows) can bring radical innovation breakthroughs, which trigger adjustments to socio-technical systems. 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" [22] (p. 1244).

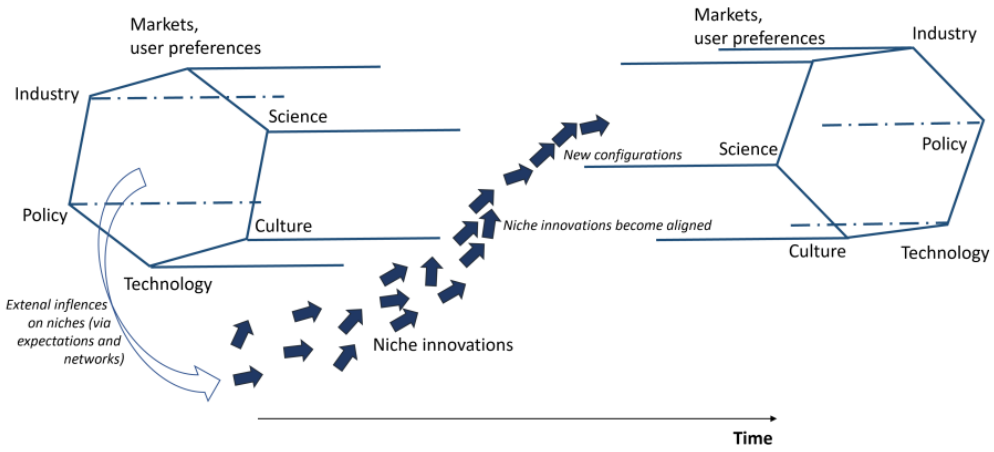

Figure 2. Socio-technical system elements. Simplified and adapted from [22].

In particular, it is argued that to motivate citizens to change their 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. Businesses and citizens' support toward decarbonization can be built "through bottom-up learning processes, participatory governance and polycentric stakeholder" [22] (p. 1245).

In a more recent paper, the same author [5] 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 these 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 constructivism approach, Geels [5] identified the "idealist bias (limited attention for competition, markets, financial resources)", "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 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)" are found among the weakness of the approach [5] (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" [5] (p. 11).

In the paper "Why Sustainable Development Requires Societal Innovation and Cannot Be Achieved without This", Diepenmaat, Kemp and Velter [2] 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, on sustainability strategy and on sustainability transitions, adding the "recursive perspective on innovation and society" 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" [2] (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" [2] (p. 13). Their work presents a historical discussion of the modalities in which businesses address 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" [2] (p. 3).

In the article, they specifically review societal innovation, framing it as a systemic type of innovation that 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)" [2] (p. 16). The focus on design thinking is justified by the method's ability to find configurations that are suitable for several actors (users, governments, finance). They base their argument on the work of Ceschin and Gaziulusoy [27], who visually presented the evolution of design for the field of sustainability: from the level of product design to that of product-service system, then spatio-social and, finally, to the socio-technical system level (p. 17). Thus, more recently, the focus of design has 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 [27] (p. 31).

Wolfram and Frantzeskaki [14] conducted a qualitative analysis of the literature on systemic change for sustainability, specifically for the urban context, and identified four key drivers of change: "(A) transforming urban metabolisms and political ecologies; (B) configuring urban innovation systems for green economies; (C) building adaptive urban communities and ecosystems; and (D) empowering urban grassroots niches and social innovation" (p. 1)

Creutzig, Niamir, Bai et al. [48] analysed mitigation solutions in terms of their effects on human wellbeing. Although such solutions are usually evaluated in terms of GHG (greenhouse gases) reduction, they systematically assessed the potential of demand-side solutions in terms of *avoiding*, *shifting* and *improving* consumption, and calculated the link to human wellbeing. With a methodology based on expert judgment and an analysis of extant literature, they evaluated "306 combinations of well-being 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." (p. 36). In terms of solutions' categories, they identify: (1) Building: sufficiency, efficiency; lower carbon and renewable energy; (2) Food: food waste, overconsumptions, 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, circular economy [48].

3.3. Social Innovation Models and Frameworks Applied to Climate Neutrality and Sustainability

According to Unceta et al. [13], social innovation "measurement and socioeconomic impact have been a required and challenging area of research inside SI studies for a long time, as 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 the major and determining methodological tools and indicators involved in its measurement and impact assessment. 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" [29] (p. 908).

A Special Issue on "Social innovation and the energy transition" was published in the journal *Sustainability* in 2018, with 20 articles contributing to the topic from different academic disciplines. The Special Issue editors [36] categorize the contributions into key topics that are 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 behavioural change; and (vi), serious energy games" (p. 141).

A recent literature review on "social innovation related to ecological crises" has analysed the 40 most relevant articles related to the topic and found that only five explicitly aligned with the definition of *strong* sustainability [46]. For the literature analysis, the authors deployed the framework developed by Howaldt et al. [34] which combines innovation studies and theories of social change. The framework was developed within the EU-funded project SI Drive: it focuses on social practices oriented toward societal challenges and has already been specifically applied to environmental challenges [32]. The framework is composed of five dimensions that can guide stakeholders in facilitating social innovation development. The focus is on an audience of policymakers and actors within the civil society, with the aim to assess the potential for diffusion when social innovations are imitated and diffused across contexts [46]. The five dimensions of the framework (Figure 3; [34]) 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 EU-funded research projects, Terstriep, Rehfeld and Kleverbeck [40] reflect on social innovation ecosystems. The results suggest that the establishment of a social innovation ecosystem 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 analysed SIMPACT project [13,39], a practical framework is proposed [28,30] for policymakers and social innovators to forecast ex ante the potential impact of social impact options. This 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.

A very comprehensive framework for evaluating social innovation has been developed by Secco and colleagues ([37], Figure 4) and applied to a variety of contexts, from forest-dependent rural communities [37] to social farming, community energy, and food cooperatives. The framework is the backbone of the EU-funded project Social Innovation for Marginalized Rural Areas (SIMRA) and has been utilized in the assessment of social innovations across Europe. It was established based on a literature review of over hundreds of existing social innovation papers [37]—not necessarily specific to climate neutrality—with the aim of developing a method and categories for evaluating social innovations in rural areas. The resulting SIMRA framework particularly builds on the Theory-of-Change approach, detailing the causal mechanisms that led to changes, which is

the basis of any evaluation approach. More specifically, it outlines the intervention logic (logic model) that provides the causal link from inputs to activities, which lead to outputs and culminate into outcome and impacts, with the additional contribution of feedback and learning processes that loops back. The comprehensive SIMRA framework [31] includes an analysis of the context that considers nine main elements: (1) the trigger (that is, individual and collective needs), (2) the perceived context at international, national, regional and local level, (3) the agents (ideas, values, willingness, reflexivity, capacity for change) which influence the context and the (4) preparatory actions for collective benefit, which in turn affect the (5a) 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 service, and, consequently, (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 the social innovation activities. In practical terms, these nine key aspects are assessed with a mixed quantitative-qualitative methodology [31] and a combination of expert and participatory-based evaluations [37].

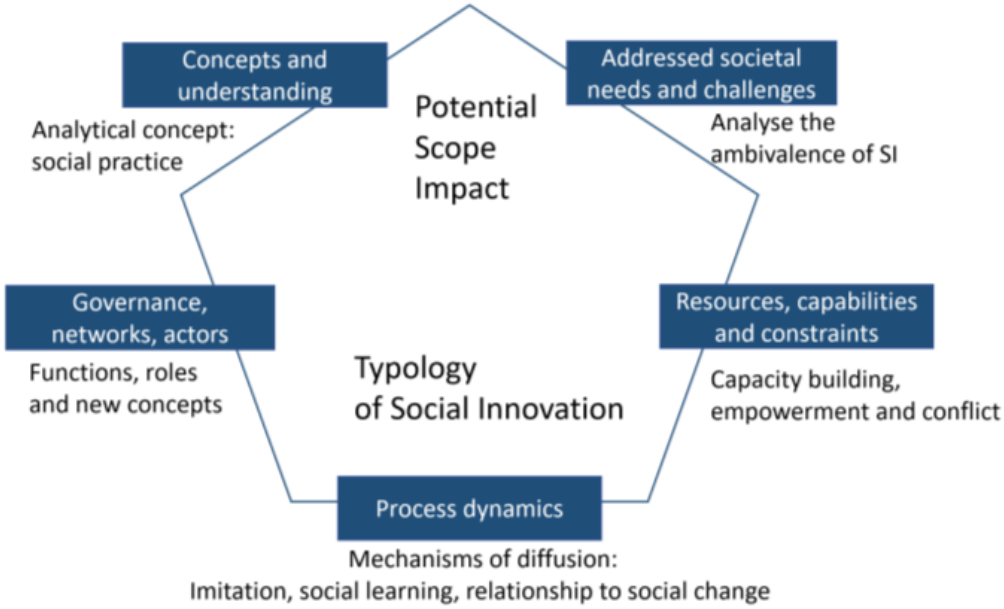

Figure 3. SI Drive framework. Adapted from: [34]. SI Drive project key dimensions of social innovation.

The Regional Social Innovation Index (RESINDEX) Model [29] 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 earning, (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 and colleagues [6] proposed five dimensions that reinforce or hinder social innovation in cities, based on the case of the Brazilian city Florianopolis. The dimensions are categorized according to the scale of analysis: macro, meso and micro levels. 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 public arena" [6] (p. 1276).

Angelidou and Psaltoglou [33] 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 analysed the literature to identify domains of social innovation for sustainable urban development, categorized into content (principal subject, sustainability challenge, urban setting characteristics), process (organization type, innovation mechanism, and ICT component), and empowerment (type, beneficiaries, outcome).

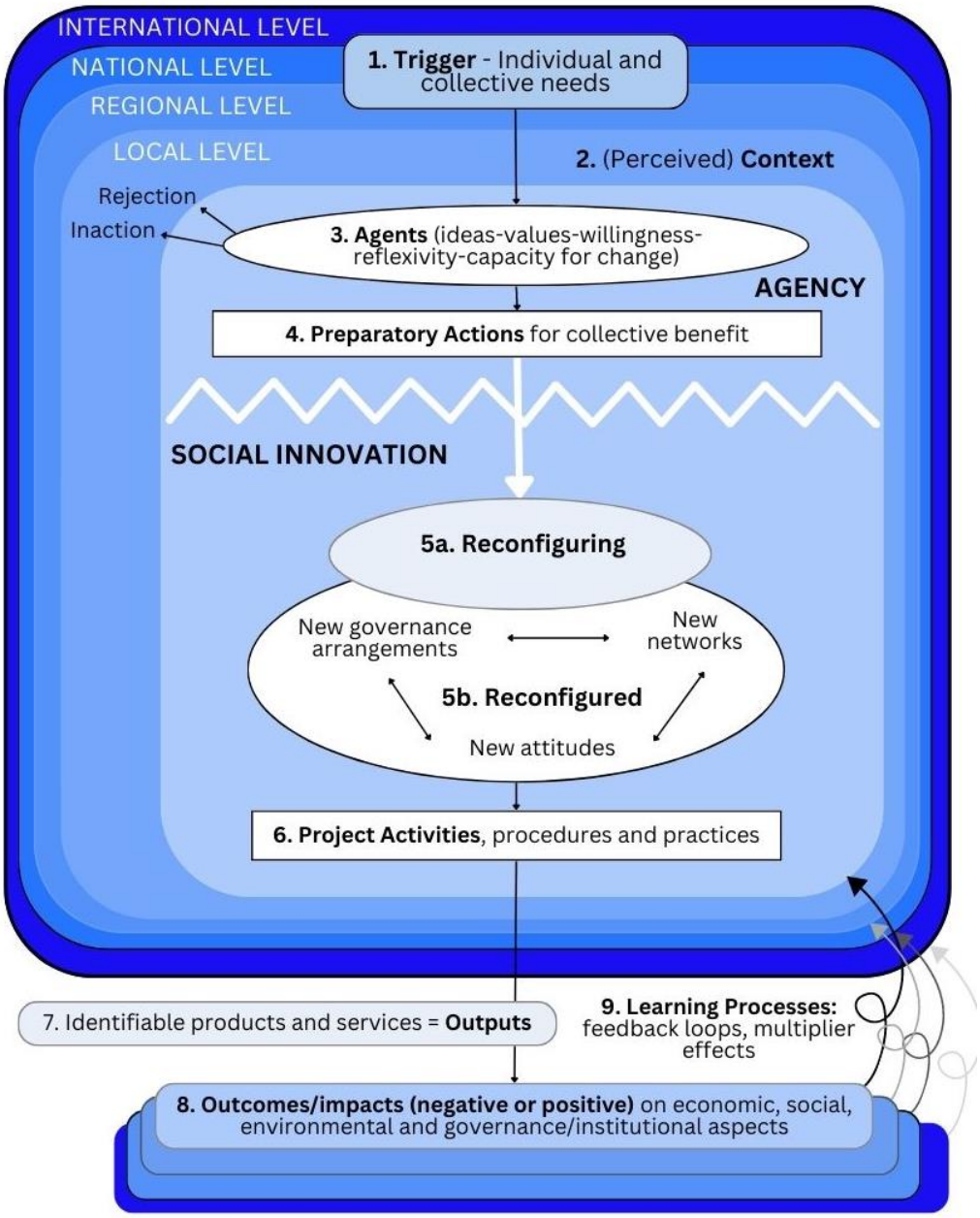

Figure 4. The SIMRA framework adapted from [31].

In 2014, Cajaiba-Santana [25] proposed an approach to go beyond the polarization between "agentic and structuralist approaches" of social innovation, and proposed an integrated model, which sees an agent at the same time as being enabled and constrained by institutions in the re-creation of social systems.

Baer et al. [45] 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.

Focusing solely on the human agency level, Angelidou and Psaltoglou [33] (p. 113) provide 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'".

4. Toward a Comprehensive Framework of Social Innovation for Climate Neutrality

4.1. Structure of the Framework

The literature reviewed above provides an overview of the rich body of knowledge which was recently developed regarding social innovation for environmental sustainability and climate neutrality. However, such complexity needs to be synthesized in order to be manageable and actionable by citizens and societal actors. In order to reduce complexity, we graphically mapped the dimensions, categories and characteristics identified in the literature using the well-established logic model [20] as the underpinning structure (Appendix A) and then mapping content according to semantic similarity (Figure 5). Given the broad number of elements identified for the category of social innovation actions/initiatives, some of the original categories of the logic model were expanded. In particular, the social innovation actions category was further organized into three sub-categories: social innovation capacity building activities, types of social innovation activities and scaling approaches. While we are aware that the sub-dimensions are not necessarily mutually exclusive (particularly considering that systemic change requires multiple co-occurring strategies), we found the clustering useful to organize the multitude of social innovation approaches and initiatives sourced from the literature. For the mapping of the extant literature, capacity building seemed to emerge as a pre-requisite for supporting the emergence and scaling of social innovation initiatives, thus indicating a sequential pathway. The categories related to the results were defined according to the newest labelling adopted by the European Commission (Horizon Europe Key Impact Pathways): results, output and impacts.

In the visual map (Appendix A and Figure 5), columns correspond to three key categories (identified with dark blue color): (1) *Input*—composed of (1.1) *resources*; (2) *Social Innovation Activities*—composed of (2.1) *capacity building*, (2.2) *types of social innovation activities*, and (2.3) *scaling*; (3) *results*—composed of (3.1) *outputs,* which are concrete immediate results of activities; (3.2) *outcomes,* which are assessed in the medium-term, and (3.3) *impacts,* which are broader changes measured in the long-term.

Scholars seem to have recently converged toward focusing on the ultimate goal of *wellbeing*, symbolized in Figure 5 (and Appendix A) with the target: the relevance of having a clear and shared goal is particularly relevant for defining social innovation pathways for climate neutrality, where the goal is not only the reduction in greenhouse gasses but, more broadly, physical and mental wellbeing for all [12,36,38,48].

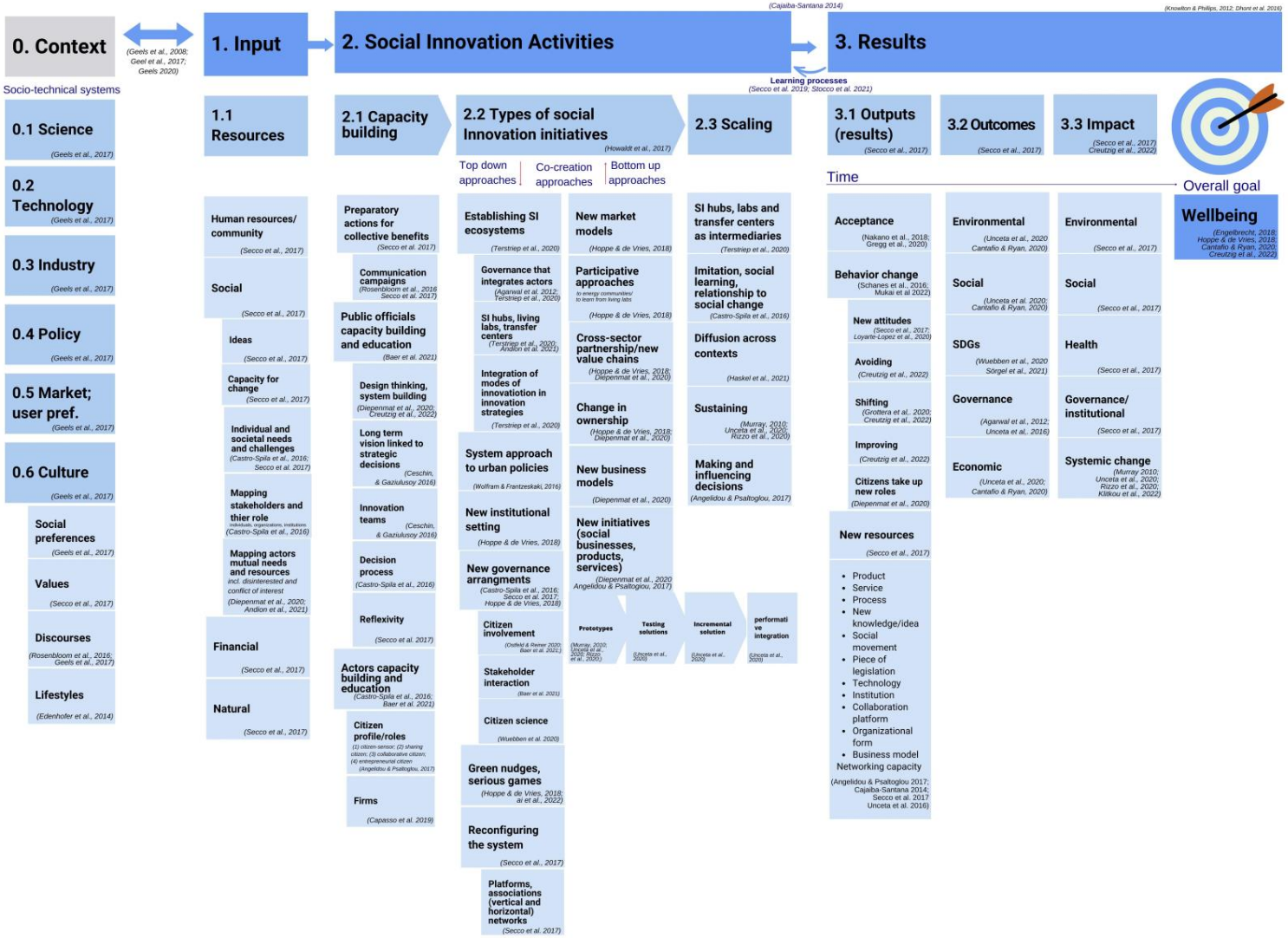

Figure 5. A comprehensive framework of Social Innovation for Climate Neutrality [1,2,4,6,8,12–14,20–23,26,27,30,31,33,35–41,44–49,51–53].

4.2. Elements of the Framework

For each category of the framework, specific concepts or actions are listed and related scientific references are reported in brackets. On the left-hand side of the map, the *context* (category 0) is characterized with the six elements of socio-technical systems identified by Geels et al. [22]: *(0.1) science, (0.2) technology, (0.3) industry, (0.4) policy, (0.5) market and user preferences, (0.6) culture*. The last element of *culture* is further detailed in the context of social innovation contribution to climate neutrality into social preferences [22], values [31], discourses (i.e., in the media; [22,51] and lifestyles [26].

The *context* influences the *input* (category 1 of the framework), which correspond to *(1.1) resources* that feed and shape the emergence and growth of social innovation. In more details, scholars identified resources in terms of *human resources* [31] including community intended as human resources; *social resources* [31], and *financial* and *natural* resources [31]. With regard specifically to social resources, scholars identify ideas [31], capacity for change [31], the identification and awareness of societal needs and challenges [30,31].

The second category—*social innovations actions*—is the heart of the framework and structures scholarly contributions regarding social innovation activities into a pathway composed of (2.1) *capacity building*, (2.2) *types of social innovation initiatives*, and (2.3) *scaling*. *Capacity building* (2.1) activities are identified as a pre-requisite for further actions and can be clustered in *preparatory actions for collective benefit* [31], *public officials' capacity building and education*, *actors' capacity building and education*. The literature provides specific methods and actions, which are further detailed in the framework (Figure 5). After building capacity, social innovation initiatives can be created with top-down approaches and/or bottom up-approaches. *Top-down approaches* are actions developed by governmental actors such as cities, which include the deliberate design of activities and infrastructure for the emergence and scaling of social innovations, such as developing *social innovation ecosystems* [40], taking a *systemic approach to (urban) policies* [14], *develop new institutional settings* [36] and even *new governance arrangements* (Hoppe & de Vries, 2017) [30,31,36], i.e., with increased stakeholder interaction and citizen involvement, including with citizen science methods. Other methods outlined by the literature are *nudging and serious games* [36,49], and *reconfiguring the system* [31] such as with novel platforms, associations and networks.

Bottom up and *participative approaches* for the creation of social innovation initiatives supporting climate neutrality are typically started as market-driven or grassroot initiatives and entail *new market models* [36], *participative approaches to establish energy communities* [36,54], *cross-sector partnership/new value chains* [2,36,52], *change in the ownership* (i.e., of energy; [2,36]), the *emergence of new business models* [2], and *new initiatives including social businesses, products, services* [2,33]. The emergence of such new initiatives usually follows a four-step process: developing prototypes, testing them, obtaining an incremental solution, and integrating it into the system [13].

After prototyping and testing, when new initiatives demonstrate their sustainability, scaling strategies support the growing the impact. The literature identifies scaling strategies and methods (category 2.3): *SI hubs, labs and transfer centers as intermediaries* [40], *imitation, social learning, relationship to social change* [30], *diffusion across contexts* [46], *sustaining new initiatives after the initial hype* [13,23,39], and *making and influencing decisions* [33] such as at the policy making level [53].

The category of *results* (3) is composed of *outputs* (3.1), *outcomes* (3.2) and *impacts* (3.3)—according to the logic model [20] and to the European Commission's definitions. These sub-categories do not only differ in terms of timing but also in terms of level of assessment. For instance, the implementation of a social innovation initiative, a novel sharing practice in a neighborhood, can be immediately assessed in terms of *output* by measuring how many people took part to the initiative or how many items were shared. *Outcomes* can be measured in terms of sustained changes in the practices and social dynamics of the neighborhood with a medium-term timeframe (i.e., two years from the start of the

initiative). Impacts are typically measured with a longer timeframe (i.e., 5 years or more) and are related to systemic and cultural changes, which can be assessed but cannot be uniquely attributed to the specific social innovation initiative. According to the literature, outputs can be classified into the following: *acceptance, behavior change, new resources* (incl. products, services, processes, knowledge, social movements, legislations, collaborative platforms, etc.). Outcomes and impacts can be assessed at numerous levels: *environmental, social, governance, economic, with the SDGs* (United Nations' 17 Sustainable Development Goals) [47], *health* and ultimately *systemic change*.

5. Discussion

Visually mapping the extant literature regarding social innovation for climate neutrality offers a multi-faceted overview, indicating the variety of levels and perspectives adopted by researchers in diverse fields. It provides a picture of the rich contributions of scholars to the understanding of social innovations potential contribution to the pressing global challenge of climate neutrality.

The categories of the framework can be useful for scholar and practitioners, as a pathway outlining the connection between inputs (category 1), initiatives (category 2) and their results (category 3), considering contextual factors (category 0), and that mapping input and developing capacity (within governmental/urban actors as well as with citizens and stakeholder) should be conducted before developing actual initiatives. The results' categorization into outputs, outcomes and impacts can help scholars, policymakers and stakeholders (such as citizens, firms, organizations, etc.), to align the vocabulary and measurement logics. Such a framework is utilized in the EU-funded NetZeroCities project which involves 112 European cities.

In addition, the framework is populated with key contributions from the academic literature, which are semantically clustered, and thus offers a structured synthesis of the available scientific knowledge. Such a structured mapping outlines that, in the extant literature, a rich contribution can be found regarding the categories of context (0), input (1), social innovation initiatives' capacity-building (2.1) and types of social innovation initiatives (2.2), while there is no systematic understanding of social innovation scaling strategies and methods (2.3). Thus, future research should focus on identifying and systematizing strategies and methods to grown and diffuse social innovations, and to deliberately design ecosystems that allow for social innovation initiatives for climate neutrality to scale.

Secondly, the literature's contribution to the category of results (3) is still not specific to social innovation for climate neutrality: contributions can mostly be found in papers on social innovation, which can be adapted to climate neutrality applications. However, this is an important gap in the current literature, because assessing social innovations' role in the journey toward climate neutrality requires a dedicated approach with specific sub-categories and specific indicators. Such a gap should be addressed by scholar with transdisciplinary approaches that integrate social and environmental sciences, as well as the identification of feasible and measurable impact categories and a focus on wellbeing [12,38,48].

Finally, the framework can be utilized by scholars to further map the evolution of the scholarly literature, and to cluster real cases, matching cases to the identified categories and types of initiatives.

6. Implications and Conclusions

Our work contributes to theory by starting to systematize the available knowledge on the dimensions that influence social innovation, specifically for climate neutrality. The comprehensive multi-disciplinary framework has practical implications, as it can be utilized to support the strategizing, selecting, designing and assessing of a social innovation's impact for a sustainable society. The visual mapping seems to indicate that scholars, citizens and policymakers may find it useful to acknowledge the complexity of the discourse of social innovation's contribution to climate neutrality.

Readers should be aware that the methodology employed for this study is not free of limitations: a search with the same criteria in different databases, such as Scopus or Web of Science, could lead to the identification of different articles. The proposed framework has the limitation of providing categories that are not mutually exclusive: specific social innovations might well extend across multiple categories, precisely because the framework is intended as a pathway. Thus, specific approaches or initiatives could be found or placed under multiple categories. Secondly, the mapping and clustering of concepts was performed manually, with a qualitative approach; a certain degree of uncertainty can thus be expected, and could be further populated as knowledge of the topic advances.

Nevertheless, we believe the framework can provide a structured overview and guidance for researchers and citizens. We presented models and frameworks from extant literature, then aggregated and categorized all the dimensions that emerged. The resulting framework is theoretically grounded 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 has come for a comprehensive framework to help cope with the complexity of the challenge of addressing climate action.

Author Contributions: Conceptualization, S.B., F.R. and A.D.; methodology, S.B., F.R. and A.D.; data collection S.B., conceptualization, S.B., F.R. and A.D.; writing—original draft preparation, S.B.; writing—review and editing, S.B., F.R. and A.D.; visualization, S.B.; funding acquisition, F.R. and A.D. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 101036519 NetZeroCities. The APC was funded by the project.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: The authors are thankful to Francesco Mureddu, Hedwige Serot Almeras, Marzia Mortati, Nikhil Chaudhary, Tamami Komatsu and the three anonymous reviewers.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

Appendix A

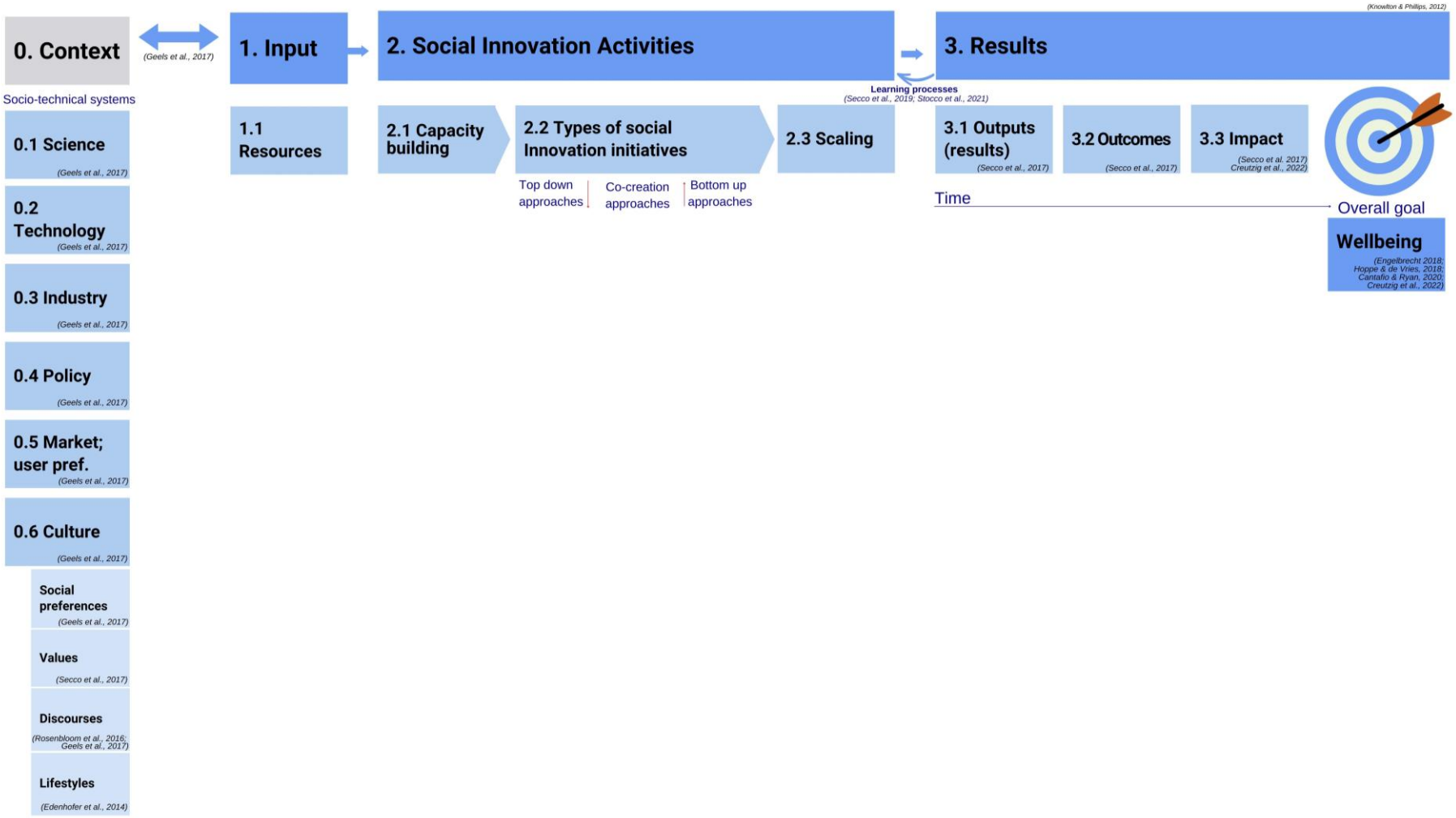

Figure A1. Structure of the Framework of Social Innovation for Climate Neutrality [12,21,22,26,31,36–38,48,51].

References

1. Bolwig, S.; Bolkesjø, T.F.; Klitkou, A.; Lund, P.D.; Bergaentzlé, C.; Borch, K.; Olsena, O.J.; Kirkerudb, J.G.; Chen, Y.; Gunkel, P.A.; et al. Climate-friendly but socially rejected energy-transition pathways: The integration of techno-economic and socio-technical approaches in the Nordic-Baltic region. *Energy Res. Soc. Sci.* **2020**, *67*, 101559. [CrossRef]
2. Diepenmaat, H.; Kemp, R.; Velter, M. Why sustainable development requires societal innovation and cannot be achieved without this. *Sustainability* **2020**, *12*, 1270. [CrossRef]
3. Kempenaar, A.; Puerari, E.; Pleijte, M.; van Buuren, M. Regional design ateliers on 'energy and space': Systemic transition arenas in energy transition processes. *Eur. Plan. Stud.* **2021**, *29*, 762–778. [CrossRef]
4. Gregg, J.S.; Nyborg, S.; Hansen, M.; Schwanitz, V.J.; Wierling, A.; Zeiss, J.P.; Delvaux, S.; Saenz, V.; Álvarez, L.P. Collective action and social innovation in the energy sector: A mobilization model perspective. *Energies* **2020**, *13*, 651. [CrossRef]
5. Geels, F.W. Micro-foundations of the multi-level perspective on socio-technical transitions: Developing a multi-dimensional model of agency through crossovers between social constructivism, evolutionary economics and neo-institutional theory. *Technol. Forecast. Soc. Chang.* **2020**, *152*, 119894. [CrossRef]
6. Andion, C.; Alperstedt, G.D.; Graeff, J.F.; Ronconi, L. Social innovation ecosystems and sustainability in cities: A study in Florianópolis, Brazil. *Environ. Dev. Sustain.* **2022**, *24*, 1259–1281. [CrossRef]
7. Schanes, K.; Giljum, S.; Hertwich, E. Low carbon lifestyles: A framework to structure consumption strategies and options to reduce carbon footprints. *J. Clean. Prod.* **2016**, *139*, 1033–1043. [CrossRef]
8. Klitkou, A.; Bolwig, S.; Huber, A.; Ingeborgrud, L.; Pluciński, P.; Rohracher, H.; Schartinger, D.; Thiene, M.; Żuk, P. The interconnected dynamics of social practices and their implications for transformative change: A review. *Sustain. Prod. Consum.* **2022**, *31*, 603–614. [CrossRef]
9. Bugge, M.M.; Fevolden, A.M.; Klitkou, A. Governance for system optimization and system change: The case of urban waste. *Res. Policy* **2019**, *48*, 1076–1090. [CrossRef]
10. Puerari, E.; De Koning, J.I.; Von Wirth, T.; Karré, P.M.; Mulder, I.J.; Loorbach, D.A. Co-creation dynamics in urban living labs. *Sustainability* **2018**, *10*, 1893. [CrossRef]
11. Eschweiler, J.; Brandsen, T.; Ecchia, G.; Nogales, R. Co-Creating a Social Innovation Research Agenda for Europe; Social Innovation Europe/EMES Network, Belgium. 2016. Available online: https://emes.net/content/uploads/research/social-innovation-europe-sie/SIE-CoSIRA-report_July2016.pdf (accessed on 17 October 2022).
12. Engelbrecht, H.-J. The (social) innovation—subjective wellbeing nexus: Subjective well-being impacts as an additional assessment metric of technological and social innovations. *Innov. Eur. J. Soc. Sci. Res.* **2018**, *31*, 317–332. [CrossRef]
13. Unceta, A.; Luna, Á.; Castro, J.; Wintjes, R. Social Innovation Regime: An integrated approach to measure social innovation. *Eur. Plan. Stud.* **2020**, *28*, 906–924. [CrossRef]
14. Wolfram, M.; Frantzeskaki, N. Cities and systemic change for sustainability: Prevailing epistemologies and an emerging research agenda. *Sustainability* **2016**, *8*, 144. [CrossRef]
15. Yanez, S.; Uruburu, A.; Moreno, A.; Lumbreras, J. The sustainability report as an essential tool for the holistic and strategic vision of higher education institutions. *J. Clean. Prod.* **2019**, *207*, 57–66. [CrossRef]
16. Capasso, M.; Hansen, T.; Heiberg, J.; Klitkou, A.; Steen, M. Green growth–A synthesis of scientific findings. *Technol. Forecast. Soc. Change* **2019**, *146*, 390–402. [CrossRef]
17. Star, S.L.; Griesemer, J.R. Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39. *Soc. Stud. Sci.* **1989**, *19*, 387–420. [CrossRef]
18. Moher, D.; Altman, D.G.; Liberati, A.; Tetzlaff, J. PRISMA statement. *Epidemiology* **2011**, *22*, 128. [CrossRef]
19. Page, M.J.; McKenzie, J.E.; Bossuyt, P.M.; Boutron, I.; Hoffmann, T.C.; Mulrow, C.D.; Shamseer, L.; Tetzlaff, J.M.; Akl, E.A.; Brennan, S.E.; et al. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ* **2021**, *372*, n71. [CrossRef]
20. Knowlton, L.W.; Phillips, C.C. *The Logic Model Guidebook: Better Strategies for Great Results*; Sage: New York, NY, USA, 2012.
21. Stocco, N.; Gardona, F.; Biddau, F.; Cottone, P.F. Learning Processes and Agency in the Decarbonization Context: A Systematic Review through a Cultural Psychology Point of View. *Sustainability* **2021**, *13*, 425. [CrossRef]
22. Geels, F.W.; Sovacool, B.K.; Schwanen, T.; Sorrell, S. Sociotechnical transitions for deep decarbonization. *Science* **2017**, *357*, 1242–1244. [CrossRef]
23. Murray, R.; Caulier-Grice, J.; Mulgan, G. *The Open Book of Social Innovation*; Nesta: London, UK, 2010; Volume 24.
24. Agarwal, A.; Perrin, N.; Chhatre, A.; Benson, C.S.; Kononen, M. Climate policy processes, local institutions, and adaptation actions: Mechanisms of translation and influence. *Wiley Interdiscip. Rev. Clim. Chang.* **2012**, *3*, 565–579. [CrossRef]
25. Cajaiba-Santana, G. Social innovation: Moving the field forward. A conceptual framework. *Technol. Forecast. Soc. Chang.* **2014**, *82*, 42–51. [CrossRef]
26. Edenhofer, O.; Pichs-Madruga, R.; Sokona, Y.; Kadner, S.; Minx, J.C.; Brunner, S.; Agrawala, S.; Baiocchi, G.; Igor, B.; Gabriel, B.; et al. Technical summary. In *Climate Change 2014: Mitigation of Climate Change. IPCC Working Group III Contribution to AR5*; Cambridge University Press: Cambridge, UK, 2014.
27. Ceschin, F.; Gaziulusoy, I. Evolution of design for sustainability: From product design to design for system innovations and transitions. *Des. Stud.* **2016**, *47*, 118–163. [CrossRef]

28. Dhondt, S.; van de Ven, H.; Cressey, P.; Kaderabkova, A.; Luna, Á.; Moghadam Saman, S.; Castro Spila, J.; Ziauberyte, R.; van der Torre, W.; Terstriep, J. *Evaluation Toolbox: Ex-Ante Impact Assessment and Value Network Analysis for SI*; SIMPACT Project Report: Gelsenkirchen, Germany, 2016. Available online: http://docplayer.net/125674671-Simpact-project-report.html (accessed on 17 October 2022).
29. Unceta, A.; Castro-Spila, J.; Garcia Fronti, J. Social innovation indicators. *Innov. Eur. J. Soc. Sci. Res.* **2016**, *29*, 192–204. [CrossRef]
30. Castro-Spila, J.; Cressey, P.; Shondt, S.; Kaderabkova, A.; Luna, A.; Moghadam Saman, S.; Terstriep, J.; van de Ven, A.; van der Torre, W.; Ziauberyte, R. *Social Innovation Evaluation Toolbox*; SIMPACT Project; Institute for Work and Technology, Westfaelische Hochschule, University of Applied Sciences: Gelsenkirchen, Germany, 2016; ISSN 2365-1121.
31. Secco, L.; Pisani, E.; Burlando, C.; Da Re, R.; Gatto, P.; Pettenella, D.; Vassilopoulos, A.; Akinsete, E.; Koundouri, P.; Lopolito, A.; et al. Set of methods to assess SI implications at different levels. In *Deliverable 4.2 of the SIMRA Project*; EU: Brussels, Belgium, 2017. Available online: http://www.simra-h2020.eu/wp-content/uploads/2017/10/SIMRA_D4.2_Set_of_Methods_to_Assess_SI_Implications_at_Different_Levels_Instructions_for_WPs_5_and_6.pdf (accessed on 17 October 2022).
32. Schartinger, D.; Wepner, B.; Andersson, T.; Abbas, Q.; Asenova, D.; Damianova, Z.; Zirngiebl, M. Social innovation in environment and climate change: Summary report. In *SI-Driver EU Project Deliverable*; Technische Universität Dortmund: Dortmund, Germany, 2017.
33. Angelidou, M.; Psaltoglou, A. An empirical investigation of social innovation initiatives for sustainable urban development. *Sustain. Cities Soc.* **2017**, *33*, 113–125. [CrossRef]
34. Howaldt, J.; Schröder, A.; Butzin, A.; Rehfeld, D. Towards a general theory and typology of social innovation. SI-DRIVE Deliverable, 1.6 of the Project. In *Social Innovation: Driving Force of Social Change (SI-DRIVE)*; Sozialforschungstelle: Dortmund, Germany, 2017.
35. Nakano, R.; Miwa, T.; Morikawa, T. Comparative analysis on citizen's subjective responses related to their willingness to pay for renewable energy in japan using latent variables. *Sustainability* **2018**, *10*, 2423. [CrossRef]
36. Hoppe, T.; De Vries, G. Social innovation and the energy transition. *Sustainability* **2018**, *11*, 141. [CrossRef]
37. Secco, L.; Pisani, E.; Da Re, R.; Rogelja, T.; Burlando, C.; Vicentini, K.; Pettenella, D.; Masiero, M.; Miller, D.; Nijnjk, M. Towards a method of evaluating social innovation in forest-dependent rural communities: First suggestions from a science-stakeholder collaboration. *For. Policy Econ.* **2019**, *104*, 9–22. [CrossRef]
38. Cantafio, G.U.; Ryan, S. Incorporating innovation metrics in urban indices: The Sustain-LED Index. *Reg. Stud. Reg. Sci.* **2020**, *7*, 133–163. [CrossRef]
39. Rizzo, F.; Deserti, A.; Komatsu, T. Implementing social innovation in real contexts. *Int. J. Knowl. Based Dev.* **2020**, *11*, 45–67. [CrossRef]
40. Terstriep, J.; Rehfeld, D.; Kleverbeck, M. Favourable social innovation ecosystem(s)?—An explorative approach. *Eur. Plan. Stud.* **2020**, *28*, 881–905. [CrossRef]
41. Wuebben, D.; Romero-Luis, J.; Gertrudix, M. Citizen science and citizen energy communities: A systematic review and potential alliances for SDGs. *Sustainability* **2020**, *12*, 96. [CrossRef]
42. Loyarte-López, E.; Barral, M.; Morla, J.C. Methodology for carbon footprint calculation towards sustainable innovation in intangible assets. *Sustainability* **2020**, *12*, 1629. [CrossRef]
43. Grottera, C.; Lèbre La Rovere, E.; Wills, W.; Pereira Jr., A. O. The role of lifestyle changes in low-emissions development strategies: An economy-wide assessment for Brazil. *Clim. Policy* **2020**, *20*, 217–233. [CrossRef]
44. Ostfeld, R.; Reiner, D.M. Public views of Scotland's path to decarbonization: Evidence from citizens' juries and focus groups. *Energy Policy* **2020**, *140*, 111332. [CrossRef]
45. Baer, D.; Loewen, B.; Cheng, C.; Thomsen, J.; Wyckmans, A.; Temeljotov-Salaj, A.; Ahlers, D. Approaches to Social Innovation in Positive Energy Districts (PEDs)—A Comparison of Norwegian Projects. *Sustainability* **2021**, *13*, 7362. [CrossRef]
46. Haskell, L.; Bonnedahl, K.J.; Stål, H.I. Social innovation related to ecological crises: A systematic literature review and a research agenda for strong sustainability. *J. Clean. Prod.* **2021**, *325*, 129316. [CrossRef]
47. Sörgel, B.; Kriegler, E.; Weindl, I.; Rauner, S.; Dirnaichner, A.; Ruhe, C.; Hofmann, M.; Bauer, N.; Bertram, C.; Bodirsky, B.L.; et al. A sustainable development pathway for climate action within the UN 2030 Agenda. *Nat. Clim. Chang.* **2021**, *11*, 656–664. [CrossRef]
48. Creutzig, F.; Niamir, L.; Bai, X.; Callaghan, M.; Cullen, J.; Díaz-José, J.; Figueroa, M.; Grubler, A.; Lamb, W.F.; Leip, A.; et al. Demand-side solutions to climate change mitigation consistent with high levels of well-being. *Nat. Clim. Chang.* **2022**, *12*, 36–46. [CrossRef]
49. Mukai, T.; Nishio, K.I.; Komatsu, H.; Sasaki, M. What effect does feedback have on energy conservation? Comparing previous household usage, neighbourhood usage, and social norms in Japan. *Energy Res. Soc. Sci.* **2022**, *86*, 102430. [CrossRef]
50. Geels, F.W.; Hekkert, M.P.; Jacobsson, S. The dynamics of sustainable innovation journeys. *Technol. Anal. Strateg. Manag.* **2008**, *20*, 521–536. [CrossRef]
51. Rosenbloom, D.; Berton, H.; Meadowcroft, J. Framing the sun: A discursive approach to understanding multi-dimensional interactions within socio-technical transitions through the case of solar electricity in Ontario, Canada. *Res. Policy* **2016**, *45*, 1275–1290. [CrossRef]

52. Hewitt, R.J.; Bradley, N.; Baggio Compagnucci, A.; Barlagne, C.; Ceglarz, A.; Cremades, R.; McKeen, M.; Otto, I.M.; Slee, B. Social innovation in community energy in Europe: A review of the evidence. *Front. Energy Res.* **2019**, *7*, 31. [CrossRef]
53. Moore, M.L.; Riddell, D.; Vocisano, D. Scaling out, scaling up, scaling deep: Strategies of non-profits in advancing systemic social innovation. *J. Corp. Citizsh.* **2015**, *58*, 67–84. [CrossRef]
54. Chilvers, J.; Longhurst, N. Participation in transition(s): Reconceiving public engagements in energy transitions as co-produced, emergent and diverse. *J. Environ. Policy Plan.* **2016**, *18*, 585–607. [CrossRef]