Power and empowerment of grassroots innovations for sustainability transitions: A review

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ABSTRACT

The sustainability transitions scholarship is increasingly applying power and empowerment frameworks to investigate the role of grassroots innovations in the politics of societal change; however, theoretical fragmentation persists. This paper presents a systematic literature review of 88 studies on grassroots innovations for sustainability transitions that employ the lenses of power and empowerment. We take stock of the conceptual development of power and empowerment in the grassroots innovations literature and propose directions for future research to stimulate further theorisation of these terms. Our study shows that grassroots innovation scholars reproduce an epistemic bias towards power and empowerment as strategic exercises, thereby inhibiting our understanding of the range of forms of power and empowerment manifested in and through grassroots innovations and how these forms shape innovators' struggles and achievements to leverage societal change. We call for a richer theorisation of power and empowerment of grassroots innovations beyond strategic conceptualisations of these terms.

1. Introduction

Sustainability transitions are inherently political (Meadowcroft, 2011; Avelino et al., 2016; Köhler et al., 2019). As argued by Scoones (2016), the processes and outcomes of sustainability transitions are shaped by the ways in which different actors frame issues and set goals, assert positions and form alliances for or against change, and more generally try to influence the direction and speed of transitions.

There is a growing realisation of the limitations and inability of state and corporate interventions to lead sustainability transitions on the scope and magnitude needed to adequately respond to environmental change (Leach et al., 2012; Castán Broto, 2016; Swilling et al., 2016). Consequently, many researchers have turned their attention to grassroots innovations.[1] Grassroots innovations are solutions for sustainability that prioritise the values and beliefs of local communities involved over profit—a core element of conventional models of innovation (Seyfang and Smith, 2007). In particular, grassroots innovations 'arise in reaction to perceived social injustices and environmental problems' (Smith et al., 2013, p.115). These community-based solutions aim to address local needs while also potentially influencing broader societal change from the bottom up (Leach et al., 2012; Smith et al., 2013). Studies of grassroots innovations cover various thematic research areas, such as energy (e.g. Seyfang and Haxeltine, 2012; Schreuer, 2016), agri-food (e.g.

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[1] We follow Seyfang and Smith (2007) in using the term grassroots innovations, as this term is mostly used by the sustainability transitions scholarship (Hossain, 2016). However, we also acknowledge and include studies that refer to grassroots movements, initiatives or organisations.

Smith, 2006; Rossi et al., 2019), housing (e.g. Seyfang, 2010; Chatterton, 2016); and various geographical locations such as Europe (e. g. Celata and Coletti, 2018; Hölscher et al., 2019), North America (e.g. Laforge et al., 2017; Nicolosi et al., 2018), and Asia (e.g. Lee et al., 2017; Wolfram 2018). Well-known examples of grassroots innovations in the sustainability transitions literature include the Transition Towns movement (e.g. Seyfang et al., 2010; Feola and Nunes, 2014), community energy (e.g. Seyfang et al., 2014; Martiskainen et al., 2018), and ecovillages (e.g. Boyer, 2018; Frantzeskaki et al., 2016).

Grassroots innovations play a critical role in the politics of sustainability transitions, interacting with state or private actors, negotiating access to external resources and influencing the direction and speed of transitions (Hess, 2013; Laforge et al., 2017; Schreuer, 2016; Marletto and Sillig, 2019; Gregg et al., 2020). In turn, these politics affect the nature of grassroots innovations (Hess, 2013; Laforge et al., 2017; Celata and Coletti, 2018; Rossi et al., 2019).

Within the literature on the role and impacts of grassroots innovations on the politics of sustainability transitions, researchers have explored the central notions of *power* and *empowerment* through various perspectives. For instance, power has been conceptualised as the capacity of grassroots innovations to leverage transformations in their field of action (e.g. Hess, 2013) or the ability to align internal interests, mobilise resources, seize external opportunities and overcome barriers to scale-up (Gregg et al., 2020). Furthermore, grassroots innovations have been considered as niches 'where projects can develop away from the normal selection pressures of mainstream systems' (Seyfang and Longhurst, 2013, p. 881), and as such may function as protective spaces of empowerment for (a) the configuration and development of alternative and bottom-up solutions for sustainability; and (b) local and marginalised actors (Seyfang and Smith, 2007; Schreuer, 2016; Marletto and Sillig, 2019). As niches, grassroots innovations face the risk of co-optation by incumbent actors in socio-technical regimes. On the one hand, co-optation may undermine the degree of radicality and alterity of grassroots innovations (Smith, 2006; Laforge et al., 2017); on the other hand, it may create an opportunity to access resources in order to survive and to scale-up (Pel, 2016; Laforge et al., 2017). To avoid the risk of co-optation and retain autonomy, grassroots innovations exercise political power to access external resources that foster long-term independence and survival (Smith and Ely, 2015).

In sum, studies of grassroots innovations for sustainability transitions have employed a variety of conceptual approaches to study manifestations of power and empowerment. Such diversity is consistent with the claim that power cannot be understood by means of 'one all-encompassing theory that applies to each context' (Avelino and Rotmans, 2009, p.544), but rather 'requires different conceptualisations depending on the empirical phenomena and analytical and political interests of the investigator' (Ahlborg, 2017, p.123). Although this diversity has enriched our understanding of power and empowerment of grassroots innovations for sustainability transitions, it has also created theoretical and methodological fragmentation (Köhler et al., 2019), thereby hindering the ability to assess both the depth of our knowledge on this phenomenon and the suitability of existing theoretical and analytical approaches for understanding the range of forms of power and empowerment manifested in and through grassroots innovations for sustainability transitions. Although studies of power and empowerment in sustainability transitions have flourished in recent years (e.g. Avelino et al., 2016; Ahlborg, 2017; Avelino, 2017; Hölscher et al., 2019; Rossi et al., 2019), no research has yet taken stock of the progress made in this field and specifically examined how power and empowerment are conceptualised and empirically investigated in the context of grassroots innovations for sustainability transitions. Indeed, among others, Köhler et al. (2019) have recently called for mapping the research on the role of power and empowerment in sustainability transitions, specifically those involving grassroots innovations.

This paper aims to conduct a systematic literature review of studies of grassroots innovations for sustainability transitions that investigate power and empowerment. Our objective is two-fold. First, we take stock of the conceptual development of power and empowerment in the grassroots innovations literature. We answer two research questions: (a) What concepts of power and empowerment are used in the grassroots innovations literature? (b) What understanding(s) do these concepts enable researchers to achieve? Second, we propose directions for future research to stimulate further theoretical development of power and empowerment in grassroots innovations. We address two additional research questions: (c) What are the strengths and limitations of the concepts of power and empowerment currently adopted in the grassroots innovations literature? (d) How can future research address such limitations?

The paper is structured as follows. Section 2 presents five predominant research areas on power and empowerment in sustainability transitions. Next, section 3 first builds upon these five principal research areas to introduce the two meta-level frameworks that create a conceptual ground for the literature review, and then explains the methodological approach. The results are presented in section 4, following the first two research questions. Sub-section 4.1 maps the concepts of power and empowerment used in the grassroots innovations literature. Sub-section 4.2 elaborates on the understandings that these concepts enable researchers to achieve. Section 5 addresses the remaining questions, discusses the strengths and limitations of the concepts of power and empowerment currently adopted in the grassroots innovations literature, and proposes avenues for future research. We conclude our study in section 6.

2. Power and empowerment in sustainability transitions research

Research on sustainability transitions has discussed power and empowerment in relation to the concept of socio-technical transitions. Two publications stand out for indicating the achievements and remaining knowledge gaps of this sub-field of research (Avelino et al., 2016; Köhler et al.,2019). By and large, we identify five predominant research areas on power and empowerment in sustainability transitions.

Firstly, researchers have explored manifestations of power and empowerment and their impacts in socio-technical transitions through the prominent Multi-Level Perspective (MLP) framework. The MLP describes systemic change towards sustainability resulting from the interactions between three levels of aggregated societal functions: (1) niches, or spaces for innovative socio-technical practices and institutions; (2) regimes, or dominant socio-technical practices and institutions; and (3) landscapes, or slow-changing

developments (e.g. demographic changes) and external shocks (e.g. wars) on socio-technical systems (Geels, 2019). Comparably, Grin (2010) and Avelino (2017) attribute different aspects of power to each level of the MLP and distinctively theorise how power relations and dynamics between niche-regime-landscape and transition dynamics mutually constitute one another.[2] Similarly, de Haan and Rotmans, (2011) and Smith and Ravens (2012) discuss empowerment in the case of socio-technical innovations developed within niches that scale-up and become more competitive towards the established regime practices and institutions, hence leading sustainability transitions from the bottom up.

Secondly, researchers have investigated actors' *capacities and abilities* exercised in social interactions that enable or constrain socio-technical innovations for sustainability. Through and beyond the MLP model, studies have analysed both human and nonhuman agency,[3] albeit analyses of the latter have been limited to a few studies (e.g. Castán Broto, 2016; Hoffman and Loeber, 2016; Avelino et al., 2016; Ahlborg, 2017). Examples of conceptualisations of power in this category include innovative, transformative and reinforcive power (Avelino, 2017), relational and dispositional power (Grin, 2010; Hoffman, 2013), and regimes' resistance to change (Geels, 2014).

Thirdly, attention has been given to the *effects* of the exercise of power on the creation and implementation of socio-technical innovations for sustainability (Hoffman, 2013; Hoffman and Loeber, 2016; Ahlborg, 2017). These studies contrast with a more static understanding of power in their exploration of the dynamic character of power relations. For example, Avelino and Wittmayer (2016) examine how such forms of power relations shift throughout transition processes, whereas Rossi et al. (2019) discuss the redefinition of repressive power relations that would typically constrain the unfolding of sustainability agri-food transitions. In addition, Partzsch (2017) explores the interrelations of coercive power, individual empowerment and collective power that shape the processes and outcomes of environmental innovations.

Fourthly, analyses of power in sustainability transitions have examined how power relations are *historically constituted and geographically situated* and consequently empower or silence agency in socio-technical innovation processes (Castán Broto, 2016; Swilling et al., 2016; Ahlborg, 2017). This strand of literature has investigated the constitution of path-dependencies and their effects on sustainability transitions. Examples include studies of how social structures of gender, class and race define the winners and losers of sustainability transitions and particularly call for just transitions (e.g. Swilling et al., 2016; Ahlborg, 2017) and explorations of the structured arrangements of orders of signification, domination and legitimisation (structural power; Grin, 2010).

Finally, scholars have investigated *the empowerment and disempowerment* of agents in socio-technical innovation processes. Besides the above-mentioned notable works of de Haan and Rotmans, (2011)and Smith and Raven (2012), Avelino (2017) and Hölscher et al. (2019) draw on organisational psychology studies to define dis/empowerment both as a process that diminishes or enhance actors' abilities to achieve desired outcomes that grant or impede the feeling of being empowered. From a different standpoint, Ahlborg (2017, p. 5) argues that empowerment refers to a 'situated capacity of individuals and collectives to exercise power in ways that positively shape their lives and societies'. At the network level, Loorbach et al. (2020) build on Pel et al. (2020) to indicate that social innovators' networks can empower transformative innovations by (i) sustainably embedding innovations in the local context, (ii) forming supportive translocal networks, and (iii) creating social cohesion and resilience.

As this brief overview clearly shows, research on power in sustainability transitions may be ordered with respect to five core areas. However, many frameworks and conceptualisations of power and empowerment coexist in the literature. Köhler et al. (2019) suggest that such diversity has created theoretical and methodological fragmentation and called for mapping the research on the role of power and empowerment in sustainability transitions, specifically those involving grassroots innovations. Power and empowerment are not only studied in this specific field of research but also in many other kinds of literature. To construct a conceptual basis on power and empowerment that allows us to examine how these terms are conceptualised and empirically researched in the context of grassroots innovations for sustainability transitions, we turn to meta-level frameworks of power and empowerment developed in sociology and political science.

3. Conceptual Framework and Methods

3.1. Meta-level frameworks of power and empowerment

Sociology and political science aggregate an extensive and diversified debate on what power is and what it is not, when power manifests itself, and with what consequences (Morriss, 2002; Lukes, 2004; Allen, 2005).[4] As a result, these disciplines have produced various approaches to conceptually and empirically examine power and empowerment (Allen, 2005). By drawing on frameworks of power and empowerment conceived by schools of thought outside the grassroots innovations literature as well as the sustainability transitions literature more broadly, we seek to discern which approaches to power and empowerment are reflected in the reviewed literature and which remain obscured.

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[2] Grin (2010) offers a framework to examine how sustainability transitions may come about when a regime's dispositional power, i.e. "rules, resources, actor configurations and dominant images of the issues involved' (p.283) is altered by pressures from landscape's structuring power or niche agent's relational power, Avelino's (2017) typology considers varying power relations and dynamics within each of the levels in the MLP.

[3] In this paper, we understand nonhuman agency in line with Braun and Whatmore (2010) as the active participation of e.g. energies, artefacts, technology and creatures in the constitution of social collectivities, political associations and knowledge production.

[4] As an example, political science theorists have engaged in a five-decade-long debate on the "faces of power" that has provoked fruitful discussions, opened up new areas for research, and refined epistemic perspectives to the study of power (Lukes, 2004).

We follow the frameworks developed by Allen (2005) and Cohen (1985), which we find particularly useful because they categorise different conceptual approaches to studying power and empowerment in political sciences and sociology, respectively. We use Allen's framework to analyse manifestations of power that are *already produced* in a given context. In contrast, Cohen's framework is used to examine manifestations of the social processes of *producing* power, i.e. empowerment. We also show how these perspectives relate to the aforementioned five main research areas and current discussions on grassroots innovations' power and empowerment.

3.1.1. Power frameworks

Allen (2005) outlines a thorough review of concepts of power in sociology and political sciences, resulting in a typology of three distinct theoretical approaches to power: *action-theoretical, constitutive* and *systemic* power. Common to all three types is a relational conceptualisation of power that foregrounds the intentions and actions of one person in relation to another (i.e. action-theoretical power) and to nonhuman elements (i.e. constitutive power) and how these are conditioned by several contextual factors (i.e. systemic power). Such a multifaceted relational approach deviates from the understanding of power as something owned and exercised by agents independently of its embedded context, which implies a static manifestation of power incompatible with the changing dynamics inherent to sustainability transitions (Ahlborg, 2017). Although Allen's typology has been used in one sustainability transitions study (Ahlborg, 2017), it is relatively new to this scholarship and has not yet been applied to the sub-field of grassroots innovations.

Action-theoretical power is exclusively related to the realm of human agency, and its focus is two-fold, encompassing 'either the actions or the dispositional abilities of [these] particular actors' (Allen, 2005, p.3). The focus on actions foregrounds the *intentions* of those who exercise power towards others and the surrounding environment (Ahlborg, 2017; Ahlborg and Nightingale, 2018). It includes, for example, the exercise of the power to act or refrain from action that can either take form as power over others (e.g. dominance) or power with others (e.g. collective power to resist domination). In contrast, the focus on *dispositional abilities* highlights the human attributes that are unequally distributed in society and *may* be exercised (e.g. decision-making power at the disposal of elite actors). The action-theoretical perspective of power relates to current debates in the sustainability transitions literature regarding whose capacities and abilities may or may not be exercised during interactions between social actors (e.g. Grin, 2010; Avelino, 2017). Examples of action-theoretical manifestations of power in the context of grassroots innovations include, on the one hand, the collaborative or resistance actions of grassroots actors towards government officials, and vice-versa (Hess, 2013; Laforge et al., 2017); and on the other hand, the varying capacities and abilities of grassroots innovators to align internal interests, mobilise material resources and seize external opportunities to overcome barriers to scale-up (Gregg et al., 2020).

Constitutive power corresponds to the 'fundamentally transindividual and relational ways in which individuals and the social worlds they inhabit are themselves constituted by power relations' (Allen, 2005, p.3). This perspective of power foregrounds the multiplicity of elements that interact in a given system, thereby decentralising power from the human sphere and expanding the understanding of power as emerging from the interactions between human and nonhuman actors (Foucault, 1979 in Allen, 2005). In simplified terms, nonhuman elements can co-constitute human's capabilities (e.g. the hammer in the hand of a worker) or constrain them(e.g. complex technical devices that unskilled people cannot fix).[5] Some sustainability transitions scholars have employed this view of power to analyse how relationships between human agents and e.g. electricity infrastructure and technology influence the conception and implementation of socio-technical innovations for sustainability (e.g. Castán Broto, 2016; Ahlborg, 2017). Constitutive power is reflected in the context of grassroots innovations, such as in the ways that participants of repair cafés along with repairing tools co-constitute sites of social transformation (Schmid and Smith, 2020, p. 13).

Lastly, *systemic* power refers to 'the ways in which broad historical, political, economic, cultural, and social forces enable some individuals to exercise power over others, or inculcate certain abilities and dispositions in some actors but not in others' (Allen, 2005, p.3). In this sense, power refers to more elusive and contextual forces produced by the way that a particular system functions. Examples of systemic power include culturally institutionalised practices, legal institutions and discourse that condition human and nonhuman exercises of power (Ahlborg, 2017). Like other frameworks of power in sustainability transitions, Allen's typology is consistent with a systems thinking approach; it relates to sustainability transitions research on *how* agency in innovation processes is empowered or hindered by social conditions historically constituted and geographically situated (Grin, 2010; Castán Broto, 2016; Swilling et al., 2016; Ahlborg, 2017). Manifestations of systemic power include grassroots actors that develop and guarantee democratic socio-technical innovations (e.g. Smith and Stirling, 2018) while acknowledging that local challenges are embedded in broader political systems (Schipper et al.,2019).

3.1.2. Empowerment frameworks

Social movement theory is another focal point in the social science debate that allows us to evaluate empowerment. In this context, Cohen (1985) conducts a literature review on how collective action is researched in 'new social movement' theory and distinguishes between two prominent theoretical paradigms, namely 'resource-mobilisation' and 'identity-oriented'. Although social movement theory has evolved since Cohen's review, e.g. by englobing collective action geared towards the protection and survival of human actors and the natural environment (Rocheleau et al., 1996), the categories of each theoretical paradigm remain meaningful and consistent with current times.

Below, we describe how the 'resource-mobilisation' and 'identity-oriented' paradigms reveal different ways to make sense of

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[5] Ahlborg (2017, p.127) clarifies the analytical purpose of including non-human agents in studies of power by arguing that 'this idea does not necessarily suggest that artefacts themselves exercise power, rather, artefacts become enrolled in exercises of power by planners, development practitioners, designers etc.'

current social movements' empowerment and how they are applicable to grassroots innovations' empowerment. These theoretical paradigms are not mutually exclusive and could be simultaneously used to identify distinct manifestations of empowerment happening under different circumstances in grassroots innovations.[6] By highlighting the specific strengths and weaknesses of each paradigm, Cohen (1985) provides a conceptual and analytical framework that is helpful to understand how the usages of these two conceptual approaches vary among studies of grassroots innovations and what manifestations of empowerment have been neglected by the grassroots innovation literature.

The *resource-mobilisation* paradigm approaches 'collective action in terms of the logic of strategic interaction and cost-benefit calculations' (Cohen, 1985, p.675). Studies of this kind have discussed, for instance, activists' and social movement organisations' strategies to create online campaigns and mobilise collective environmental action (e.g. Lee, 2015) or how social movement organisations negotiate their independence from national governments to support local innovations for energy transitions (Hisschemöller and Sioziou, 2013). Accordingly, empowerment refers to a process in which individual and collective actors construct (i) strategic and instrumental reasoning and (ii) sophisticated organisational forms and modes of communication. In the context of grassroots innovations, this paradigm sheds light on a type of empowerment that relates to the actions and negotiations that grassroots innovators strategically employ to obtain, maintain, or enhance access to material and ideological resources, e.g. financial, political and mediatic repercussions as well as knowledge (e.g. Martin et al., 2015; Kooij et al., 2018a).

The *identity-oriented* paradigm offers analytical dimensions to the study of collective action that 'involve a reflexive relation to the objective, subjective, and social worlds insofar as [these dimensions] thematise issues of personal and social identity, contest the social interpretation of norms, communicatively create and agree on new ones, and propose alternative ways of relating to the environment' (Cohen, 1985, p.708). For example, this paradigm highlights aspects of political ecology struggles associated with the definition of gendered identities and environmental racism that fundamentally constitute the type of actions organised by social movements and their outcomes (Campbell et al.,1996; Miller et al., 1996). As such, empowerment refers to a productive process that includes active reflection, contestation and discursive reconfigurations that actors bring to the situation, including dimensions such as worldviews, epistemology and social identities. Drawing on this perspective, grassroots innovations are understood as collectives that engender individuals' awareness of their capacity to contest, recreate and disseminate alternative life choices and socio-ecological relations, to reinterpret norms and create new meanings (Udovyk, 2016; Hill and Connelly, 2018), by reflecting on the power relations that are both symbolically (e.g. ideologies) and materially (e.g. social norms and social hierarchies) involved in this process (Smith et al., 2013).

3.1.3. Analytical frameworks

We first applied Allen's (2005) typology on power to aggregate clusters of paradigms among studies that conceptualise similar types of power. The action-theoretical cluster was used to group two notions of power exclusively from a human agency perspective: firstly, the *dispositional properties* of grassroots actors and the social actors with whom they interact, including capacities or abilities to bring about effects;[7] secondly, the *intentions* underlying the relationships between members of grassroots innovations and with external social actors, or how power constitutes specific types of relationships (e.g. domination, dependency, collaborations). Furthermore, the constitutive power cluster gathered notions of power that focus on the *co-constitution* of power involving human and nonhuman elements associated with grassroots innovations. The systemic cluster was used to bring together notions of *social conditions*—such as social practices, hierarchies and institutions—that shape and are shaped by grassroots innovations. Table 1 summarises how we operationalised Allen's typology in the context of power in grassroots innovations for sustainability transitions.

Table 1

Analytical framework on power (authors' elaboration based on Allen, 2005).

Types of power	Unit of analysis	Power of grassroots innovations (examples)
Action-theoretical	Dispositional properties	The ability of grassroots actors to align internal interests and mobilise material resources.
	Intentions	The collaborative or confrontational interactions between grassroots innovations and government officials, corporations and other actors in the mainstream system.
Constitutive	Co-constitution of power	Co-production of power between human actors and infrastructures, technologies, objects, and other materialities.
Systemic	Social conditions	Social structures of gender, class and race that act against or in favour of grassroots innovations.

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[6] For example, analyses of awareness-raising and cultivation of local knowledge in grassroots innovations (i.e. identity-oriented empowerment) can be complemented with observations of the strategies developed by grassroots innovations to mobilise technological resources to support such endeavour (i.e. resource mobilisation empowerment; Smith et al., 2013).

[7] Morriss (2002) explains that power can be understood as an actor's *dispositional property*, meaning that it is a capacity that actors have. Such capacity can be exercised or not depending on the social context; different social contexts provide the conditions that enable or disable the exercise of power.

Table 2

Analytical framework on empowerment (authors' elaboration based on Cohen, 1985).

Type of empowerment	Unit of analysis	Empowerment of grassroots innovations (examples)
Resource-mobilisation	The production of power concerning the development of strategic and instrumental reasoning and organisational abilities	Building up strategic actions to mobilise resources, alignment of interests, goal-setting capacities.
Identity-oriented	The production of power concerning active reflection, contestation and discursive reconfigurations that include dimensions of worldviews, epistemologies and social identities	Building up capacities and abilities to reflect, contest and reconfigure gendered identities, winners and losers of environmental change, social structures of oppression

Secondly, we followed Cohen's (1985) description of the resource-mobilisation and identity-oriented paradigms to aggregate clusters of paradigms among studies that have used similar conceptualisations of empowerment (Table 2). Social movement theory and grassroots innovations literature share a common interest in collective action and offer insights on the process of building up individual and collective power, i.e. empowerment. Within the resource-mobilisation cluster, we identified notions of empowerment that refer to the production of power concerning the development of strategic and instrumental reasoning and organisational abilities. Through the identity-oriented paradigm, we identified notions of empowerment that elucidate the production of power in terms of individual and collective active reflection, contestation and reconfiguration of the social constructions of their worldviews, epistemologies and social identities that enable them to take action.

In sum, Allen's and Cohen's frameworks were helpful instruments to achieve our research objectives. They enabled us to identify in the grassroots innovations literature (i) differences in the conceptual development of power and empowerment and (ii) limitations to be addressed in future research.

3.2. Methods

This study is based on a systematic literature review that entailed three main phases: (i) the selection of relevant literature on grassroots innovations; (ii) the identification of conceptual and empirical elements linked to power and empowerment through coding; and (iii) the analysis of these elements based on the frameworks introduced by Allen (2005) and Cohen (1985). Ultimately, we aim to address the four research questions mentioned in the introduction.

In this section, we first present the coding criteria and how they relate to the analytical frameworks, following which we explain the steps we took to select relevant literature on grassroots innovations.

3.2.1. Coding

We created a coding book comprising seven criteria to facilitate the screening of the selected literature, namely 'research topic', 'study location', 'thematic research area', 'type of grassroots innovations', 'level of analysis', 'type of power/empowerment', and 'theoretical approach'. Appendix A describes each criterion in detail and shows how each was operationalised into specific descriptors, examples, a guiding question and a justification. The coding book was conceived to extract relevant information that could be examined through the two analytical frameworks.

3.2.2. Selection of literature

In order to obtain relevant literature, we ran queries in the Scopus database in March 2020. Only literature in English was included. The final list is mostly comprised of peer-reviewed articles but also includes book chapters, conference papers and reviews. The diversity of sources ensures the credibility of the reported findings. Appendix C presents a profile of the selected literature. We used two sets of keywords combinations: (i) 'sustainability transitions' AND 'grassroots' or 'community' or 'civil society' AND 'power' or 'politics' or 'empowerment';[8] and (ii) 'grassroots innovations' or 'grassroots initiatives' or 'grassroots movements' AND 'power' or 'politics' or 'empowerment'. From a total of 18 different keyword combinations (Appendix B), 317 unique titles and 139 duplicates were shortlisted. Furthermore, we included 14 peer-reviewed articles that were either frequently cited by the shortlisted titles or referred to in key studies on power and/or grassroots innovations in the sustainability transition literature. This process resulted in a list of 331 titles.

Next, the abstracts of the 331 titles were scanned, and we filtered the list according to the following exclusion criteria: (i) studies that were out of the scope of sustainability transitions (e.g. studies that did not explicitly mention sustainability issues or did not apply sustainability transition frameworks); (ii) studies that were out of the scope of grassroots innovations (e.g. studies that mentioned grassroots, civic society or communities but did not study them). This action narrowed the number of relevant titles to 116. Through screening of the main bodies of the remaining articles in the light of the coding criteria, we excluded an additional 28 studies for the following reasons: (i) the terms power or empowerment were only mentioned once or twice and did not play a significant role in the theoretical development or the analysis; and (ii) peer-reviewed articles and book chapters that were no longer available online. Such filtering resulted in a final list of 88 works that were systematically reviewed as per the coding book, comprising 85 peer-reviewed articles, two conference papers and one book chapter. This list includes 75 empirical studies, four literature reviews and nine

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[8] We include 'community' and 'civil society' as alternative keywords for 'grassroots innovations' because scholars sometimes use these terms when referring to the same phenomenon that characterises grassroots innovations.
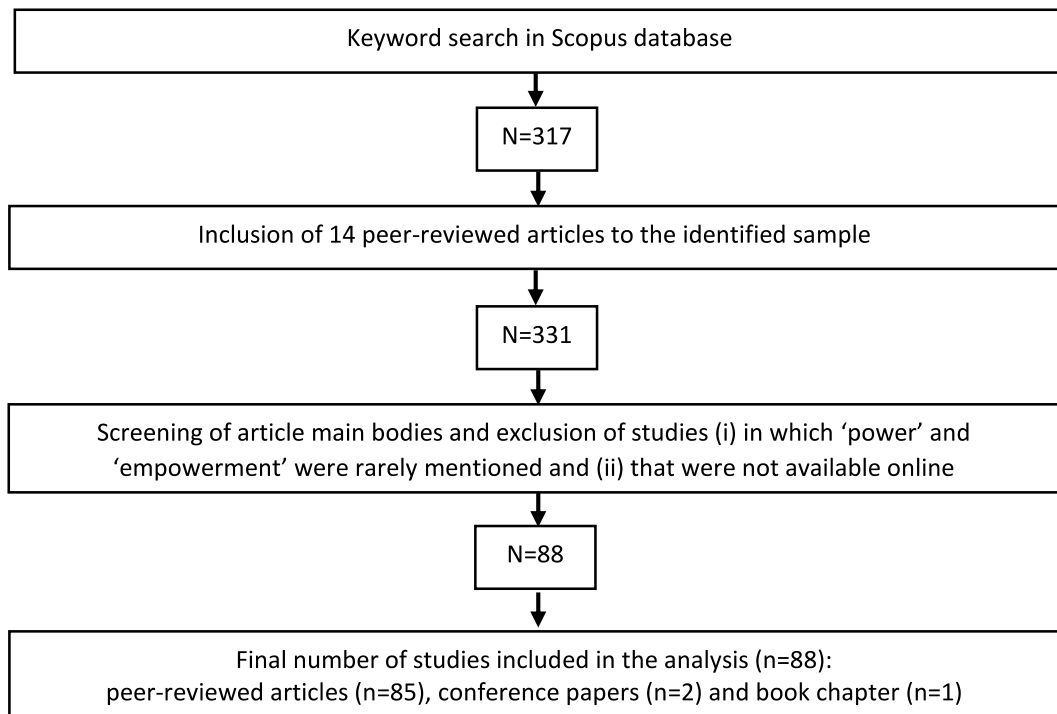
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│    which 'power' and 'empowerment' were rarely mentioned and (ii) that  │
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│    peer-reviewed articles (n=85), conference papers (n=2) and book      │
│    chapter (n=1)                                                        │
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Fig. 1. Systematic research process.

conceptual papers with some empirical illustrations. Fig. 1 illustrates the systematic research process of relevant literature on grassroots innovations for our study.

4. Results

4.1. Conceptualisations of power and empowerment

4.1.1. Conceptualisations of power and empowerment of grassroots innovations

We observed that in 18% of the 88 reviewed studies, scholars refer to different types of power without providing any conceptualisation. In these cases, the term 'power' is mainly used to convey the idea of specific actors' 'capacity' or an 'ability' to do something—e.g. grassroots innovations that 'gain and establish certain forms of credibility within the wider debate around the future of the energy transition' (Longhurst and Chilvers, 2019, p. 985). In addition, 'power' often implies a certain resource that some actors own in larger proportions than others—e.g. 'a coalition that included diverse civil society organisations and powerful allies in the state government' (Hess, 2019, p. 48). Similarly, the term 'empowerment' appears without explanation in 20% of the reviewed studies. In these cases, 'empowerment' seems to indicate a certain kind of actor, such as (dis)empowered communities, or a certain kind of process that actors go through, for example, 'citizen empowerment' (e.g. Martin, 2016; Ehnert et al., 2018; Mourato and Bussler, 2019). Furthermore, 81% of the 88 reviewed works explicitly employ notions of power and empowerment in their theoretical framings; however, the majority of these studies do not operationalise such notions, but rather merely refer to them in general terms when establishing the theoretical background. Therefore, we note that the larger share of the studied literature only superficially engages with theorisations of power and empowerment.

In the few studies that do operationalise theories of power, scholars most commonly draw on frameworks of action-theoretical power developed in sociology and political science such as Bourdieu's (2005) fields theory of power relations (Hess, 2013;2014), Wolf's (1990) anthropological theory of power relations (Lehigh et al., 2020), and Gui's (1991) and Hansmann's (1996) framework of decision-making power (Lambert et al., 2019). When scholars use concepts of power that have been developed in the sustainability transition literature, they frequently refer to power as a capacity of actors to mobilise resources to achieve a certain goal, as put forward by Avelino and colleagues (Avelino and Rotmans, 2009; Avelino and Wittmaywer, 2016; Avelino, 2017). Other concepts of action-theoretical power in sustainability transitions exist (e.g. Geels, 2014; Hoffman, 2013); however, with the exception of Ahlborg (2017), these concepts have not yet been applied in the context of grassroots innovations.

Among the small batch of 15 studies that operationalise theories of empowerment, most draw on frameworks of resource-mobilisation empowerment developed in the sustainability transition literature. In particular, scholars refer to the niche empowerment theory (see Smith and Raven, 2012) that is grounded in the MLP (Geels, 2002). To this end, grassroots innovations are defined as niches, or spaces 'where projects can develop away from the normal selection pressures of mainstream systems' (Seyfang and Longhurst, 2013, p. 881), and they function as 'protective' spaces of empowerment for the configuration and development of bottom-up innovations (Smith and Raven, 2012). In this view, empowerment manifests itself in two forms: 1) as a process through which grassroots innovations become more competitive and increase the diffusion of their socio-technical innovations in a given system (e.g. Martin et al., 2015; Grabs et al., 2016; Boyer, 2018; Kooij et al., 2018a); or 2) as an outcome that reflects two possible types of change that empowered grassroots innovations can bring about in a dominant system, namely fit-and-conform (incremental change) or stretch-and-transform (disruptive change; e.g. Feola, 2014; Kooij et al., 2018a).

4.1.2. Conceptualisations of power and empowerment tailored to grassroots innovations

The literature review revealed five conceptualisations of power and empowerment that were tailored to the phenomenon of grassroots innovations for sustainability transitions. These conceptualisations were developed through studies that mostly operationalise theories of power and empowerment developed in sociology and political science to inform research on the political struggles and achievements of grassroots innovations.[9] Table 3 describes these concepts, the traditions of thought in which they are rooted, and the types of power or empowerment to which they refer.

Table 3
Conceptualisations of power and empowerment tailored to grassroots innovations.

Author	Concept of power	Tradition of thought	Type of power or empowerment
Hess (2013)	Countervailing power: 'to show how a government entity (such as a city or state government) and a related industry (large financial and technology corporations) have formed alliances with distributed solar energy advocates that have provided them with the capacity to transform their field of position.' (p.849)	(1) Pierre Bourdieu (2005): Fields theory (2) John K. Galbraith, 1993: Countervailing power	Action-theoretical power
Schreuer (2016)	Empowerment is 'the increase of disadvantaged actors' ability to mobilise and use resources for their goals.' (p.1)	(1) Hannah Arendt (1970): Power as productive and power as distributive (2) John Allen (2004): Power as an amorphous omnipresent form (3) Talcott Parsons (1963): Power as a resource that actors have at their disposal (4) Flor Avelino and Jan Rotmans (2009): Power in sustainability transitions	Resource-mobilisation empowerment
Laforge et al., 2017	A four-part typology of different modes of interactions between grassroots innovators and government officials, namely containing, co-opting, contesting and collaborating	(1) Michel Foucault (1991): Governmentality (2) Gibson-Graham (2006): the politics of possibility	Action-theoretical power
Marletto and Sillig (2019)	Empowerment is conceptualised as 'the grassroots innovations' ability to influence the development of the societal function of reference; empowerment can manifest both through diffusion (to gain presence) and as changes in norms, routines and practices (e.g. new agriculture regulations).' (p.94)	No reference to any traditions of thought on empowerment	Resource-mobilisation empowerment
Gregg et al. (2020)	Power encompasses 'Internal power as a collective active initiative's ability to align internal interests, build networks, and mobilise resources, and external power as a collective active initiative's ability to seize opportunities and overcome barriers.' (p.17)	(1) Charles Tilly, 1977: resource-mobilisation approach to social movements	Action-theoretical power

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[9] We do not include frameworks developed in the literature for studies of power and empowerment in sustainability transitions more broadly rather than only grassroots innovations, for example Ahlborg (2017) and Avelino (2017).

4.2. Understandings of power and empowerment

4.2.1. Prevailing perspectives on power and empowerment of grassroots innovations

As shown in Fig. 2, the grassroots innovation literature largely investigates action-theoretical power and resource-mobilisation manifestations of empowerment.

This finding indicates an epistemic orientation of the grassroots innovation literature to approach power and empowerment in instrumental and strategic terms. We observe a prominent analytical purpose of these types of power and empowerment, namely the analysis of influence (e.g. Ornetzeder and Rohracher, 2013; Kooij et al., 2018b) . However, we also note that this tendency is rather implicit, as none of the studies discusses the causal relations between power and influence. As such, these studies seem to have overlooked the differences and commonalities between the concepts of power and influence that correspond to different analytical foci and may require distinct theoretical perspectives (Morriss, 2002; Lukes, 2004).[10]

Additionally, Fig. 2 shows that studies on power and empowerment of grassroots innovations are predominantly investigated in the Global North. In particular, studies explore cases in Europe (n=46) and North America (n=8). Grassroots innovations in Europe are most frequently studied through the lens of resource-mobilisation empowerment, whereas the action-theoretical type of power is more prevalent in the literature on grassroots innovations in North-America. Arguably, North American studies may use action-theoretical notions of power because this approach reflects an account of power extensively debated by the U.S. political science community, in particular decision- and non-decision-making power (Lukes, 2004).

Most studies employ meso-level (44%) and macro-level (34%) perspectives to the study of grassroots innovations, whereas less attention is paid to the micro-level (10%). Overall, these studies substantially contribute to the literature with the lessons they draw from the political struggles of grassroots innovations to adjust to or contest repressive or productive actions—e.g. how local policies or development programs developed by regime actors affect grassroots actions and their transformative potential (Béal, 2012; Joutsenvirta, 2016)— as well as discussions on the implications of such lessons for systemic change driven from the bottom up— the action and potential of grassroots innovations to reconfigure local and global levels of politics (Ely et al., 2013; Blanco and León, 2017). Among the few studies that apply a micro-level perspective, we observed a preference to examine behavioural change. For example, Sharp and Salter (2017) investigate the impact of experiments with low-carbon living on participants' perspectives on sustainability transitions, and Roysen and Mertens (2019) analyse patterns of transitions in practices among the members of an ecovillage.
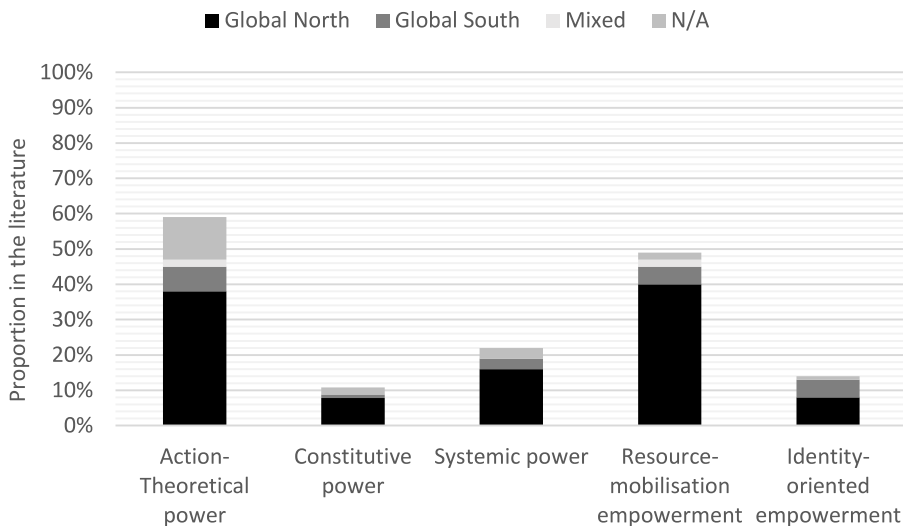

Fig. 2. Types of power and empowerment used in the grassroots innovation literature.

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[10] One way to distinguish the two concepts is proposed by Morriss (2002), who argues that power defines a dispositional capacity or ability that *may* be exercised, whereas influence necessarily describes an act that is exercised and affect something or someone.

Table 4

Main findings of the literature on power and empowerment of grassroots innovations.

Research areas on power and empowerment in sustainability transitions	Type of power (Allen, 2005) and empowerment (Cohen, 1985)	Main findings
Actors' capacities and abilities	Action-theoretical power	- Grassroots actors develop socio-technical innovations that reconfigure dominant political discourses and institutions - Grassroots actors provide examples of sustainable practices and visions for future societies
	Constitutive power	- Grassroots actors develop socio-technical innovations for sustainability through their interactions with objects, infrastructure and energy, and their socially constructed meaning.
Effects of the exercise of power on socio-technical innovations for sustainability	Action-theoretical power	- Characterisation of the struggles between powerless grassroots actors and powerful state and market actors - Examination of the dominant-subordinate power relations that constrain grassroots actors to access material resources - Examination of advantages and disadvantages of the co-option of grassroots innovations - Grassroots actors contest and resist oppression and exclusion
Historical and situated constitution of power relations	Systemic power	- Grassroots innovations' potential to raise awareness about social hierarchies or dominant-subordinate power relations - Historical constitution of political systems that constraints grassroots innovations
Empowerment and disempowerment of actors	Resource-mobilisation	- Grassroots narratives of change strategically used to mobilise funding and collective action - Established grassroots translocal network as useful means to provide institutional support for local and marginalised projects - Grassroots internal communication stimulates community participation and the unfolding of social innovation
	Identity-oriented	- Grassroots innovations create networks of solidarity and strengthen the sense of community - Grassroots innovations mobilise technology for social inclusion and marginalised knowledge - Grassroots innovations facilitate the creation of critical consciousness of structural issues and power imbalances - Grassroots actors transform values and practises and feel empowered to address structural issues and power imbalances

4.2.2. Diversity of understandings achieved by grassroots innovations scholars

Table 4 summarises the main contributions offered by grassroots innovations scholars to our understanding of power and empowerment in line with the various research areas on power and empowerment developed in sustainability transitions. We expand on these achievements in the remainder of this section.

Action-theoretical power

Scholars considering action-theoretical approaches to power often examine the different capacities and abilities of human actors involved in grassroots innovations. Such studies uncover the potential of grassroots actors to develop socio-technical innovations that, for instance, foster sustainable consumption patterns (e.g. Martin, 2016; Signori and Forno, 2019; Gregg et al., 2020) and reconfigure, to a greater or lesser degree, dominant political discourses and institutions reinforced by regime actors (e.g. Kooij et al., 2018b; Haderer, 2020). Many scholars also perceive this innovative and transformative potential of grassroots actors as a prefigurative capacity unique to grassroots innovations; they set examples of what democratic production and energy distribution look like in practice and provide alternative social norms and behaviour for visions of future societies (e.g. Cameron and Hicks, 2014; Grabs et al., 2016; Longhurst and Chilvers, 2019; Schmid and Smith, 2020).

Despite showcasing these different abilities of grassroots actors, scholars have also distinguished such capacities from those of elite actors. Such a distributed understanding of power also underpins the investigation of the intensions that shape the power relations between 'powerless' grassroots innovations and 'powerful' elite actors or social institutions—for instance, the dominant-subordinate power relations that constrain grassroots innovators' access to material resources (Ferguson and Lovell, 2015; Celata and Coletti, 2018; Lehigh et al., 2020). Particular attention is paid to the outcomes of such interactions, such as the advantages and disadvantages of the co-optation of grassroots innovations (e.g. Martin et al., 2015; Pel, 2016; Hess, 2019). However, a limited number of studies explore in-depth how grassroots innovations contest and resist oppression and exclusion (e.g. Laforge et al., 2017; Ahlborg, 2017; Rossi et al., 2019).

Constitutive power

Despite the calls for more research on the material participation of e.g. objects and infrastructure in the constitution of power and agency in sustainability transitions (Avelino et al., 2016), this research area remains more marginal in the grassroots innovations literature. Most studies examine forms of materiality in terms of resources managed by grassroots innovations. Implicit in this view is the notion that nonhuman elements are merely instruments passively used by humans to achieve their goals rather than active agents possibly influencing the outcomes of actions. Therefore, this view excludes nonhuman elements from the politics of sustainability transitions. In total, 11 out of the 88 reviewed studies employ a constitutive perspective of power and expand analyses of power of grassroots innovations to nonhumans. These studies highlight the role of objects, infrastructure and energy in co-constituting with human agents the capacities and abilities of grassroots innovations to develop bottom-up solutions for sustainability (e.g. Chilvers and Longhurst, 2016; Martiskainen et al., 2018; Ehrnström-Fuentes and Leipämaa-Leskinen, 2019). Examples of such co-constitution of power include the capacity to control energy practices and expenses that energy bills generate on socio-economically vulnerable participants of Energy Cafés (Martiskainen et al., 2018), but also how electricity infrastructure stabilises socio-economic and gender inequalities, which can either be reinforced or destabilised by a community-led hydropower system (Ahlborg, 2017).

Systemic power

Through the systemic power lens, scholars inquire into the historical and situated social conditions that act against or in favour of grassroots innovations. This approach is in line with research on sustainability transitions that emphasise the structural dimension of power in processes of societal change (Grin, 2010; Castán Broto, 2016; Swilling et al., 2016; Ahlborg, 2017). Some examples of research on systemic power include grassroots innovations' ability to raise awareness about social hierarchies or dominant-subordinate power relations that affect women's decision-making power in advancing transitions (e.g. Allen et al., 2019; Joshi and Yenneti, 2020). Similarly, Zhang (2012) describes the historical constitution of China's political system and highlights the constraints that this system currently imposes on community organisations that advocate for democratisation and political innovation in rural areas. Joutsenvirta (2016) argues that the neoliberal foundations of the Finnish taxation system, which government officials actively maintain, plays a crucial role in blocking the flourishing of a national economic grassroots network based on time exchange.

Resource-mobilisation empowerment

Through a resource-mobilisation approach, scholars emphasise an instrumental interpretation of how grassroots innovations relate to materials and discourses to build up their strategic abilities to achieve desired goals. In particular, several scholars employ this empowerment lens to study one type of grassroots innovations, namely Transition Towns (e.g. Seyfang et al. 2010; Seyfang and Haxeltine, 2012). For instance, attention is given to how narratives of change are strategically used to mobilise funding and collective action to expand the reach of social impacts (e.g. Feola, 2014) and how established translocal networks are a useful means to provide institutional support for local and often marginalised projects (Seyfang et al. 2010; Seyfang and Haxeltine, 2012).

Grassroots innovations are viewed through the lens of resource-mobilisation empowerment as vehicles for empowering citizens to take action—for example, through participation in policy-making processes (Frantzeskaki et al., 2016), redevelopment projects (Lehigh et al., 2020), and broader forms of political engagement (Frantzeskaki and Rok, 2018). Moreover, some studies examine the impact of urban policies on opening up possibilities for resource mobilisation, symbolic support or constraining the development of grassroots innovations (e.g. Lee et al., 2017; Wolfram, 2018)

Identity-oriented empowerment

A minority (13%) of the reviewed studies discuss empowerment in terms of individual or collective identity formation through grassroots innovations. A range of different drivers for empowerment is identified among this small batch of studies. Grassroots in-novations create networks of solidarity and strengthen the sense of community, which is favourable to mobilise, on the one hand, technology for social inclusion (Smith et al., 2013), and on the other hand, marginalised knowledge (Udovyk, 2016; Souza et al., 2020). By exploring the new capacities enabled by technology and cultivating diversified marginalised knowledge, grassroots in-novations foster critical consciousness of structural issues and power imbalances in economic relations, knowledge production and political power (Smith et al., 2013; Udovyk, 2016; Souza et al., 2020). This process of social learning leads to changes in both the values and practices of grassroots innovation participants, who then *feel* empowered to address structural issues and power imbalances through individual or collective agency (Udovyk, 2016; Souza et al., 2020). For example, grassroots innovations support the recognition and engagement of women in collaborative forms of leadership that integrate climate, energy and gender equality concerns into the co-creation of visions and actions for just energy transitions (Allen et al., 2019).

5. Discussion

The results of the literature review indicate what concepts of power and empowerment grassroots innovations scholars use and what understandings they enable scholars to achieve. As illustrated in the previous section, some of the strengths of the grassroots innovations literature include the five conceptualisations of power and empowerment tailored to grassroots innovations, as shown in Table 3, and the main findings achieved by research on each of the different theoretical approaches to power and

Table 5

Limitations of conceptual developments of power and empowerment of grassroots innovations and avenues for future research.

Limitation	Implication	Avenue for future research
Restricted conceptualisations of 'power' and 'empowerment'	Scholars tend to use these terms as *explanans* (terms that contain the explanation), rather than *explanandum* (terms that require explanation)	More engagement with 'power' and 'empowerment' as *explananda*
Epistemic bias towards action-theoretical power and resource-mobilisation empowerment	Researchers overstress the exercise of power without considering its counterfactuals Limited understanding of grassroots innovations beyond their strategic abilities	Problematisation of the understanding of power as an overt, strategic and instrumental exercise to enable further documentation and analysis of other manifestations of power and empowerment of grassroots innovations

Table 6

Limitations of the conceptual development of power and empowerment of grassroots innovations and avenues for future research.

Area of research	Implication	Avenue for future research
Conceptualisations of constitutive power and identity-oriented empowerment	Limited understanding of the role of collective identities (including ontologies, epistemologies, values) of grassroots innovations in sustainability transitions	Further development of research area on the process of collective identity formation in grassroots innovations
Micro-level analysis of power and empowerment of grassroots innovations	Limited understanding of the micro-politics of grassroots innovations	Further development of research area on the linkages between micro-level politics and macro-level societal change
Empirical studies on the Global South	Empirical studies concentrated on the Global North. There are missed opportunities for theory development	Further development of research area on grassroots innovations on the Global South to encompass notions and empirics of power and empowerment rooted

empowerment, as illustrated in Table 4. In this section, we first reflect on two important limitations of the current conceptual development of power and empowerment of grassroots innovations (Table 5) and then propose avenues for future research. In doing so, we suggest that future grassroots innovations research can build on three promising but to-date under-represented research areas (Table 6).

5.1. Main limitations of the current conceptual development on power and empowerment of grassroots innovations

An important finding of our review is that many studies in the grassroots innovation literature fail to conceptualise and operationalise the notions of 'power' and 'empowerment'. Frameworks of power and empowerment tailored to grassroots innovations do exist (Table 3); however, they have not been widely used in this literature. In a fifth of the studies, the terms 'power' and 'empowerment' were not conceptualised at all. This finding highlights an implicit pattern within the grassroots innovation literature; scholars use these terms as *explanans* (terms that contain the explanation), rather than *explanandum* (terms that require explanation; Jessop, 2016). Jessop (2016) stresses the analytically fruitful nature of power when used as explanandum—i.e. when scholars provide a detailed specification of the context, attributes and effects of a given action and employ the concept of power to explain 'only what is left unexplained by contextual factors' (p.86). We recommend that grassroots innovations scholars not take the notions of power and empowerment for granted and rather approach these terms as *explananda*.

In particular, our study shows that grassroots innovations scholars predominantly investigate 'power' and 'empowerment' through two theoretical approaches, namely action-theoretical power and resource-mobilisation empowerment (Fig. 2). On the one hand, the grassroots innovation literature provides in-depth knowledge about the human agency involved in grassroots innovations during processes of societal change. In particular, studies explore the strategic abilities of grassroots actors to align interests, mobilise resources and influence sustainability transitions. On the other hand, the predominant focus on action-theoretical power and resource-mobilisation empowerment leads the grassroots innovation literature to reproduce an epistemic bias of sustainability transitions scholarship oriented towards analysing power and empowerment as *overt exercises* and overemphasises their *strategic* and *instrumental* nature. This bias is consistent with the growing debate on the politics of sustainability transitions more generally, which is usually centred on the questions of who steer transitions process and in what ways and who are the winners and losers of sustainability transitions (Köhler et al., 2019).

The aforementioned bias is problematic as it fails to stimulate the conceptual development of the full range of forms of power and empowerment manifested in and through grassroots innovations for sustainability transitions. We contend that moving away from this bias in future research involves two considerations.

First, the grassroots innovation literature needs to problematise overt, strategic and instrumental conceptualisations of power and empowerment. Notably, more attention should be granted to critiques formulated within sociology and political science, such as the so-called *exercise fallacy* discussed by Morriss (2002)—i.e. the unfounded assumption that if one social actor has power, she/he always actively exercise it, which leads researchers to attach importance to the exercise of power without considering its counterfactuals. The power of grassroots innovations in the context of sustainability transitions should be addressed not only by the analysis of *how* they

exercise power, but also by looking at their *dispositional abilities* that are enabled or constrained by given social conditions. We argue that in order to improve theorisations of power of grassroots innovations, the latter can be better investigated through the lens of constitutive or systemic approaches to power, which in turn sheds light on how the power of grassroots innovations is co-constituted during interactions between humans and nonhumans or how social hierarchies and institutions (e.g. policy frameworks or cultural norms) enable or constrain grassroots innovations to exercise their power (Allen, 2005), which is understood in this context as strategic power.

Second, better theorisations of power and empowerment of grassroots innovations would benefit from integrating non-strategic and non-instrumental conceptualisations of power. The aforementioned epistemic bias towards strategic and instrumental conceptualisations of power and empowerment overshadows existing analyses of other capacities and abilities of grassroots actors that diverge from these dominant conceptualisations of power and empowerment and, yet are potentially crucial to leverage social change. Cohen (1985) argues that overt, strategic and instrumental accounts of the power of social movements imply that they are *already organised* and inform analyses of how they produce negotiable demands for particular resources of their interest; however, such accounts are absent when these collectives engage in processes of *collective organisation*. In this context, reflexive, contesting and discursive accounts of power come into play and inform analyses of social movements' capacities to perceive, signify and articulate the social practices, hierarchies and institutions that shape the production of their collective identity and actions. Certainly, these two distinct accounts of power are not mutually exclusive, and there is great potential to study how they relate to one another, such as whether and how the ability of grassroots innovations to develop strategies to influence societal change is enabled by their capacity to construct a favourable space for 'social engagement and experimentation, lifestyle changes, [and] awareness raising' (Mourato and Bussler, 2019; p.276), which are often suppressed by antagonist dominant power structures and actors (Smith and Stirling, 2018)

5.2. Marginal but crucial research areas on power and empowerment of grassroots innovations

There is ample room for further theoretical development in determining what constitutes the power and empowerment of grassroots innovations beyond the action-theoretical and resource-mobilisation theoretical approaches. In effect, our study reveals three research areas on grassroots innovations that explore power and empowerment beyond their overt, strategic and instrumental aspects, namely (i) the conceptualisation of constitutive power and identity-oriented empowerment; (ii) the discussion about power and empowerment at the micro-level; and (iii) empirical studies of grassroots innovation in the Global South (Table 6). However, these research areas remain marginal in the grassroots innovations literature. Here, we add to our earlier call for future studies to research power and empowerment as *explananda* and advocate for further development of these research areas to help strengthen existing, yet under-represented, theoretical and epistemic approaches to power and empowerment of grassroots innovations. Doing so allows future studies to avoid further theoretical and methodological fragmentation. The literature already provides pertinent theoretical and epistemic tools that support a better grasp of the range of forms of power and empowerment of grassroots innovations.

Firstly, the existing literature on constitutive power and identity-oriented empowerment offers many insights on which modalities of human-nonhuman relationships are influential and how these, along with social norms, hierarchies, and institutions, enable or constrain grassroots innovations to construct a critical consciousness about structural issues and power imbalances that leads them to exercise their strategic power. Through the reshaping of collective identities, grassroots innovations contest neoliberal modes of socio-ecological interactions in food systems (e.g. Laforge et al., 2017; Hoey and Sponseller, 2018), engage with certain types of technology and associated infrastructure to foster the inclusion and participation of socio-economically vulnerable groups in sustainability transitions (e.g. Ahlborg, 2017; Longhurst and Chilvers, 2019), and resist the unjust power relations that constitute the foundations of the global food system (e.g. Celata and Coletti, 2018; Rossi et al., 2019). Accordingly, we encourage future studies to explore questions of *collective identity* (including issues of worldviews and epistemology) and thereby enrich the current understanding of the constitution of grassroots innovations' power geared towards addressing social inequalities and environmental problems (Smith et al., 2013).

Secondly, we observe in the literature a latent potential to examine power and empowerment of grassroots innovations in sustainability transitions at the micro-level. Currently, micro-level analyses mostly concern behavioural change (Sharp and Salter, 2017; Roysen and Mertens, 2019). However, behavioural change is only one of the potential foci of micro-level analyses. Some studies of grassroots innovations have investigated how everyday forms of politics within grassroots innovations influence the speed and direction of transitions (e.g. Lange and Bürkner, 2018; Schmid and Smith, 2020) or how collective modes of governance and the ways in which grassroots actors negotiate meanings to be inscribed into practices can serve as examples for the governance of societal change (Chatterton, 2016). These are promising approaches to power and the empowerment of grassroots innovations at the micro-level; they highlight dynamics that to date have remained under-researched. These studies contribute insightful analyses of the propagation of change across levels, and therefore can, among others, inform future research to entail further investigation of the linkages between *micro-level politics in and of grassroots innovations and macro-level societal change*.

Lastly, a small portion of grassroots innovations studies investigates empirical cases in the Global South. Our review may have obscured research on grassroots innovations published in languages other than English, and it has focused more on the sustainability transitions research community than other communities that are engaged in applying a more global perspective toward researching social change at and from the grassroots—e.g., diverse economies, seeds of good Anthropocene (Bennett et al., 2016; Gibson-Graham and Dombroski, 2020). Nonetheless, it is known that sustainability transition scholarship has only recently geographically expanded to non-European and non-Western countries (Hansen et al., 2018), and this situation is clearly reflected in our review. Research on sustainability transitions outside of Europe and the Western world challenges established theoretical frameworks and concepts in this field (Hansen et al., 2018; Ramos-Mejía et al., 2018; Yuana et al., 2020). In our view, the same applies to concepts of power and

empowerment, whereby grassroots innovations in the Global South often operate in contexts characterised, among other factors, by colonial legacies (e.g., of exploitation, dependency), high levels of informality and social inequality, and epistemic plurality (Ramos Mejía et al., 2018). Although socio-environmental issues and associated grassroots innovations in the Global South 'prompts different power questions, and begs for different types of knowledge and interventions' than in the Global North, these different regions are interlinked and their historical and situated power relations are mutually constituted (Schipper et al., 2019, p.10). Accordingly, we envision research on power and the empowerment of grassroots innovations *outside the Global North* where political systems and the politics of transition may substantially differ from those of that region, hence having the potential to enrich conceptualisations of power and empowerment for subsequent application in different geographical contexts.

6. Conclusion

This systematic literature review aimed to take stock of conceptual developments of power and empowerment in the grassroots innovations literature and propose directions for future research to stimulate further theoretical development of these terms in the context of grassroots innovations for sustainability transitions. The results of the study reveal that the literature has discussed power and empowerment in diverse ways, ranging from the dispositional abilities of grassroots actors and the intentions behind their interactions with external actors to how they contest and reconfigure the social construction of their worldviews, knowledge and social identities to take action. However, this study indicates an implicit pattern within the grassroots innovation literature to use these terms as *explanans* (terms that contain the explanation) and evinces that scholars predominantly discuss power and empowerment in line with two theoretical paradigms, namely action-theoretical power and resource-mobilisation empowerment. These tendencies lead grassroots innovations scholars to reproduce an epistemic bias towards power and empowerment as *overt exercises* and overemphasise their *strategic* and *instrumental* nature. We propose three avenues for future research to overcome this epistemic bias, namely to: (i) address questions of collective identity; (ii) investigate the linkages between micro-level politics and macro-level societal change; and (iii) expand empirical investigations beyond the Global North. Grassroots innovations scholars would benefit by challenging the epistemic bias on power and empowerment as strategic exercises and engaging more in-depth with other characteristics of grassroots innovations, including identity, ontologies and values. Doing so will enable a better grasp of the range of forms of power and empowerment manifested in and through grassroots innovations that shape their struggles and achievements to leverage societal change.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

Appendix A: Coding book used to assist the screening of the 88 selected studies

Criteria	Descriptors	Examples	Guiding question	Justification
Research topic	The subject or issue related to grassroots innovations for sustainability transitions investigated through the lens of power or empowerment.	The influence of grassroots innovations on sustainability transitions, the upscaling of grassroots innovations, etc.	What is the topic of research investigated through the lens of power or empowerment?	This coding criterion allows the identification of general empirical phenomena investigated in the literature.
Location of the study	The geographical location where the study is conducted	Netherlands, Tanzania, etc.	In which geographical location is the study conducted?	Cultural/political/ economic aspects of different geographical locations may require the adoption of appropriate perspectives on power and empowerment.
Thematic research area	The social or economic sector, or the problem area in which the studied grassroots innovation is involved.	Social or economic sectors: Agri-food, water, energy, etc. Problem area: urban or rural development, housing, etc.	In which thematic research area is the studied grassroots innovation studied?	Specific characteristics of the thematic research area may require the adoption of appropriate perspectives on power or empowerment.

(*continued*)

View of grassroots innovations	The ontological approach to grassroots innovations.	Strategic actors capable of instrumental reasoning, collectives that create the means for awareness raising, etc.	Which ontological approach is used to qualify the studied grassroots innovation?	Different ontological approaches to grassroots innovations may require the adoption of appropriate perspectives on power or empowerment.
Level of analysis adopted in the study	Micro Meso Macro	Individual level Collective level Societal level	Which level of analysis is employed by the study to investigate grassroots innovation?	This coding criterion enables the identification of theoretical approaches to power and empowerment used in different levels of analysis of grassroots innovations.
Type of power/ empowerment	Following Allen (2005) and Cohen (1985) frameworks	Ability, capacity, power relations, systemic power, empowerment, etc.	What type of power or empowerment is used in the study?	This coding criterion enables the identification of type(s) of power or empowerment is (are) used in the study.
Theoretical approach used in the study	Power/ empowerment	Disciplinary power, strategic power (Foucault, 1996 in Allen, 2002); collective power (Arendt, 1958 in Allen, 2002), etc.	Which theory (ies) of power or empowerment is (are) used in the study? From which school of thought?	This coding criterion enables the identification of theories of power or empowerment used to conceptualise these terms.
	Sustainability transitions	Strategic Niche Management (SNM), Transition Management (TM), etc.	Which theory (ies) of sustainability transitions is (are) used in the study?	

Appendix B: Eighteen keyword combinations used to identify relevant literature on grassroots innovations

Keywords	"Sustainability transitions"			-		
	Grassroots	Civil Society	Community	Grassroots innovations	Grassroots initiatives	Grassroots movements
Power	"Sustainability transitions" AND grassroots AND power	"Sustainability transitions" AND "civil society" AND power	"Sustainability transitions" AND community AND power	"Grassroots innovations" AND power	"Grassroots initiatives" AND power	"Grassroots movements" AND power
Politics	"Sustainability transitions" AND grassroots AND politics	"Sustainability transitions" AND "civil society" AND politics	"Sustainability transitions" AND community AND politics	"Grassroots innovations" AND politics	"Grassroots initiatives" AND politics	"Grassroots movements" AND politics
Empowerment	"Sustainability transitions" AND grassroots AND empowerment	"Sustainability transitions" AND "civil society" AND empowerment	"Sustainability transitions" AND community AND empowerment	"Grassroots innovations" AND empowerment	"Grassroots initiatives" AND empowerment	"Grassroots movements" AND empowerment

Appendix C: Profile of the selected literature

In this appendix, we present a profile of the 88 papers included in the systematic literature review following four criteria of the coding book, namely (i) the three main researched topics, (ii) the three most studied thematic research areas, (iii) the geographical location of the studies, and (iv) the levels of analysis adopted in the studies. The remaining criteria—i.e., 'view of grassroots innovations,' 'type of power/empowerment' and 'theoretical approach used in the study'— are elaborated in more detail in the Results section.

Coding book criteria	Description	Profile
Research topic	The main subject or issue related to grassroots innovations for sustainability transitions investigated through the lenses of power and/or empowerment	• The influence of grassroots innovations on sustainability transitions (40%) • Upscaling of grassroots innovations (15%) • Social conditions that shape grassroots innovations (15%)
Thematic research area	The socio-economic sector (e.g. energy sector), or the problem area (e.g. urban development) in which grassroots innovation are involved.	• Energy (29%) • Agri-food (17%)

(*continued*)

Location of the studies	The geographical regions (i.e. Global North or Global South) in which grassroots innovations are empirically investigated.	• Urban development (15%) • Global North (70%) • Global South (14%) • Mixed (3%) • N/A (13%)
Level of analysis adopted in the study	The impact of grassroots innovations on individuals (i.e. micro-level), collectives (i. e. meso-level) or society (i.e. macro-level).	• Macro-level (33%) • Meso-level (43%) • Micro-level (10%) • Multi-level (13%) • N/A (1%)

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