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Collective Action and Social Innovation in the Energy Sector: A Mobilization Model Perspective

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Abstract: This conceptual paper applies a mobilization model to Collective Action Initiatives (CAIs) in the energy sector. The goal is to synthesize aspects of sustainable transition theories with social movement theory to gain insights into how CAIs mobilize to bring about niche-regime change in the context of the sustainable energy transition. First, we demonstrate how energy communities, as a representation of CAIs, relate to social innovation. We then discuss how CAIs in the energy sector are understood within both sustainability transition theory and institutional dynamics theory. While these theories are adept at describing the role energy CAIs have in the energy transition, they do not yet offer much insight concerning the underlying social dimensions for the formation and upscaling of energy CAIs. Therefore, we adapt and apply a mobilization model to gain insight into the dimensions of mobilization and upscaling of CAIs in the energy sector. By doing so we show that the expanding role of CAIs in the energy sector is a function of their power acquisition through mobilization processes. We conclude with a look at future opportunities and challenges of CAIs in the energy transition.

Keywords: collective action; social innovation; mobilization model; energy communities; energy collectives

1. Introduction

In this conceptual paper, we develop a framework to better understand mobilization of Collective Action Initiatives (CAIs) within the energy sector. In so doing, we draw from sustainable transition theory and social movement theory to analyze the underlying mechanisms of CAIs in the energy transition.

As part of meeting sustainable development challenges, it is becoming increasingly recognized that the social aspect is an essential, and often overlooked, component to the energy transition. Research has traditionally focused on market-based, technology-driven changes, while the social aspect has traditionally been framed in terms of "social acceptance" (e.g., [1]).

Recognizing the importance of co-evolutionary innovation, this viewpoint is now broadening beyond social acceptance, especially towards "sustainability transitions" [2–4]. This has led to a more nuanced understanding of the dynamics between local communities and the energy transition [5]. The literature on sustainable transitions (e.g., [2,3]) has contributed to a better understanding of the role of citizen initiatives and CAIs in transitioning towards sustainable energy systems [6]. However, a range of prominent transition scholars [7] have called for clarifying how sustainable energy projects, such as urban living labs and other initiatives, can 'scale up' and impact society beyond their initial geographical scope [8]. Furthermore, they encourage inclusion of new theoretical approaches to challenge the current academic socio-technical transition regime, arguing that too little attention is being paid to 'opposition movements' and their effects on sustainability transitions [7].

Transition scholars have emphasized the relevance of social movements in relation to socio-technical transitions [9,10] since socio-technical transitions in the energy sector imply changes in both the social and technical systems. Transition scholars recognize that social movements affect cultural values and beliefs in society [7]. Scholars have argued that social movement theory may be useful in relation to transition studies to investigate a range of topics related to the effectiveness of activists' repertoire of contention, such as how various forms of activism complement or detract from each other, and which technological innovations are socially acceptable [10]. Recent research has highlighted how the energy transition is motivating changes in communities and neighborhoods [11], indicating that disparate movements can be interlinked and synergistic.

Moreover, the exchange of theoretical ideas goes both ways: social movement scholars also see potential in elaborating their theoretical approaches based on transition studies. For example, Törnberg [12] recognizes that socio-technical transition theory may support theory development in the social movement literature. Thus, by combining these perspectives, this allows us to address issues regarding how social movements break through and change social systems, as well as how social innovation can lead to institutional reform. This may be a cyclical process, as other research indicates that institutional reform may play an increasingly important role in motivating the formation of CAIs in a variety of sectors in response to the changing role of the welfare state and privatization of public services [13].

CAIs can take several forms of management and organizational structures—from working groups, grassroots organizations, and foundations to neighborhood associations and cooperatives. These structures provide opportunities for citizens to be more engaged with each other and can offer platforms to be involved in policy-making processes. Tilly [14] created a model for understanding how individuals from the civil society form collectives that mobilize and act as contenders to challenge incumbent regimes.

In particular, the emergence of citizen-led energy CAIs is motivating many municipalities, towns, and villages to create a more low carbon society that involves sustainable energy [11]. In this respect, involving citizens and their local communities in the energy transition is paramount [6]. Self-organization in particular can facilitate socio-institutional practices which link citizen-driven energy projects to local government institutions [15]. This, in turn, can have lasting effects on policy making to support the sustainability and scaling up of CAIs.

This paper augments sustainable transition theory with social movement theory to better understand the role of social innovation and CAIs within the energy sector. We argue that incorporating the concept of mobilization offers a perspective on how change occurs within the energy sector, and thus serves as the structure of this paper. We aim to contribute to a better understanding of civil society's role in sustainability transitions by applying four dimensions that shed more light on mobilization and upscaling of CAIs. With this approach, we suggest a framework that enlightens dimensions of importance for the mobilization and upscaling of CAIs that support social innovation within the energy sector. Moreover, this perspective allows us to discuss the generative and innovative power in mobilizations against the status quo and explore why some CAIs are successful and others are not.

2. Social Innovation in the Energy Sector

2.1. Social Innovation

Mulgan, et al. [16] define social innovation as "innovative activities and services that are motivated by the goal of meeting a social need and that are predominantly developed and diffused through organizations whose primary purposes are social." This is seen in opposition to "business innovation", which is mostly driven by maximization of profit and diffused through organizations in the private industry [16]. Furthermore, the European Union expands the definition of social innovation analogously to the one above: "Social innovations are innovations that are social in both their ends and their means. Specifically, we define social innovations as new ideas (products, services and models) that simultaneously meet social needs (more effectively than alternatives) and create new social relationships or collaborations. They are innovations that are not only good for society but also enhance society's capacity to act" [17]. Notably, social innovation has been linked to critical societal challenges, such as climate change, because of the need for multi-level governance and a coordinated effort to succeed [17]. In the following, we utilize the definition from the European Union, elaborating on the relevance of social innovation for the energy sector.

2.2. Social Innovation and Social Movements

While social innovation can be understood as new processes and practices with social means and ends, social movements, on the other hand, consist of dynamic alliances and complex interactions between social actors and motivations that are not as easy to define. In a literature review, Diani [18] developed the following definition for social movements, as "networks of informal interactions between a plurality of individuals, groups and or organizations, engaged in political or cultural conflicts, on the basis of shared collective identities." We thus understand a social movement as a grouping of civil society actors engaged in a common goal to bring about social change. Consequently, social movements, such as CAIs, can be seen as instantiations and drivers of social innovation. Beyond this, social movements also seek to disrupt and redefine power structures, form new collective identities, and overcome social and structural barriers to change [19]. Social innovation can itself be viewed as a social movement in that its adherents frame the current issues from a social perspective and see social innovation as a promising pathway to achieve solutions to our pressing needs [20] (e.g., the energy transition).

While researchers are increasingly emphasizing the importance of social innovation to the energy transition, it nevertheless still remains unclear as to what extent social movements such as CAIs are contributing to the current energy transition. Additionally, it remains unclear as to how they can better bring the transition to fruition by changing power structures, forming identities around community energy systems, and overcoming political and cultural barriers. Therefore, as we frame the concept of CAIs for the energy transition, it may not only be promoted in terms of instrumental solutions, nor to convince others that such solutions matter, but rather to question technical regime conventions and to debate the critical implications of sustainable energy when understood in new ways [21]. These types of initiatives can be framed theoretically through Critical Theory [22] as far as they activate processes

that make apparent the social structure dominating an issue and propose actions to liberate people from such dominance.

2.3. Energy Communities as Social Innovation

The transition towards sustainable energy not only entails a shift from centralized systems of energy provision towards mixed forms, but also a change in the organizational structure, which comes along with new actors who partly replace incumbents in the market. Decentralized, community-based ownership of energy equipment, sources, and distribution systems (i.e., an energy community) is a prominent example of energy generation and distribution under the control of local owners and used by the community members [23] and thus represents a CAI for the energy transition.

Energy communities are typically understood to be locally based, non-commercial, and small enough that they rely on engagement of motivated people with otherwise limited power and resources [24]. Walker and Devine-Wright [25] defined an energy community as entities that have a high degree of citizen ownership and control, that derive collective benefits, and include both supply and demand side energy initiatives. In this way, an energy community is defined by the beneficiaries of an initiative (who the project is for) and who is participating (who the project is by) [25].

The ambitions for local communities to achieve carbon neutrality through self-sufficient, sustainable energy production have also led a trend toward decentralized, renewable energy [11]. CAIs are characterized by local involvement and ownership, grassroots innovation, citizen participation, individual motivations, consumer demand and incentives, and financial and legislative support mechanisms [15]. According to Hielscher et al. [26], community energy projects differ from governmental or private sector projects in three principal ways: (1) community energy projects tend to be multifaceted, in that they tend to address more than one technology, as well as incorporate behavior changes (e.g., energy efficiency measures); (2) they empower communities to collectively change their social, economic, and technical contexts (e.g., energy poverty mitigation); and (3) they enable citizen participation to develop solutions applicable at the local context. Thus, energy communities may go beyond energy to address a wide range of sustainable development issues [6].

Informal networks and social movements are often very important to the development of energy communities (see the case study represented by the Cloughjordan Ecovillage, in [27] (pp. 13–17). These communities may be supported by networks of individuals or by associations which may in turn be supported by local administrators. Social movements and network initiatives in this area are often the result of initiatives undertaken by citizens denouncing problems generated by over-professionalization, privatization, and lack of a real commitment to sustainability from major energy suppliers [28].

There is a myriad potential social impacts from energy community CAIs. For example, local energy communities contribute to local economic development [29,30], address issues of energy poverty [31–33], raise awareness and engagement in sustainable energy [6,34,35], and promote energy justice through grassroots democratic processes [36–40]. Barr and Devine-Wright [40] found that community energy projects help to promote a more sustainable and resilient society while offering communities legitimacy, consensus, and voice. Along these lines, Seyfang et al. [6] highlight that by enabling and empowering communities to collectively change their social, economic, and technical contexts to transition to more sustainable lives, their ideological commitment to sustainability and community energy projects helps groups and individuals to overcome the structural limitations of individualistic measures by bringing communities together with a common purpose.

3. CAIs in the Energy Domain and Sustainable Transition Theory

Current research on citizen initiatives, social innovation and the energy transition has relied on a variety of different analytical and theoretical frameworks. Specifically, the family of sustainable transition theories includes the Multi-Level Perspective (MLP) [2], Strategic Niche Management (SNM) [41,42], Technology Innovation Systems (TIS), and Transition Management

(TM) [3]. Such theories recognize that grand societal challenges, including the energy transition, require more than incremental technological improvements, but also radical transformation of our socio-technical systems [7]. Of these theories, MLP and SNM include significant social aspects and have been applied to understand social innovation within the energy transition. TIS and TM focus on innovation and governance perspectives, respectively, and have not yet been as extensively applied to the role of CAIs in the energy transition. In addition to sustainable transition theory, we also consider theories from institutional dynamics [43,44], which scholars have recently applied to understand CAIs role in the energy transition. Central to all of these perspectives, and the strength of sustainable transition theory in this regard, is the co-evolutionary and multidimensional understanding of transition processes; i.e., how the social and technological aspects of society co-develop. This implies a systemic perspective to capture not only co-evolutionary complexity, but also key phenomena, such as path-dependency, emergence, and non-linear dynamics [7].

3.1. Multi-Level Perspective (MLP)

The MLP approach argues that transitions come about through the interaction between three analytical levels: (1) Niches or niche situations, which are protected spaces and locus for radical innovation (e.g., demonstration projects, social movements, etc.); (2) socio-technical regimes, which represents the institutional structuring of existing systems; and (3) exogenous socio-technical landscape developments (which includes demographic trends, political ideologies, societal values, and macro-economic patterns) [7] (p. 4) [45] (p. 28).

The socio-technical regime is characterized by being locked-in to certain pathways, i.e., it is difficult to change. Multiple dimensions, i.e., rules, practices, and institutions related to the system, co-evolve with each other (hence socio-technical), thus upholding the system: science, technology, industry, politics, markets, user preferences, and cultural meanings.

Niche-innovations may widely break through if landscape developments (e.g., the increasing recognition of effects of climate change) put pressure on the socio-technical regime (e.g., incumbent fossil-based energy system) that leads to tensions in the regime and creates windows of opportunity. Thus, in a transition theory perspective, CAIs occur in the interaction between the niche level and the existing regime. One potential role of CAIs is to take a proactive position in order to shape and moderate a transition (promote an evolution of the regime) and avoid a chaotic regime collapse [5].

Seyfang and Haxeltine [5] emphasize the importance of balancing attention and resource allocation between internal niche-formation and external diffusion, strategically focusing on how group cohesion is maintained, i.e., how identity, belonging, purpose, and community can bolster a CAI and the evolution of its vision.

3.2. Grassroots Innovation and Strategic Niche Management (SNM)

Grassroots innovation takes the perspective of the CAIs as (social) innovation niches. By doing so, the theory seeks to provide insight into the challenges, needs, and potential of grassroots initiatives [46]. When regimes undergo radical change, there is typically an underlying network of organizations and technologies on the margins (i.e., niches). Such niches allow for the development of new ideas and practices (e.g., social innovation) while being shielded to some degree from the processes affecting regime development [41,46–49]. From this perspective, strategic niche management (SNM) is seen as a means to present revolutionary solutions that could not otherwise emerge from the dominant incrementally path-dependent regime [50]. Seyfang and Haxeltine [5] see civil society as an agent of innovative change, able to form new protected niche spaces and develop new practices and ideas.

Hasanov and Zuidema [15] argue that the niche-regime interaction leads to small, adaptive changes that lead to new socio-institutional structures. They focus on how communities self-organize to form new niches, and the value-led features that facilitate that process. They find that energy communities are motivated by collective norms and they are strengthened by sharing a common

vision and activities. However, such initiatives typically require intermediaries: e.g., semi-public organizations [15].

Dóci, et al. [51], also find that links with powerful regime actors are a key indicator for the success of a renewable energy community. Additionally, a clear vision and knowledge of the goals, clear structural rules, common events, and networking platforms, and heterogeneity (in actors, motivations, and technologies) of the group are all attributes that contribute to its success [51]. They distinguish between externally oriented niches, which are organized around technological innovations and internally oriented niches, where technology is primarily a tool for some other social goal [51]. As such, renewable energy communities are more about developing new social innovations, such as strategies for managing behaviors and social groups, than they are about promoting a specific technology [51]. These practices strengthen civil society and seek to meet social goals [51].

From a SNM perspective, the important features for contributing to a growing sustainability transition are replication, scaling, and translation [5]. Moreover, a niche development process is more successful if the expectations (i.e., visioning) for the movement are widely shared, specific, realistic, and achievable [5,52]. Additionally, niche experiences are successful when internal and external networks are continually strengthened and when first and second-order learning comes from their activities and experience [5,52].

3.3. Technological Innovation Systems (TIS)

From the TIS perspective, sustainable transitions are linked to innovation processes and national innovation policies. As such, it is rarely and only tangentially applied to the dynamics of energy CAIs. However, there may be a future role for employing TIS to energy CAIs, as the theory does contain aspects of knowledge diffusion, resource mobilization, and support from advocacy coalitions.

For example, Agbemabiese et al. [53] employ TIS to gain insights into how innovation policies can accelerate the energy transition in Africa. Among their recommendations, they suggest that entrepreneurs learn to organize to form alliances so that they can act collectively to influence national policies. Hawkey [54] also used a TIS framework to analyze how regional district heating networks can emerge in the United Kingdom, with a focus on local entrepreneurialism, especially on how they mobilize resources (particularly human resources), and build legitimacy within communities, and ultimately the link between local and national scales.

3.4. Transition Management (TM)

The TM perspective was developed to analyze policy and governance of sustainable development transitions, and address the challenges that arise from disagreements of political priorities, distributed political power, pathway determination and lock-in prevention, and short-term versus long-term planning [55]. TM has been less frequently applied to the energy CAIs, as it typically is applied to understand how top-down national policy can facilitate and steer the co-evolution of technology and society within sustainable transitions [55].

Nevertheless, Kaphengst and Velten [56] utilized TM because the theory allows for some description of the normative aspects involved in prescriptive governance. They employed TM to empirically analyze energy collectives in northern Bavaria, Germany (and augmented their study with established cases in Denmark and Spain), focusing on the role of societal actors- including governments, firms, NGOs, and other organizations, and the networks created between them. Kaphengst and Velten [56] sought to identify the features that contribute to the success of energy CAIs, e.g., bottom-up, user-driven innovation processes (in contrast to top-down), business acumen of the members, financial security (e.g., governmental guarantees) during the transition, and high levels of trust between members of the CAIs. From a TM perspective, these factors could then be translated into policy recommendations, such as crafting a favorable legal framework, providing funding opportunities, backing local front-runners and first-movers, and establishing spaces and capacities for open dialogues between citizens.

Späth and Rohracher [57] also employed TM to explore the role that strategic promotion and institutionalization of energy visions by regional governments can have in the creation and mobilization of regional community energy districts. In their case study in Austria, they found that visions helped create discursive niches that helped align the heterogeneous interests of the actors [57].

3.5. Institutional Dynamics

Moss et al. [58] employ theories of intuitional dynamics. While they acknowledge the linkages to MLP and SNM theories, they argue for a more direct focus on the role of institutions (including organizations, such as governing bodies, as well as CAIs) as constitutive components to socio-technical transitions. As such, institutions are both a medium and product of the transition [58]. Oteman et al. [59] show how the institutional arrangement of the energy sector can either promote or restrain community involvement. In particular, decentralization of energy production and multi-level alignment of government discourse and strategies are important enablers of community involvement, providing some degree of stability and predictability [59].

The institutional configuration of the energy sector is a large factor on how community-led initiatives develop because it influences the available space for new initiatives to emerge from the community [59]. As such, barriers to the success of energy communities can include administrative obstacles as well as socio-economic structures [60]. Thus, CAIs as institutions must have agency and power in order to shape the context of the energy transition [58]. Such agency and power is manifested in their ability to create and promote new ideas [58], i.e., drive social innovation. Finally, the concept of ownership within an institution, such as a CAI, is an important dimension, where ownership is understood in the larger context of ideational ownership, such as in a commons: community control, distributional justice, environmental sustainability, and enhanced participation [61].

4. A Mobilization Framework for CAIs in the Energy Sector

4.1. Sustainable Transitions and Mobilization

Sustainability transition theories (and institutional dynamics) have been an essential field of research for improving our understanding of the energy transition as a socio-technical transition. This is especially relevant to the role energy CAIs have in the energy transition from the perspectives of regime structures, innovative niches, of technological innovation, and strategic management policies. While these theories describe the role of CAIs in the energy transition from the different perspectives and institutional dynamics theory shows the necessity of agency and power for CAIs to impact the socio-technical regime, these theories do not yet offer much insight concerning the underlying social dimensions for the formation and mobilization of energy CAIs and how power and agency are acquired [62].

A mobilization perspective, on the other hand, takes into consideration the power structures and the agents that underlie attempts to transform the energy regime. In contrast, adopting a mobilization model best supports investigating how actors are involved in these dynamics. In this light, mobilization is a precondition for the current studies on community energy [63]. To this end, we adapt the mobilization model developed by Tilly [14] and apply it to energy CAIs as a social movement: "Collective action is joint action in pursuit of common ends" [14] (p. 84). Tilly [14] argues that CAIs depend on shared interests, the identity of their organization, and the mobilization that includes the resources available to the group. Furthermore, this framework can be useful in understanding how energy CAIs can mobilize to challenge the current socio-technical regime of the centralized energy system. In so doing, we aim to also build on Hess [64], who explores how social movements mobilize to challenge resistant incumbents to bring about an industrial transition in the energy system.

4.2. The Mobilization Model

Tilly [14] argues that neglected political issues that exacerbate power disparities serve as an impetus for social movements to arise. Thus, people can be motivated to mobilize and thereby impact the current decision-making regime. These movements are a product of the current socio-political structures, but tend to take on a life of their own as the movements test boundaries, and are shaped by the ensuing response and interactions from the incumbent actors [65].

The mobilization model [14] is largely based on a structuralist ontology, and not on a socio-technical perspective. Nevertheless, the mobilization model shines light on several dimensions, including materialities, structures and individual versus collective interests that are of relevance when analyzing the mobilization and upscaling of CAIs in the energy transition. This lens also provides understanding to the contingency of collective action and illuminates factors that can explain why some CAIs are successful and others are not.

The mobilization model describes the behavior of a single contender through some overall dimensions. A contender, according to Tilly [14] (p. 52) is "any group which, during some specified period, applies pooled resources to influence the government. Contenders include challengers and members of the polity. A member is any contender which has routine, low-cost access to resources controlled by the government; a challenger is any other contender. [The polity] consists of the collective action of the members and the government." The mobilization model has both internal dimensions (Interests, Organization, Resources, and Mobilization), as well as external dimensions (Opportunities and Threats) (Figure 1).

Internal dimensions are those related to agency of a collective movement, what Tilly [14] (p. 6) refers to purposive explanations. The internal domain tends to be more normative and receives little attention in the sustainability transition research. The first part of the internal dimension looks at Interests, which includes the costs and benefits to individuals resulting from their interactions within the group. Organization refers to the aspect of a group's structure, which most directly affects its capacity to act on its interests. Resources refers to endowments and forms that can drive collective action, such as financial resources and knowledge. Mobilization is the process through which both the amount of resources and the collective control of the former by the contender can increase over time.

The external dimension of Opportunities and Threats refers to the relationship between a CAI and the current state of the world around it. The external domain lends itself more easily to causal explanation [14] (p. 6), and tends to be the current focus of the research in energy collectives. The opportunity dimension also includes supporting or deterring reactions to the CAI, which can affect the cost-benefit ratio of the CAI. Changes in these relationships can threaten the group's interests or alternatively provide new chances to act on those interests.

Power, according to Tilly [14] (p. 55), is "the extent to which the outcomes of the population's interactions with other populations favor its interests over those of the others; acquisition of power is an increase in the favorability of such outcomes, loss of power a decline in their favorability; political power refers to the outcomes of interactions with governments." In our adapted framework, power is understood both in relation to processes internal to the CAI (interest alignments, functional organization, and command of resources) as well as the external power asserted over the political and social barriers to gain control over the energy systems, which includes the relations to other actors, including government. In the case of energy CAIs, we aim to show that these internal and external domains are interlinked; as the dimensions of mobilization align, the CAI gains more momentum and a greater degree of agency, and thus is able to exert more influence on external structures to gain control over their energy system and moreover reap the social benefits of doing so.

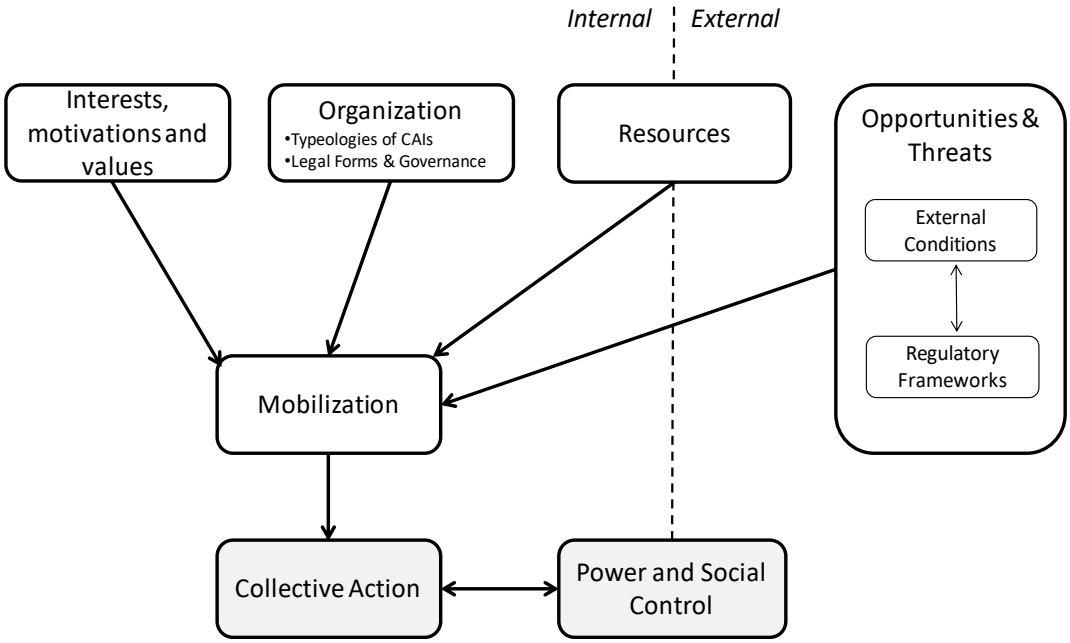

Figure 1. The Mobilization Model, inspired by Tilly [14]. Tilly [14] created a general mobilization model for all forms of collective action from worker strikes to large scale political revolutions. We simplify the model in order to apply it to CAIs in the energy sector. Whereas Tilly [14] describes dimensions of repression and facilitation, we divide this into the two components of external conditions and the regulatory framework, and place this under the opportunities and threats in the external domain. Resources are also not explicitly a component in Tilly's [14] mobilization model, but are an important factor in energy CAIs and this dimension straddles both internal and external domains. Power is also more narrowly defined here than in Tilly's [14] model (which can be applied from striking unions to political revolutions). An energy collective seeks only control over its local energy system with the goal of attaining social benefits that come with this action (e.g., stability, cohesion, identity, etc.). Power internal to the CAI influences its external power, and vice versa. The linkages between these are also simplified, though we acknowledge, similar to Tilly [14], that the processes are complicated and secondary and tertiary links are possible.

5. Dimensions of Collective Action

5.1. Interests, Motivations and Values

Tilly [14] describes the dilemmas of analyzing the interests of groups. The first highlights the contrast between a group's stated interest and their inferred interests from their observable actions, while the second looks at the contrast between individual and collective interests.

When considering the first dilemma with respect to energy CAIs, in order to make energy a collective and common good, a plurality of citizens needs to emerge and claim ownership of the energy system. To claim ownership is not simply a question of defining property rights in the legal sense, but also governs its development, energy production, and consumption within the group, and ultimately, its sustainability. From this perspective, an energy CAI is defined by its interest in liberating a local energy system, specifically electricity, from being a private good—thereby transforming it to a collective good. They are collective goods in the sense that their use value is to a plurality [66]. Thus, on the surface, the response to the first dilemma that Tilly [14] identifies with interests in collective action is straightforward for the case of energy CAIs, since an energy CAI is defined by a goal of developing and managing the community energy system in order to localize its social benefits. However, given the diversity of energy CAIs, recent research has revealed that the picture is more complex. Analyzing a database of German community energy initiatives, Holstenkamp and Kahla [67] found that these entities functioned as "social investments", and in that respect, how the return on that

investment was assessed varied significantly across different social settings, geographical locations, and climates.

The second dilemma harkens back to a classical philosophical problem, and is more problematic for the mobilization of energy CAIs. Research in behavioral theory holds that people are driven by a mix of self-regarding motivations as well as pressure to conform to social, cultural, and moral norms [68] (pp. 57, 58). Thus, on the one hand, individuals are more likely to act collectively when there are expectations of some return on the horizon. This return can be determined by an improvement of the current individual or social situation in terms of money (e.g., energy cost savings, return on investment, greater price transparency), self-determination (e.g., greater democratic voice and influence in energy-related decision-making, more control and power over local resources, taking responsibility) and other tangible or intangible goods (e.g., personal environmental consciousness). On the other hand, social cohesion creates a sense of solidarity, equality and participation, and thus shared interests arise. Indeed, studies have found that the so-called "neighbor effect" can have a greater influence on CAI mobilization than information campaigns or financial incentives [69]. In this context, the energy CAIs can be seen as an embodiment of the members' valuing the principle of collective ownership of local energy infrastructure and resources as well as collective governance of the local energy system; i.e., collective autonomy [63]. Some shared vision appears to be necessary in order mobilize collective action and facilitate social resilience within the CAI [70].

Interests and motivation for individuals to form energy CAIs is a topic that is only recently gaining interest in the scientific literature, and is now beginning to be addressed by sustainable transition theory. For example, recent survey-based studies have shed some light on the motivating factors of individuals within CAIs. When Kaphengst and Velten [56] surveyed leaders of energy CAIs, they found that they had a combination of strong social ties, a desire for agency (personal responsibility), and a zest for pioneering new energy technologies. Interestingly, they found that the motivations were more altruistic versus profit-seeking: in their study of Bavarian CAIs, environmental sustainability, followed by a desire to support the local community were the main motivations for members to participate (as opposed to an interest in economic returns on investment) [56]. However, there were differing views among the membership, particularly by age group: investment returns were more important among younger members whereas supporting the community was more important for older members [56]. Bauwens [71] likewise found that members had heterogeneous interests (including monetary, social, and moral) in his survey of members from four community renewable energy initiatives in Belgium. Members' interests were dependent on individuals' psychological, social and moral factors: of interpersonal trust, social identification with the group, and pro-environmental orientation. Moreover, as the collectives evolved from idealistic beginnings to more supply-based initiatives, they attracted members based on different interests, and at different participation levels [71]. With studies such as these, a picture is beginning to emerge that energy CAIs are efforts in aligning and balancing diverse and evolving interests toward a common goal.

5.2. Organizational Perspective

5.2.1. Typologies of CAIs

Tilly [14] (pp. 62–63) describes the organizational perspective as an amalgamation of network connections and categorical similarities (taxonomies) between individual members. Neither network connections, nor categorical similarities on their own, are a sufficient basis for collective action organization. A collection of individuals that are too diverse are unlikely to have shared interests, even if networked; likewise, a collection of individuals with similar categorical characteristics (taxonomy) cannot organize if they are not networked. On the other hand, categorical identities can form the basis for networking.

For example, research has shown that energy CAIs are typically dominated by male participation (e.g., [56]). Gender aspects are rarely considered in research about the determinants of energy

communities' development. Among the few examples, a study focused on investments involved in renewable electricity production by citizen participation schemes in Germany [72] revealed differences between men and women in the ownership of citizen participation schemes, in the average investment sum and in the decision-making bodies. Given this situation, a rural Swedish activist Wanja Wallemyr and a small group of nine women, started a women's only collective, Qvinnovindar, to promote sustainable energy, with one of the goals being to shift the gender power balance in the energy sector in rural communities through the economic empowerment of women [27]. Based on this identity, and shared frustration resulting from the reluctance of banks to finance rural female entrepreneurs, the network quickly grew to over 80 members and expanded to a form a second energy collective, Q2 [27]. Kaphengst and Velten [56], found that trust as an essential factor in building networks to grow CAIs, and that furthermore, this trust was built upon the members sharing similar local traditions and having a personal profile and long history within the community.

In other instances, categorical similarities may limit diversity in the network. For example, 50% of the Transition Town members in the UK are aged between 45 and 64, making this group significantly over-represented in the movement compared to the general population (31%) [5]. Time and financial resources (discussed below) may be one possible explanation for why this age-group is over-represented, but another possibility is that other age groups simply lie outside of the network due to the categorical differences from the current members.

Current literature usually refers to CAIs in the energy field as community energy initiatives [6,73–75], which are often organized in the form of energy cooperatives. Individuals in these cooperatives are linked primarily through geographical location, and this aspect is the foundation of the network connections through neighborhood proximity, facilitated by demographic and cultural similarities. Place-based, community identity can thus form the basis for organization, as members have the incentive to join, cooperate, and make sacrifices when they are reassured by the perception that others in the community will act similarly [63].

The International Cooperative Alliance [76] identified a set of principles that are commonly used to characterize the structural properties of cooperatives (the seven principles of the cooperative identity are: voluntary and open membership; democratic member control; member economic participation; autonomy and independence; providing education, training and information; cooperation among cooperatives; concern for the community). Second, most member states of the European Union provide a specific form for cooperatives within their national legislation [77–79]. While there is high variety across legal forms in different countries (discussed below), the most commonly adopted feature is the strong participation of members in decision-making.

The definition of energy communities is far less clear than the energy cooperatives. The heterogeneity in the sector has led to a variety of different definitions: the International Renewable Energy Agency's (IRENA) Coalition for Action, defines an energy community as projects that fulfill two of the following three elements [80]: local stakeholders own the majority or all of a renewable energy project; voting control rests with a community-based organization; the majority of social and economic benefits are distributed locally. Hicks and Ison [81] characterize community energy along different spectra, which include the range of actors and scale of technology, distribution of voting rights, balance of decision-making power, distribution of financial benefits, and the level of community engagement.

Walker and Devine-Wright [25] created a framework, adapted by Candelise and Ruggieri [82], that defines the space of variation of energy communities among the process and outcome dimensions (Figure 2). The process dimension describes the degree to which citizens finance, own, and control the development of an energy initiative, and encapsulates both economic and participatory elements. The outcome dimension describes the degree to which citizens benefit, both monetarily and non-monetarily, from an energy initiative. Examples are given for each of the quadrants within this framework. In the bottom left, a distant and closed energy scenario is represented by a case where a utility external to the community creates a wind farm to add to its energy production portfolio.

No citizen engagement has been responsible for its development, and no citizens directly benefit in any socially defined way; the farm only produces returns for the utility and its shareholders. In the upper left, a distant yet open energy scenario is represented by a utility offering its customers an option to pay a fee to ensure that a greater share of their household electricity consumption is supplied by renewables—so-called green power or renewable energy certificates. In this case, individual citizens are responsible for promoting the shift to renewable energy though their own interests, but there are no direct collective social benefits as there is no organization between the various individuals who purchase the certificates. In the bottom right, a scenario is described where neighboring individual land owners (e.g., farmers) install their own wind turbines. The interests in this scenario are individual, so there is no collective decision to take this action, yet the outcome is nevertheless a community that produces its own renewable energy, thus attaining collective autonomy. The final scenario in the upper right is exemplified by residents of a shared building complex collectively deciding to invest in solar panels on the roof of their building. In this case, both the development process and the benefits are collective. Candelise and Ruggieri [82] expand the upper right quadrant further to include the intersecting dimensions of institutional characteristics (low participation/market logic vs. high participation/community logic) and returns (monetary vs. non-monetary). Alternatively, researchers have also considered degree of integration versus value generation [83]. These participatory and economic elements are the major features that define the overall structure of community energy initiatives, which can be affected by their relative weight by skewing them toward more market- or community-based logics in their dynamics of development and operation [82].

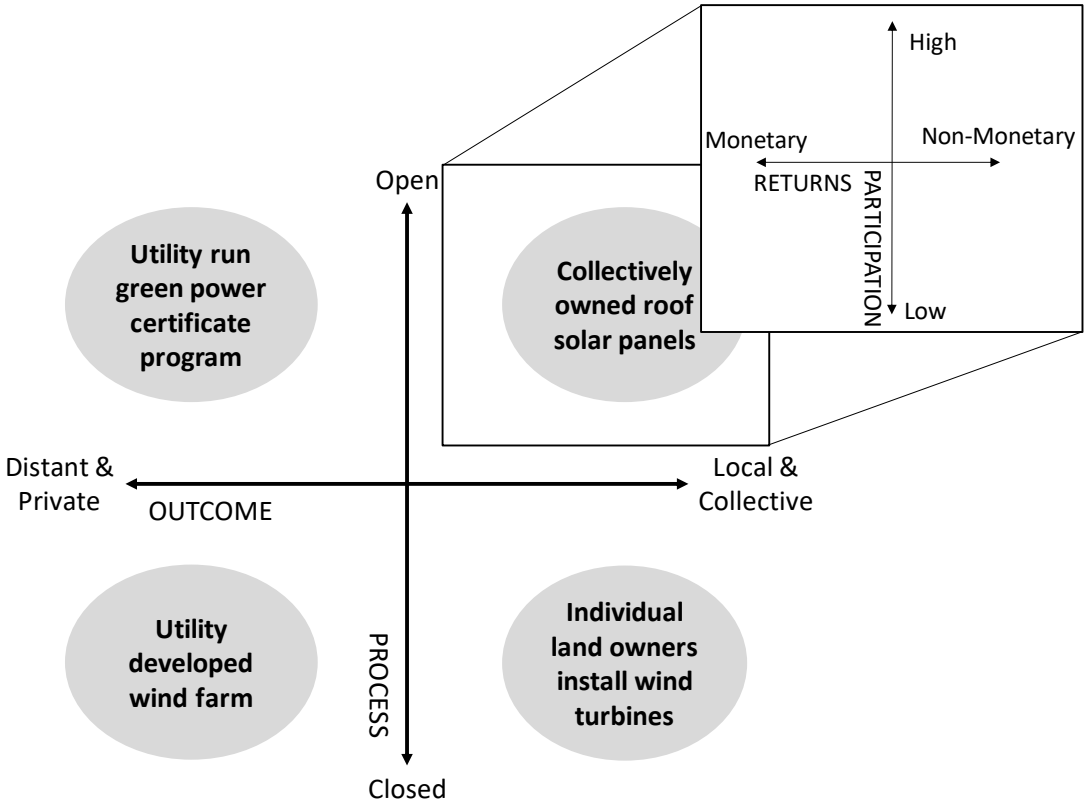

Figure 2. Community energy—two dimensions. Understanding of community renewable energy in relation to project process and outcome dimensions. Adapted from Devine-Wright [25] and Candelise and Ruggieri [82].

There are many alternatives for creating CAI taxonomies. For instance, the Council of European Energy Regulators (CEER) has identified three different types of CAIs with regard to their operational profile, namely: community owned generation assets, virtual sharing over the grid, and sharing of

local production through community grids [84]. Moroni et al. [85] suggests a taxonomy for energy communities by intersecting place-based and non-place-based collectives with single and multi-purpose outcomes. Non place-based communities can arise when individuals buy shares into a larger project, for example, Retenergie in Italy [85]. The concept of community can be highly ambiguous [86], and we expect that the concept will continue to evolve. As the digital technologies progress (e.g., blockchain, Carrotmob), the emergence of virtual sharing and thus virtual energy communities becomes a possibility through coordinated consumption infrastructures [87]. This lies at the frontier of research into energy communities, as the members are then no longer geographically localized, and thus the organization is based in virtual spaces of networks of those with similar characteristics. For a successful CAI, the social benefits would also need to apply to the virtual community.

5.2.2. Legal Forms and Governance

In addition to the organizational dynamics of energy communities, it is relevant to highlight how the organizational structure of CAIs is affected by the institutional and legal frameworks of the specific countries in which they are developed. The legal form affects the organization dimension by dictating the available avenues for how CAIs are able to structure themselves. Legal forms can generally be classified into three categories depending on their relevance for renewable energy CAI:

1. Legal forms that require some form of participative decision-making structure, such as the 'one member—one vote' principle (the category with the highest relevance);
2. Legal forms that allow for participative structures (but not required);
3. Legal forms that do not allow participative structures (the least relevant).

Cooperatives are the most common legal form used in the European community energy sector and are generally deemed to provide the best institutional framework for locally owned and participatory approaches to renewable energy projects. They encompass both the social and economic dimension in their scope and are often characterized by a 'one member—one vote' decision making process, thus providing high levels of co-determination [75,88–90].

Depending on the national legal framework, other potentially relevant legal forms are associations, (limited) partnerships and foundations or trusts differently implemented around EU national contexts. Sometimes associations and cooperatives are combined into the same legal form (Denmark and Sweden), while in other cases these are separate legal entities (Germany). Partnerships, on the other hand, are common legal forms for CAIs in Denmark and can be set up by a minimum of two legal or natural persons, while CAIs in the form of trusts can be found in the United Kingdom, as so called 'community development trusts' [6] where the members generally have the right to vote, however this right can be restricted to a specific group of members [91].

The legal form can furthermore provide information on the outcome dimension. Certain legal forms may require the generation and distribution of specific societal benefits such as in the case of Sweden, which differentiates between 'ekonomisk förening' (economic association) and 'ideell förening' (non-profit association) [92,93]. A similar classification can be found in the United Kingdom, where the legislation differentiates between the 'cooperative society (co-op)' and the 'community benefit society (bencom)'. The first, again, focuses on the members' financial interests while the second focuses on community benefits [94].

While the specific governance structure varies depending on national legislation, the participative nature of cooperatives is generally ensured through a general assembly, which convenes at regular intervals. For smaller cooperatives, the general assembly may directly manage its affairs, while larger cooperatives tend to have a board of directors elected by the general assembly [79].

5.3. Resources

Tilly's mobilization model places emphasis on the general idea that the more resources a group has access to, the better the chances are for mobilizing collective action. In Tilly's words, "mobilization

refers to the acquisition of collective control over resources" and "contending for power means employing mobilized resources to influence other groups" [14] (p. 78). Tilly and other scholars' focus on resource mobilization has been identified as a separate school of thought in the analysis of social movements as 'Resource Mobilization Theory' [95–97]. This body of work departed from earlier collective behavior studies by moving the focus away from individual participation in social movements and explaining movements as caused by 'individual grievances' and irrational behavior to placing emphasis on the rationality of movement actors. The new focus explained the success of social movements by the ability of movement actors to develop strategies and to arrange and coordinate the use of resources to impact political processes [95,97].

Resources have many definitions—they can be 'internal' (e.g., skills of CAI members) or 'external' (e.g., money) to the group or individual members. Some distinguish between 'tangible' and more 'human' assets [63]. Originally, time and money as well as Tilly's traditional categories of land, labor, capital, and technology have been seen as crucial resources [39], but resources have come to be understood more broadly as "any social, political, economic asset or capacity that can contribute to collective action" [39,98]. Other classifications of resources that have been put forward are socio-organizational resources (e.g., networks, organizations), knowledge resources (e.g., skills, know-how, and technological expertise), material resources (e.g., equipment), symbolic resources (e.g., collective understanding, quest for autonomy, visible and meaningful actions), or structural resources (e.g., investment subsidies or feed-in-tariffs) [39,63]. Bourdieu's [99] notion of economic, social, and cultural capital has also been drawn on by Schwartz [100], who argues that "Bourdieu's view of capitals aligns with resource mobilization perspectives that are open to multiple forms of power resources (not just economic), that can animate social movements." (p. 24). Even Tilly [14] acknowledges the shortcomings of focusing too much on monetary and physical aspects, pointing out that attitudes were more important than any material resource (p. 8).

In an energy transition perspective, it is relevant to consider funding strategies in order to understand monetary resources available to CAIs. For instance, it is self-evident that it is necessary for a cooperative to secure large amounts of capital in order to establish a wind turbine. These require considerable financial commitments and long-term financial planning. In contrast, PV projects are more scalable, and can be completed and expanded with less financial risk. However, with the general increase in the size and complexity of renewable energy projects, the scope for 'traditional' CAIs with direct participation governance and equal rights may be reduced, demanding an adoption of second generation, even more innovative organizational models in the future. In that sense, the collective control over resources in the mobilization model concerning CAIs depends heavily on the chosen energy sources demanding different level of investments. Also, certain types of CAIs do not mobilize separately from existing institutions, e.g., governmental subsidies or other support schemes. The most widely adopted funding strategies for CAIs that are also strongly influenced by the specific national legal frameworks are member-share financing, membership fees, bank loans or community loans, governmental subsidies, tax exemptions and other support-schemes, crowdfunding platforms, refinancing through economic returns, and donations [101].

Other resources that could play a role include, for instance, the extent of communication skills and public awareness, the availability of free technical information and competences, variations in close-knit community spirit [102], and time availability for volunteer-based work (with a side-work for subsistence and family priorities). We consider the issue of time an interesting resource that deserves further attention in the study of energy CAIs. For instance, in the Transition Town movement, many members state they have limited resources of time and money and that this is a significant challenge for wider diffusion of the movement [5]. Internal CAI leadership is another significant resource; a charismatic and trusted initiator (i.e., prime mover) can inspire collective action, particularly in the early stages of formation, as exemplified by Wanja Wallemyr with Qvinnovindar (mentioned above) [27] and Søren Hermansen, with his efforts in establishing an energy collective on Samsø, Denmark, which achieved 100% renewable energy on the island [56].

5.4. Opportunities and Threats

5.4.1. External Conditions

There are many external conditions that influence CAIs mobilization and development. The motivations are diverse and differ across countries, and between regions of the same country. This depends on their specific challenges, such as historical development of national energy markets and other cultural, economic and political factors. The narrow focus on technical and economic aspects of the majority of renewable energy research and policy approaches adopted in this area impedes a deeper understanding of these more nuanced dynamics.

Boon and Dieperink [103] looked at different factors that lead to the formation of energy CAIs in the Netherlands and found both broad national factors: volatile energy prices, societal environmental awareness, inconsistent energy policies, dissatisfaction with national governments' lack of ambition towards environmental targets, desire to reduce dependence on foreign countries for energy; as well as more locate external factors: inspiration from other CAIs, availability of technology suppliers, and support from external parties and institutions. Boon and Dieperink [103] also found symbolic factors, e.g., a green image and enhanced social cohesion could also play a role in the emergence of CAIs. We argue that symbolic factors can also be a strong external driver, because symbols have a shared social understanding, motivate mobilization, and create external visibility. For example, energy memories, the role that the historical process of construction or destabilization of energy cultures has had for a region can be a similar symbolic factor in the creation of CAIs [104]. These key factors of environmental awareness, structural opportunities (e.g., financial incentives, structure of the national energy system) and a presence of a social support system (e.g., in terms of sharing a common identity and ideas) have been observed as positive driving forces for the development of CAIs [105]. A study in Denmark, Germany, and The Netherlands demonstrated that an evolving institutional configuration of the energy sector strongly influences the available space for community initiative development [59]. Another study in Spain concluded that the cooperative tradition is one of the factors that led to the emergence of energy cooperatives in Catalonia, i.e., the Basque Country [106].

External conditions that may play a role as barriers for CAIs' development include the lack of public awareness and sufficient communication resources, the lack of availability of free technical information and competences, limited time availability for volunteer-based work (with a side-work for subsistence and family priorities), lack of close-knit community spirit in big cities and other areas and lack of environmental concerns within influential members of the population. Technological gaps, such as the stabilization of grid infrastructure, may also hamper the establishment of CAIs [105]. Another big issue is connected to legislation and the regulatory framework (see Section 5.4.2), especially legal and regulatory uncertainty for the renewable support schemes evolution, the lack of standardization of such regimes and many other bureaucratic burdens that individuals and collectives face when deciding to start an initiative

5.4.2. Regulatory Frameworks

The structure of the energy sector is a complex structure. It includes the relationships among energy production, energy storage, distribution, energy market and energy demand and consumption. However, traditional European energy systems (in terms of its technical and commercial market design) and its regulatory framework, are organized according to a traditional value chain of production, transport, storage, and distribution of energy. That picture is now far from reality due to the changes produced in the last years [107].

The regulatory framework plays an important role in the creation and development of CAIs. In the last decades, political and legal frameworks in all of Europe have been designed to support an energy system based on centralized production using fossil fuels, in which citizens were passive consumers. The role of consumers has changed and nowadays they are increasingly becoming 'prosumers', broadly 'energy citizens'; drivers of the energy transition [77] to a fairer, democratic,

decentralized system with added social benefits [108]. In addition to this, some CAIs not only own the production of energy, but citizens are also now designing creative legal strategies to introduce themselves in the areas of grid ownership and management, and energy supply.

An analysis of community ownership and participation in the production of renewable energy [77] showed that CAIs take many different legal forms. The choice often relates to the goals of the particular community, including tax treatment, profits, or even laws and legal frameworks. Some illustrative examples are shown in this section.

Nevertheless, citizen engagement in renewable energy production only found support in some local and national policies [108]. As the concept of energy communities is varied, the approach and support by the legislative frameworks vary between Member States, e.g., The Netherlands established a regulatory exemption in licensing requirements for new business models, while in Germany there are special rules in action schemes for RES support [109]. This emphasizes that The Netherlands and Germany support a more classical local renewable energy community business models, while the UK, The Netherlands and Poland support more innovative business models. The community energy is less developed in Southern, Central and Eastern Europe, mainly due to the lack of supportive frameworks, or indeed, some abrupt policy changes (withdrawal of support, sometimes retroactively).

After 2000, changes in the EU energy policy provided some opportunities, such as the liberalization of the electricity market. The Clean Energy for all Europeans Package, agreed upon by the EU in 2018, is a significant change. The community energy movement received a boost through the EU's 2030 climate and energy legislative framework that gives more chances for citizens to get involved in the energy transition, allowing communities and individuals the right to generate, store, consume and sell their own energy.

The Package also includes the RED II (The Renewable Energy Directive II, directive 2018/2001/EU). This Directive is important for CAIs in the energy sector because it highlights: (a) citizens and communities are stakeholders in the Energy System; (b) citizens and communities have the right to produce, store, consume and sell renewable energy, and other rights such as consumer's protection or access to all energy markets directly or through a third party; (c) requires Member States produce a National Climate and Energy Plan; (d) it simplifies administration and procedures.

An in-depth assessment of the treatment of energy communities in the 28 draft National Climate and Energy Plans (NECPs) showed that most Member States positively acknowledge renewable energy communities (RECs) in their NECPs and some demonstrate their planned commitment [80]. However, in most cases, this acknowledgment lacks concrete policies or measures. In the analysis of the NECPs, some Member States, like Greece, demonstrate a strong engagement with the role of energy communities in their energy system, whereas others, such as Sweden and Germany, completely ignore this role [110].

Legal frameworks play a role also in shaping the advancement of technologies, telecommunications and data analytics that could provide CAIs with new opportunities. The digitalization of the energy sector gives suppliers the opportunity to have a stronger relationship with consumers, though the security and protection of these data are an increasingly important consideration [111]. Half of all the European Union citizens could be producing their own electricity by 2050 and meeting 45% of the EU's energy demand [112]. This would only be possible assuming that policy and regulatory barriers are removed and national grids, distribution networks, and electricity markets are developed in parallel with the growth of renewable energy production, more storage options, and flexible demand side management.

6. Discussion and Conclusions

6.1. Power and Social Control

The role of CAIs in the energy sector has increased over the last decade. The social relevance of CAIs for the energy transition comes from the fact that it can be the trigger, or at least the accelerator,

of the energy transition while creating new conditions for collective and cooperative behavior, thus generating or reinforcing social innovation.

In terms of power, Tilly [14] (p. 55) defines it as both the extent to which a group is able to favor its own interests over those of others, and political power as the outcome of interactions with governmental institutions. We augment this definition by considering internal power as a CAI's ability to align internal interests, build networks, and mobilize resources, and external power as a CAI's ability to seize opportunities and overcome barriers. In our mobilization model, we find that the internal and external domains are linked within energy CAIs. Indeed, a facet of the CAI mobilization process is that it is dynamic and self-reinforcing. As the four dimensions of interest, organization, resources, and opportunities align, and CAIs mobilize, they gain more potential to challenge external barriers to liberate the local energy system from incumbent, centralized energy firms [64]. This process plays a crucial role in building a CAI's identity, including the increase of its networks and membership base, gaining access to more financial and symbolic resources, and imbuing it with greater power to further shape both internal collective interests and external regimes.

Moreover, collective action implies a self-generation of motivations and interests, those that can be linked both to further innovation. The collective creation of guidelines for sustainable consumption of energy services implies a categorical shift in the conceptualization of energy services from a private service to a collective service. In so doing, CAIs provide a structure for fostering sustainability in the energy sector though inherent incentives to develop renewable resources and to promote sustainable consumption patterns. Thus, they garner more attention amongst national and international political and research institutions, and as argued above, this form of social innovation becomes itself a social movement.

6.2. Synthesis of Sustainable Transition Theory and Social Movement Theory

Research into the energy transition is multi-faceted, and many are currently calling for more synthesis between the various perspectives. We have shown here that much can be gained in our understanding of the energy transition by merging aspects of sustainable transition theory and social movement theory. Other researchers are making similar calls for future research to combine understanding of how social movements mobilize in order to shed light upon niche-regime interactions in sustainable transition theory [5]. Moreover, researchers have also argued that studies on energy related behavior change within the energy transition too often focus on the individual energy consumer, and that there is much to be gained from the perspective of researching the community level and viewing individuals as citizens [87]. In this respect, a deeper investigation of the relevance of mobilization in refining motivations and values for people to decide to join and support a collective action (that is tuning, selecting and adapting to the specific context of action) represents a relevant improvement in understanding CAIs' dynamics and performance.

One of the strategies emphasized in the SNM perspective is to support networking activities that involve many stakeholders who can support the growth of a niche by utilizing the available resources of their respective organizations [5]. However, in general, with rare exceptions (e.g., [39,63,113]), sustainable transition theories have not elaborated much on 'available resources' in a social movement perspective as factors that support the upscale of grassroots innovations or mobilization of social movements. There is a focus on resource mobilization within TIS (e.g., [114]), though it does not account well for social movements and collective action. There is also little focus on the other internal dimensions of interests and organization. Instead, sustainable transition theory tends to put more effort in to analyzing the external opportunities and threats to emerging niches. Yet it is highly relevant to gain a deep understanding of how the internal dimensions function in the mobilization of CAIs. This includes how interests are aligned, how organizations form and grow based on taxonomies, networks, and geography, and the how the various types of resources (for instance time, knowledge, skills, money, and materials) and their availability have implications for the mobilization and success of social movements. Thus, the synthesis of transition theory with social movement theory allows

for a more nuanced understanding of how energy CAIs form, mobilize, and gain power to affect the transition to sustainable energy.

6.3. Perspectives of CAIs in the Energy Transition

As Tilly [14] (p. 5) notes, the investigation of CAIs is necessarily political and normative, and this can pose challenges for scientific studies that seek to understand CAIs from an objective and non-normative point of view. As such, the new role of CAIs in the political landscape is by no means a one-sided discussion. Undeniably, citizens' engagement with the sustainable energy transition is on the agenda in the EU and other parts of the world, and concepts such as community energy, grassroots innovation, and decentralized energy production are flourishing in academic papers and policy reports. Often the positive merits of these civil society initiatives in terms of pushing the sustainable transition, while ensuring a just and democratic process and distribution of benefits is underlined. Also, citizen engagement and grassroots movements have become increasingly supported politically and institutionally in the first two decades in the new millennium.

However, the expectations of citizens to have an increasingly large role in society concerning, for instance, provision of energy (via energy communities) could also entail a new role of the state: a role where citizens in communities are obliged to 'take care of themselves' and where the service level from the public sector is shrinking [13]. This also relates to discussions in the area of Responsible Research and Innovation where questions of fairness and inclusion are pertinent in relation to projects in the energy sector in the EU. Moreover, many of the imagined energy futures entail investments in advanced technologies (e.g., smart energy systems), which may not be affordable for all. This is compounded by the risk that decentralization may exclude households in very isolated locations, or in areas where CAIs would not prosper, and these would face central system costs less widely socialized than the ones they face today. There is also a risk that the large-scale decentralization may create some negative selection by which the only ones left in the central system to bear most costs are precisely the ones who could not afford to join a CAI.

Outside of these cases, CAIs can be an important form of innovation that produce new types of goods or are able to restore commons that had been monopolized, captured by market forces or privatized. They are a social innovation per se because they counteract privatization and individualization, and because they promote new community interactions and consider a wider definition of social welfare than traditional approaches, which further helps fuel the growth of these initiatives. Here, social innovation, as in the case of innovations that follow from managing new collective goods, is ideally sculpted by principles of environmental and social justice, inclusion, poverty alleviation, and resource sharing as a form of mutual support. All of which generate social welfare.

History has witnessed the transition of how we have conceptualized goods and services, such as energy. One such transition occurred in the 19th century, that of a "moral economy" (one in which the community residents had a right to the resources within the community and the community recognized its obligation to assist resource-less members; i.e., goods and services as collective commons) to that of a "possessive individualism" (where all goods, including labor, should be disposable property and owners had the obligation to use them to their maximum advantage; i.e., goods and services as private) Tilly [14] (p. 4).

Now, as we push against the planet's ecological limits, we are becoming more cognizant of the world's global common resources and the services they provide. Given these constraints, we also reconsider what it means to provide economic wellbeing to citizens and what options are available to promote social cohesion within the civil society. In this light, we may be on the cusp of yet another transition. Because the modern economy is so intrinsically linked to the energy sector, CAIs in the energy sector could be a catalyst to the transformation to a paradigm where sustainability is intrinsically incorporated into our social institutions and technological infrastructure.

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