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Thinking, doing, organising: Prefiguring just and sustainable energy systems via collective prosumer ecosystems in Europe

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A B S T R A C T

This article positions collective renewable energy prosumerism as a social movement that engages in energy system transformation. Collective renewable energy prosumer initiatives engage in 'prefigurative' work through their discursive framings (ways of thinking), their activities (ways of doing) and their understanding and enactment of social relations (ways of organising). The core of this article is a comparative analysis of the prefigurative work of 13 collective prosumers from 7 European countries (Belgium, Croatia, Germany, Italy, Netherlands, Portugal, United Kingdom). The article discusses their contributions to energy system transformation, including renewable energy production, different mechanisms for involving citizens, local value creation, and the degree of desired and actual collaboration and networking within broader prosumer ecosystems. We then discuss these contributions against societal discourses and expectations towards prosumerism, such as energy democracy, energy justice, and environmental sustainability and decarbonisation. This reveals three tensions: 1) a focus on decarbonisation but not on broader environmental problems, 2) the involvement of certain people and not of others, and 3) the building of prosumer eco-systems while ignoring incumbency. Future research avenues are formulated to conclude the article.

1. Introduction

Changes in energy systems are ongoing, fuelled by, amongst others, international agreements such as the Paris Agreement [1], new European Union [2] or national policy conditions [3], global actions such as Fridays for Future [4,5] or local collective action [6]. Faced with the impending need for deep decarbonisation [7,8], there are many storylines being told and actions being engaged in – there is not one energy transition, but many [9,10]. Thinking about and acting towards specific energy system futures therefore involves contestations between parties for interpretative authority about alternative pathways. As put by Longhurst and Chilvers [11]: "*what is often presented as a primarily 'technical' transition is always normative in bringing forward particular forms of social and political order*". Each pathway taps into, and builds upon, diverse societal and cultural values, norms, symbols, and rituals and therefore mobilises different publics [11–13]. This key role of framings and discourses as an important aspect of mobilising publics has long been discussed in social movement studies [14].

We see recognition thereof in the study of energy systems change, whether it is the judgement that the main contribution of grassroots initiatives lies in "*their framing of a specific vision of a local energy transition*" [15], or that it is through civil society that "*alternative models of progress, social change, and the roles of publics*" [11] are being imagined. Scholars have also expressed expectations regarding the contributions of such energy initiatives, amongst others, involved in collective self-consumption, community energy or peer-to-peer energy trading to

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environmental sustainability and decarbonisation, as well as to energy justice and energy democracy by opening participation and ownership to 'the many' [16–19]. Moreover, supported by recent EU legislation through the Clean Energy Package, collective self-consumption and energy communities will likely gain further ground [3].

In this article, we build on this previous work and extend this argument in two ways. Focusing on collective actors involved in renewable energy prosumerism, we study 1) these initiatives as important source of alternative and heterogenous frames for energy system futures; and 2) elucidate the activities and social relations they engage in to transform energy systems; i.e. their prefigurative work. To this end, we draw on Monticelli's concept of 'prefigurative social movements', to imply that actors involved in collective renewable energy prosumerism engage in creating the future they want to see through their current activities [20]. For the purpose of this study, we conceptualise collective renewable energy prosumerism as "*the collective participation of prosumers in energy projects with [potential] social, economic and environmental benefits to society*" ([21]; brackets inserted by authors). Part of such a collective renewable energy prosumerism – further referred to as 'collective prosumerism' – are initiatives, which engage in producing, sharing, storing, and self-consuming energy from renewable sources and others, who support them in such activities through providing services and/or products [17,21,22]. As a movement, these actors co-construct and enact more distributed and decentralized energy systems.

Understanding the prefigurative work of collective renewable energy prosumerism initiatives can elucidate their desired social and political futures, and the alternative ways of doing, thinking, and organising that they engage in [cf. 23,24]. It also allows for more differentiated expectations, appreciation and interaction with their efforts and contributions towards energy system transformation, which to date remain an open question [25]. Considering prefiguration as an account of how social movements enact changes 'in the making', through engaging in new ways of thinking, doing and organising, prefigurative action becomes highly relevant as a lens to analyse prosumerism. Collective participation in energy projects implies new ways of doing (e.g., co-constructing decentralized energy systems, co-ownership of energy systems, new consumption routines). It equally implies new ways of thinking about energy systems (e.g., decentralized, citizen-led, localised, democratic decision-making). Finally, it implies new ways of organising (e.g., new renewable energy communities, virtual power plants, crowdfunding cooperatives). Thus, it becomes relevant to further understand how prosumers translate such new ways of thinking, doing and organising into energy system transformations.

To this end, this paper's research question is as follows *"How do collective renewable energy prosumer initiatives engage in energy system transformation through prefigurative work?"* In answering this question, we first embed our thinking in the growing body of research on collective renewable energy prosumerism, including community energy studies, studies of renewable energy cooperatives, energy-related grassroots, and transformative social innovation research (section 2). We then outline our methodological approach (section 3). In section 4, we address the lack of comparative studies in prosumerism-related research by presenting a comparative analysis of 13 collective prosumer initiatives from 7 European countries (Belgium, Croatia, Germany, Italy, Netherlands, Portugal, and the United Kingdom). This is followed by a dedicated discussion in which we relate these understandings to broader societal discourses (section 5), before we conclude with outlining some avenues for further research (section 6).

2. Positioning collective prosumerism in energy system transformation

2.1. Collective renewable energy prosumerism and its prefigurative work

Renewable energy prosumerism is no longer a marginal phenomenon. Although active energy citizens engage in creating the future within the limits of existing legal frameworks and energy infrastructures [21,26], their potential for development is considered significant. By modelling the potential of renewable energy technologies that can be used for both individual and collective self-consumption (e.g., solar, wind, biomass), Doračić et al. [27] found that across EU member states as much as 89% of electricity demand in households can be generated by households themselves by 2050 - by becoming prosumers. To tap into this potential, prosumers can build on long histories of communities setting up their own energy grids, starting in the early days of electrification in many European countries [28–31].

Collective prosumer initiatives can be led by civil society organisations, businesses, or public actors such as municipalities [17,22,32]. Focusing on energy cooperatives as one legal form and collaborative structure for collective prosumer initiatives, provides us with an idea of the current magnitude of the phenomena. One study found more than 2,500 energy cooperatives in Europe [33] and the European Federation of citizen energy cooperatives (Rescoop) counts 1,500 organisational members, representing over a million citizens[1]. The motivations to start collective prosumer initiatives vary from tackling climate change, being part of the clean energy transition, contributing to the decentralisation of energy production to creating a sense of community or local value [17]. Such initiatives often rely on volunteer work, and are slowly moving towards becoming more professionalised [34–36]. Horstink et al. [17] provide a state of the art of collective prosumer initiatives and identified a long list of barriers for their development including public policies and legislation, technological infrastructure, access to investment and finance and specialised knowledge.

For this study, we take a broad conception regarding who is involved in collective prosumerism including both, initiatives who engage in actual production and self-consumption (including sharing and storing) of renewable energy, as well as initiatives who facilitate these activities through providing services and/or products. These services encompass the provision of financial resources through crowdfunding or crowdlending [37], or electricity balancing services to provide the necessary access to infrastructure and ensure grid balance [38,39], but also the development of new business models [40,41] or peer-to-peer trading and sharing [42,43]. Similarly, Horstink et al. [17] distinguish between collective RES prosumers and RES prosumer stakeholders. In this article, we consider RES prosumers and their stakeholder networks as part of the broader collective prosumerism movement [21]. There have also been other ways to think about the multi-actor nature of collective prosumerism. Focusing on cooperatives, De Bakker et al. [44] identify different alliances that these enter to broaden and scale their activities, while Vernay and Sebi [34] identify how their growth and development is afforded by the characteristics of the ecosystem that they are involved in.

Campos and Marín-González [21] have explicitly explored the extent to which prosumerism can be understood as a social movement. They found that "*despite not being a classical political protest and mobilization social movement, prosumerism is a movement towards a new decentralized and democratic renewable energy system*" [21]. Drawing upon a similar understanding of local energy initiatives as a social movement, van der Schoor et al. [45] analysed the social conflict that becomes visible through these initiatives, namely the way the energy system is currently organised and how this favours certain actors and ideas and not others. They also highlight how these initiatives harbour new (collaborative) forms of organisation and governance relevant for a more sustainable energy production. Similarly, Avelino et al. [24] consider 'community energy' as a 'transformative innovation movement'. Grounded in research on sustainability transitions, and bringing together social innovation and social movements literature, the concept of 'transformative innovation movement' is understood as a network that

[1] European federation of citizen energy cooperatives (Rescoop) website, https://www.rescoop.eu/, accessed January 2021.

mobilizes around common themes and comes with new ways of doing, thinking and/or organising with the intent to transform current systems. Collective prosumerism mobilizes around common themes such as decentralisation, energy transition and tackling climate change [17] as well as collaboration, shared ownership and democratic governance [46,47], but also comes with different framings or visions for the future [21,22]. It is through this 'prefigurative work' that such transformative innovation movements challenge existing systems and thus contribute to sustainability transitions [24]. Through prefiguration they provide "*living proof that there are alternatives*" [24] since they "*embody their ultimate goals and their vision of a future society through their ongoing social practices, social relations, decision-making philosophy and culture*" [20]. Taking this prefigurative dimension on board enables analysis of collective prosumerism as a social movement that on the one hand manifests alternative visions and frames through enacted social practices and relations and thus new ways of doing, thinking, and organising systems, and on the other as a place of social conflict between actors with differing resources and competing visions and interests.

2.2. Societal expectations towards collective prosumerism

The prefigurative work of collective prosumer initiatives has been met with differing expectations as regards the economic, social, and ecological benefits for the participating citizens and communities [48]. In both, policy and scholarship, the work of these citizens and communities is linked to broader societal framings of what the future of energy systems should be and the role of collective prosumerism therein. In the following section, we introduce three relevant societal framings on energy system futures that have been associated with collective prosumerism, namely environmental sustainability and decarbonisation; energy democracy; and energy justice.

Environmental Sustainability and Decarbonisation are framings related to the activities of collective prosumer initiatives [49]. On the one hand, active energy citizens and prosumers are expected to contribute to reducing global carbon emissions, and on the other hand, they are also motivated by the opportunity to actively participate in the decarbonisation of energy systems [17]. Recent European Union Policies, including the Winter Package and the European Green Deal, which are guided by emission reductions targets for 2030 and 2050, emphasise the importance of a citizen-centred energy transition [50]. In fact, recent research has concluded that households who become prosumers will facilitate environmental protection, by limiting emissions [51]. Collective prosumer projects have also been found to contribute to environmental sustainability, by protecting biodiversity and promoting sustainable water management approaches in rural regions [52]. Thus, while the decarbonisation of the energy system requires all energy system actors to play their part, prosumer projects are motivated by this purpose and are also expected to contribute to global efforts for environmental sustainability and decarbonisation.

Energy democracy can be summarised as a call for a more democratic energy governance [18,53]. It is related to the decarbonisation of energy systems with an increased adoption of renewable energy sources, since it emerged largely in the scope of climate and environmental democracy discourses and research [54]. According to Szulecki, energy democracy revolves around a "*demand for increased accountability and democratization of a sector that was previously not seen as requiring public involvement and was (is) most often depoliticized*" [54]. Central to energy democracy is the agency and empowerment of citizens in the energy system through participation and collaborative decision-making: citizens are considered to have access to information and to have a say about how energy is produced and distributed. Procedural transparency should enable citizens to make informed decisions and is considered equally critical to ensure citizens' participation in policies for the common good. It also may include the possibility of citizens co-owning parts of the system and producing new energy infrastructures and energy practices [55]. The concept of energy democracy raises high expectations for prosumers as key vehicles enabling a more democratic energy system, and is at the same time strengthened by new participatory decision-making practices, enacted through the prosumer movement [46,54].

A similar relation can be found between prosumerism and **energy justice** [56]. Among the core notions of energy justice are its 'three A's' – availability (technical availability of a form of energy), accessibility (opportunity of local communities to access such energy) and affordability (capacity of local populations to afford such energy services) [57]. Energy justice is concerned with distributional and procedural aspects of energy production and consumption. Regarding local renewable energy production, the issue of who owns and benefits from these projects has been at the core of energy justice discussions, which bring to the foreground the distribution of costs and benefits of production [35]. Energy justice similarly highlights issues of inclusiveness, such as financial participation in energy projects (e.g., through crowdlending); co-ownership of energy production units or storage; or inclusion as a social support scheme that helps citizens implement energy efficiency measures [58,59] and tackles energy poverty (i.e., when households cannot afford to adequately heat or cool their homes) [60,61]. Energy justice is also about ensuring the participation of and benefits for marginalized or more vulnerable communities, such as migrant communities and low-income families, and thereby supporting diversity across ethnicity, gender or age [62–64].

2.3. Towards analysis

We focus in this article on three aspects of prefigurative work of collective prosumer initiatives: their discursive framings (ways of thinking), their actual activities (ways of doing) and their understanding and enactment of social relations (ways of organising). Across these three aspects, we formulate a set of four questions guiding our empirical analysis.

To understand the prefigurative work of collective prosumer initiatives, we firstly need to understand their *framings* of the energy system future they are striving towards. We have a broad take on framings, considering them as attempts to attribute meaning to what happens in the world so as to organize experiences [14] – also referred to as "cognitive schemata" [56]. To understand the future that collective prosumer initiatives want to create, we focus on two aspects of initiatives' sensemaking: current problems and future visions. We formulated the following questions to guide our empirical analysis: 1) What is considered problematic in current energy systems? 2) What does a desirable energy system future look like?

A second aspect of the prefigurative work of collective prosumer initiatives is their actual *activities or doings*. Through analysing their energy-related activities, we also come to understand the material aspects of their energy system building and where they try out alternative modes of doing. It allows us to compare discursive framings with actual activities to understand synergies and contradictions. To this end, the question guiding the empirical analysis is as follows: 3) What are the energy-related activities of the collective prosumer initiative?

Finally, prefigurative work also entails an *understanding and enactment of relations* between the collective prosumer initiatives and other

actors. An important aspect of energy system transformation are changes in the broader social fabric, such as in actor roles and social relations [65–67]. Through analysing the roles and relations between actors in the energy system as discussed and enacted by collective prosumer initiatives, we come to understand how they consider future energy systems to be organized. A final empirical question is therefore: 4) What is the role the collective prosumer initiative sees and enacts for itself and for other relevant actors in energy system transformation?

Having analysed these three aspects will allow us to discuss how collective prosumer initiatives engage in energy system transformation through prefigurative work.

3. Methodology

To explore how collective prosumer initiatives engage in energy system transformations, we want to analyse their prefigurative work, that is their framings of energy system transformations, and the activities and social relations they engage in. To achieve this, our methodology is a qualitative, case study-based approach.

Data collection took place in the context of transdisciplinary research into the institutional barriers of collective prosumers and their stakeholder networks [68]. Living labs were set-up, as physical or virtual spaces for co-learning and the co-production of knowledge, combining practical, needs-driven interventions with research-driven data collection through establishing a collaboration with a range of different stakeholders [69–71]. In total, we ran 10 living labs with a wide range of stakeholders from which we selected 13 collective prosumer initiatives for the analysis of their prefigurative work (see Table 1 below). For instance, cases PT1, PT3 and PT4, all participated in a living lab that aimed to promote the development of new energy communities in the São Luís village, Portugal, yet they are analysed here as separate case studies, as they are each a collective prosumer initiative. Conversely, other selected case studies (e.g., IT1) participated in living labs from which they were the only initiative selected for this study. The overall sample of 13 collective prosumer initiatives was to be situated in different European countries, with different degrees of maturity as regards their energy transition efforts and led by different types of actors (see Table 1 below). These cases have in common an intent to either plan or implement collective prosumer projects.

Internal methodological guidelines for the living lab research included a section detailing which data was to be collected for each of the participating collective prosumer initiatives. This specific data collection focused on four aspects of the initiatives: 1) general description including motivation, activities, and organisational model, 2) identified societal challenges and future visions; 3) critical turning points in the development of the initiative and 4) enabling and constraining conditions for the further development of the initiative. The living labs were implemented in the period from January 2018 to September 2020 and data was collected throughout the dynamic coproduction process. Importantly, the collected data does not lead to a holistic in-depth description of each initiative, which is a limitation of this study. Rather, through working together and observing the initiatives in action, the data collection focused on the actual articulation of future framings, activities and social relations related specifically to energy production, distribution, sharing, storage and/or consumption. A concrete overview of data collection methods for each case study in the context of the living lab activities is provided in Table 1.

Before advancing with both the living labs research and the individual inquiries into the 13 selected participating initiatives, an ethical approval was collected, and all research participants were duly informed about the relevance and objectives of the research conducted. Informed consent sheets were also provided and signed.

Data analysis followed a three-step process. First, (at the early stages of the living labs' activities) general data on the different initiatives was registered in a shared reporting template by each researcher involved in the living labs where initiatives participated. This data included the name of the initiative, main objectives, leading actors, participating stakeholders, stage of development, and main activities. This data enabled screening and selecting the specific initiatives which were further analysed in this study. Second, data on the future visions, framings, and activities (both planned and accomplished) of each selected initiative was added to the shared template document as the living lab work progressed. The internal reports included direct citations taken from interviews, workshops and from participant observation activities and answered to the following specific questions: What does the collective prosumer initiative consider problematic in current energy systems and what does a desirable energy system future look like?; What is the role the collective prosumer initiative sees for itself and for other relevant actors in energy system transformation?; What strategies does the collective prosumer initiative suggest for getting to/working towards those futures? Third, by taking stock of the internal reporting documents that had been filled out by the research teams, the empirical data analysis made use of thematic analysis, which offers a flexible method to analysing qualitative data, enabling the identification of crosscutting patterns or themes within the data [72]. The thematic analysis was guided by questions for empirical analysis (as outlined under section 2.3): 1) What is considered problematic in current energy systems? 2) What does a desirable energy system future look like? 3) What are the energy-related activities of the collective prosumer initiative? 4) What is the role the collective prosumer initiative sees and enacts for itself and for other relevant actors in energy system transformation?

4. Results

This section presents the key findings and is organised in relation to three aspects of the prefigurative work of collective prosumer initiatives: their discursive framings (4.1.), their activities (4.2.) and their understanding and enactment of social relations (4.3.). Throughout this section we are referring to the different cases using the country code and number assigned to them in Table 1.

4.1. Discursive framings of collective prosumer initiatives

We analysed the discursive framings of the 13 collective prosumer initiatives to establish their understanding of problems in current energy systems and their desired energy system futures. These framings include aspects of how they think that these visions are to be realized. Table 2 summarises the results from the thematic analysis of the discursive framings collective prosumer initiatives.

About half of the initiatives outline what they consider problematic in the current energy system (such as HRI; DE1; NL1; PT2; PT4; UK1), by referring to specific issues (e.g., 'energy poverty'). The other half of the initiatives focuses on their desired energy system futures (such as BE1; DE2; DE3; IT1; PT1) without an explicit detailed problem analysis of what needs to be improved in the current system, but by making more general claims (e.g., 'there is a need to decarbonise'). Desirable energy system futures are combined with targets and ambitions (e.g., to be fully

Table 1
Overview of our sample of collective prosumer initiatives and data collection methods used (in the context of a broader living labs' research).

CodeName	Collective Prosumer	Description of actor and main prosuming activities	Specific data collection methods used	Leading actor(s)	Country
BE1	Getesnipper	A collaboration between, among others, municipalities, regional government, farmers, and a landscape management authority to make use of local residue wood resources for the creation of biomass feedstock for sustainable heat.	2 interviews (1 h each) 1 meeting (1 h) 2 workshops (4 h each) Document review	Municipality (intermunicipal association)	Belgium
HR1	Community group Silba Island	Silba is an island in the Adriatic Sea in Croatia that has been facing severe water supply issues for decades	1 meeting (3 h) 3-day participant observation incl. about 20 interviews Document review continuous informal e-mail and telephone exchange	Community	Croatia
DE1	BürgerEnergie Buxtehude eG	Citizen cooperative (~250 members), producing wind and solar energy at the local level	9 interviews (0,5–1,25 h) 3 meetings (1 h each) 1 workshop (1,5h) Document review	Cooperative	Germany
DE2	RegionalEnergie Elbe-Weser gGmbH	Association for the dissemination of educational and public relations work around the energy transition, and a network for regional community energy initiatives	2 meetings (2 h, 5 h) 2 workshops (1,5–2 h) Several phone calls and e-mail exchanges	Network (non-profit company)	Germany
DE3	Suburban heat transition (SubWW)	Low-temperature local heating network with decentralised renewable energy production.	2 interviews (0,5h, 1 h) 2 meetings (2 h each) 1 workshop (3 h) 1 online survey (78 respondents) 2 participant observation events (3 h each) Document review	Municipality	Germany
IT1	Santorso Municipality	Municipality creating an inter-municipal helpdesk to support citizens involvement in the energy transition and create a renewable energy community	2 meetings (1 h, 2,5h) 2 workshops (2 h each) Document review	Municipality	Italy
NL1	Aardehuizen-Oolst	Ecovillage prosuming electricity and constituting an official legal derogation zone for a local electricity grid.	2 interviews (2 h each) 1 workshop (3 h) Document reviews Several phone calls and e-mail exchanges	Community (association)	The Netherlands
NL2	Buurtwarmte	Support network for citizen initiatives focusing on sustainable heat provision locally	4 interviews (1–1,5h) 2 meetings (1 h, 2 h) 1 workshop (3 h) 2 participant observation events (6 h each) Document review Several phone calls and e-mail exchanges	Network (association)	The Netherlands
PT1	Coopérnico Cooperative	Renewable energy cooperative producing energy from renewables in partnership with charities.	4 meetings (1 h each) 3 workshops (3 h each) Ongoing participant observation (1 year) (as member of the cooperative) Document review	Cooperative	Portugal
PT2	Herdade do Esporão	Wine producing company, using renewables, and developing new partnerships for sharing energy with local communities and other wine producers	2 interviews (1 h each) 4 workshops (3 h each) 3 participation observation events (total of 16 h) Document review	Company	Portugal
PT3	São Luís Transition Town	Transition initiative in rural village setting up an energy community	4 meetings (1 h each) 4 workshops (3 h each)	Community	Portugal

(*continued on next page*)

Table 1 (*continued*)

CodeName	Collective Prosumer	Description of actor and main prosuming activities	Specific data collection methods used	Leading actor(s)	Country
			3 participant observation events (total of 12 h) Document review		
PT4	Tamera	Ecovillage with a 'Solar Test Field' where new energy solutions are developed	2 interviews (1 h each) 1 meeting (3 h) 5-day participant observation Document review	Community (non-profit company)	Portugal
UK1	Bristol Energy Company	A municipality-owned energy company[1] developing new energy service business models for its customers	2 interviews (1 h each) 5 meetings and calls 3 workshops (2,5h, 4 h, 1 h) Document review	Municipality	United Kingdom

[1]Bristol Energy Company was fully owned by Bristol City Council until May 2020 when it was put up for sale. In this article, we cover the period, when Bristol Energy Company was still owned by Bristol City Council.

powered by renewables by 2030). Indeed, the year 2030 seems to be a common anchor for the more specific future targets. Conversely, two initiatives led by municipalities (DE3; IT1) and one led by a company (PT2) are less explicit in their targets, and have more overarching goals (e.g., accelerating the energy transition, raising awareness). Overall, the outlined problems include climate change, social inequality, ecological degradation, unsustainable energy production, dependency on fossil fuels, exclusion of citizens from energy futures, uneven distribution of profits and fuel poverty, as well as context-specific problems, such as water supply issues (HR1) and land degradation (PT2; PT4).

Across the desired energy system futures, three themes are prominent: (i) renewable energy production, (ii) the inclusion of citizens, and (iii) local value creation. Firstly, climate change and the urgency of decarbonisation are a key theme for every initiative's desirable energy system future. Energy for electricity and heat should be from renewable sources (BE1; DE1; DE2) and be sustainable (BE1) or green (DE3). Renewable energy production will be expanded leading to '100% renewable regenerative settlements' (PT4) or to 'net energy production' (NL1) – in this regard also energy self-sufficiency is considered an ideal (NL1). Additionally, the interlinkages between renewable energy systems and the protection of local ecological systems are relevant for some initiatives (e.g., HR1; PT2; PT4), which are also dealing with different ecological challenges (e.g., water scarcity, soil depletion).

Secondly, the theme on the need to decarbonise the energy system comes hand in hand with a more prominent role for citizens as producers and self-consumers (DE1; DE4; NL1; NL2; PT1; PT3; PT4) or as beneficiaries (e.g., BE1; HR1; DE3; IT1; PT2; UK1). Most initiatives attribute importance to involving citizens in the energy transition or to the 'inclusiveness' of future energy systems. Concepts used in this regard are involvement, inclusiveness, participation or 'being at the centre'. Each of these concepts accords different degrees of agency to citizens. In the initiatives which are cooperatives (DE1; DE2; NL2; PT1), energy democracy, a citizen-led inclusive transition, and the accessibility of energy are central themes. Also, energy poverty is identified as a crucial societal problem that needs to be addressed, by local grassroots community projects (NL1; PT3; PT4) but also initiatives led by municipalities (BE1; DE3; IT1). However, except for Eco-village Tamera (PT4), initiatives seem to not focus on how to integrate marginalized and more vulnerable communities, such as those discriminated by ethnicity, race, faith, or age.

A third theme relates to financial and other value creation goals. The desirable energy system futures of the studied initiatives put alongside 'benefits for the local economy' (HR1), 'local value creation' DE1, PT1); the creation of local economic value (DE3; PT2), and transparent business models, which are to ensure that the economic benefits of renewable energy production stay within local communities. Such business models are to be more accessible (PT2; UK1) or based on collaborative 'commons' principles (NL2; PT1). Locality and a place-based vision are then intertwined with a strong regional and local focus, and with a prosumer discourse around local economic value creation. Place-based grassroots initiatives (HR1; NL1; PT3; PT4) also emphasise autonomy and energy independence as intrinsic to their approach. These communities are equally concerned with protecting local ecological systems next to improving local livelihoods.

Additional elements of these initiatives' visions include a connection between energy and water management (i.e., a water neutral island in HR1) and a holistic perspective of people 'building, working and living in harmony with nature' (NL1; PT4). Also, greater financial and fiscal authority for local authorities is found to be an important feature in an energy system that will be 'overturning dominant neoliberal cultural norms' (UK1).

To sum up, clear future thematic images are renewable energy production along the inclusion of citizens and local value creation. The mechanisms for the participation of citizens including ideas on who citizens *are*, are left somewhat floating and less concrete in these discursive framings.

Table 2
Discursive framings – Results of 13 collective prosumer initiatives.

Initiative	**Societal problem and desired energy system futures**
BE1	In the long run, all households and public buildings in the **region** should be supplied by **sustainable heat**, including those struggling with **energy poverty**. Valorisation of regional residue **wood assets** (so these do not go to waste) can contribute to this and requires the **involvement** of a significant number of stakeholders. Inclusiveness is key through the involvement of concerned citizens and organizations.
HR1	The **island** faces a severe **water supply issue.** It can be resolved through a wider adoption of **renewables** and a holistic approach. To become a **water neutral island** by using RES for a desalination process. To set up a water-energy system with **benefits for the local economy**.
DE1	Main societal problems are **climate change** as well as **unsustainable energy production** with nuclear and coal-fired power plants. Overall goal is to make an own contribution to the energy transition by **expanding renewable energy production** within the **region**. Through **cooperative** structures, people should be enabled to become part by setting up and operating their own regional plants to also strengthen **local value creation.**
DE2	There is a **need to decarbonise the energy system** and to face the challenge of **integrating citizens** as producers and self-consumers. The vision is to transform the energy supply to be based on **regional, renewable energy**. Creating **real participation** means people can join discussions, take part in decisions, and partake in financial gains. To this end, they need **education and be provided with a voice**.
DE3	**Climate protection and local energy transition**, based on **transparency, participation, and inclusiveness.** Citizens are to be involved in the design and implementation of renewable energy production and energy efficiency.
IT1	The transition to a future energy system needs to **accelerate**. The future should be **inclusive** (as opposed to the present one), provide **green and accessible** energy **to all**. To this end awareness raising and education are needed to involve more citizens.
NL1	Main societal problems include individualism, social isolation & anonymity; outsourcing basic services (i.e., energy); humans damaging the earth. In the future, people **build, work, and live in harmony with nature**, in connection with each other and inspire the world (holistic approach). Individuals are involved through shared decision making. Regarding energy, buildings should realise **energy self-sufficiency and net energy production** (production is higher than consumption) – either on the scale of one building or a series of neighbouring buildings.
NL2	Dependency on **natural gas** for **heating**; **exclusion of citizens** in future scenarios or supporting frameworks; and tendency of the Dutch government to (want to) stay in control coupled with a strong market focused approach in its solutions. In a future energy system, heating infrastructures and sources are in **citizens' hands** (i.e., a heat commons) and (collaborating) citizens play an important role in providing their own **sustainable heating,** supported by local/national governments. To this end a support structure for citizen-owned/led neighbourhood heating systems is needed.
PT1	The energy transition needs to accelerate, and **citizens should be at the centre** of this process and able to benefit from an **accessible, clean, and democratic energy system**. New energy models should be transparent and support the **creation of local economic value**, through the **participation of citizens**. Participation takes place through **cooperative structures** and **crowd investing** in renewable energy production and energy efficiency.
PT2	**Climate change** has **consequences** for viticulture. Achieving **energy autonomy by 2030**, reducing **carbon footprints** and **energy costs**, while facing severe land degradation and water management challenges, towards providing a '**greener product**' from crop to bottle for wine producers. To this end **awareness raising** and the **involvement of local communities** is needed.
PT3	Large utility companies promote an **unstainable energy system**, since **profits are not locally distributed**, nor **benefiting local communities**, and result in increasing **ecological degradation**. The initiative envisions a holistic locally embedded more **transparent, inclusive, and participatory**, **self-sufficient** energy system **by 2030**. To this end, pilot experiments and energy technology labs serve to educate people.
PT4	**Ecological degradation**, **conflict, inequality**, and poverty come hand in hand with **fossil-fuel based energy systems**. The vision is to contribute to **100% renewable regenerative settlements**, by harnessing the freely available energy from the sun, without depending on a large-scale industry. The power of the sun is considered a gift from nature for peaceful and flourishing communities. To this end a **holistic approach** to energy production is necessary that includes cooperation with nature.
UK1	**Climate change** and **fuel poverty** are the key societal problems to address, through a **radical reform of energy markets**, greater **financial and fiscal authority for local authorities** and **overturning dominant neoliberal cultural norms**. The desired future was to become a low carbon gas and fully green electricity supplier. To this end, new business models need to be developed.

4.2. Activities of collective prosumer initiatives

We analysed the actual implemented energy-related activities of the 13 collective prosumer initiatives to establish an understanding of their prefigurative work – see Table 3 for a summary of the thematic analysis.

Initiatives engaged in a whole range of activities, starting with increased production of renewable energy (BE1; DE1; DE3; PT1; PT2; PT4), and a focus on energy efficiency (DE3; PT1) or self-sufficiency (NL1). The involvement of citizens is a core strategy (BE1, DE1; DE2; DE3; IT1; NL1; NL2; PT1; PT2) closely related to awareness raising and education activities (DE2; IT1; PT2; PT3). For instance, Santorso municipality (IT1) developed a helpdesk to engage citizens and to provide information on energy. To a lesser extent, initiatives also seek to directly lobby and influence legislators. This concerns particularly those that are either significantly developed, such as Coopérnico (PT1), which actively seeks to advise the national regulator on issues related to the transposition of the European Union's Winter Package policies, or those that are networks, such as Buurtwarmte (NL2), which also lobby their national government.

The involvement of citizens and/or communities is considered a vital means for almost all initiatives to arrive at their desired energy system futures. However, the actual practice of 'involvement' through their activities varies widely between initiatives. Across the 13 initiatives we distinguish six mechanisms that provide different roles for citizens to get involved (see Table 4 for an overview). The first three mechanisms put citizens and/or communities more at the receiving end – as customers of energy, as recipients of knowledge or as participant in deliberative meetings. The remaining three involvement mechanisms are expecting and/or providing a higher scope of action to citizens and/or communities – as members of a cooperative, as volunteers or as collaborators in projects.

First, citizens are involved as customers of renewable energy (DE1, PT1, UK1) – they buy the renewable energy from the initiatives. Second, citizens and communities are involved as addressees of knowledge, thus as a target group for education and awareness raising activities (DE2; IT1). For instance, energy literacy, environmental and energy related education, as well as awareness raising are common themes in initiatives that are led by municipalities. Third, citizens are involved as participants in deliberative meetings. Using a stakeholder management approach, citizens and/or organisations feeling concerned are involved by collective prosumer initiatives in deliberative meetings where the degree to which their voice is influencing decisions often remains unclear (BE1). Fourth, citizens are involved as members of a cooperative (DE1, PT1) or an otherwise delineated group (i.e., certain community) (NL1, PT3; PT4), which comes with specific decision-making rights. Cooperatives are governed through a one-member-one-vote system, where voting rights are per individual and not per share, while communities of people being in close vicinity such as in a small town (PT3) or in an eco-village (NL1) choose horizontal consensus-based mechanisms (such as sociocracy) to make decisions. For instance, in the São Luís community (PT3), although some community members have a more predominant role, all decisions are shared and made in local general assemblies and through an ongoing dialogue. Fifth, citizens are involved as volunteers (e.g., IT1; PT3) – this means they put their resources at the benefit of the collective prosumer entity. The latter thrives on the non-profit labour (including expertise, networks, and high motivation) but is also limited by it. Sixth, citizens are considered collaborators in acting upon a shared energy system future; we see this in

Table 3
Implemented activities – Results of 13 collective prosumer initiatives.

Initiative	Activities implemented
BE1	renewable energy production at a planning stage; cost-effectiveness calculations; stakeholder meetings; potential locations identified; implementation pending
HR1	planning stage; active dissemination of idea; feasibility study including a cost-benefit-analysis; implementation pending, holistic exploration of water-energy nexus
DE1	renewable energy production (wind 3 MW and solar 130 kWp) and storage (30 kWh), selling/renting installations to private homes; decisions taken based on one member one vote; involvement through cooperative structures
DE2	provision of knowledge and advice to regional partners; renewable energy related educational programmes; renewable energy production (via members) and energy efficiency services; networking with local municipalities
DE3	planning stage; technical and economical calculations; setting of the location; raising funds for implementation, energy efficiency services
IT1	helpdesk supports and engages citizens and provides information, awareness raising and education (on the energy transition); organisation of events, conferences and info stands; collaboration of municipalities and group of local volunteers
NL1	renewable energy production (solar, biomass); active knowledge sharing; sociocratic decision making; planning for microgrid including storage
NL2	support structure for citizen-owned/led neighbourhood heating systems systematisation of planning and implementation of neighbourhood-based heat systems; knowledge sharing and network building between energy cooperatives working on heat via workshops, trainings and communities of practice; lobbying with governments; active dissemination of the idea of a heat commons
PT1	renewable energy production (solar 1,9MWp) serving nearly 2000 customers; crowdfunding investments; lobbying and influencing regulations; supports development of new renewable energy communities; advises and lobbies with national energy regulator: energy efficiency services
PT2	renewable energy production and consumption (solar, biomass); using organic crops; sustainable water management, involvement of local communities
PT3	renewable energy production (solar 100 kW); horizontal consensus-based decision making; relying on volunteer work; development of non-profit business plans that reduce energy poverty and create local value; pilot experiment as education; energy technology labs
PT4	renewable energy production; researching energy autonomy and ecological life structures; piloting new energy solutions; renewable energy production (solar 250 kW); replication of new modular solutions in vulnerable communities (e.g., refugees' settlements)
UK1	customer base of 100,000; recycling profits into wider city council budget (owner until 2020); power purchase agreements with small renewable generators; energy as service business model developed

the Netherlands where (starting) cooperatives learn with and from each other about how to advance a heat commons (NL2); or in Portugal where Coopernico (PT1) supports citizens and communities to start co-operatives in its quest to bring a 100% green energy supplied Portugal closer. As collaborators, citizens start driving new initiatives.

In sum, while collective prosumers have very similar envisioned strategies, namely the involvement of citizens and/or communities, the actual implementation shows the diverse meanings that 'involvement' can take.

4.3. Social relations of collective prosumer initiatives

We analysed the understanding and enactment of social relations of the 13 collective prosumer initiatives to establish an understanding of how collective prosumer initiatives relate to one another, their stakeholder network and beyond. Table 5summarises the results from the thematic analysis, while we highlight three points in the following section.

First, along with an overall discourse regarding the increasing role of local governments and cities towards decarbonisation, municipalities and local governments are considered as vital actors by nine out of the 13 initiatives. Importantly, municipalities are expected to provide financial or administrative support and incentives (IT1; NL2; PT1; PT2), coordinate efforts (BE1), partner with initiatives (DE4), own initiatives (UK1), or lead initiatives (DE3; IT6). While two initiatives led by municipalities aimed to gather strong community support (e.g., BE1; DE3), two local grassroots initiatives were not always supported by or linked with relevant municipalities (HR2; PT4).

Table 4
Mechanisms through which citizens are involved in collective prosumer initiatives.

Mechanisms	Description of citizens' involvement
Involved as customers	Buying energy from collective prosumer initiatives (e.g., renewable energy cooperatives)
Involved as recipients of knowledge	Taking part in energy literacy and environmental education programs
Involved as participants in deliberative meetings	Participating in deliberative meetings
Involved as members	Actively participating in decision-making processes (e.g., 'one member-one vote')
Involved as volunteers	Actively taking care of and implementing activities of collective prosumer initiatives, and acting as vital human resources for non-profit and volunteer-based initiatives
Involved as collaborators	Working side-by-side with collective prosumer initiatives towards a citizen-centred energy system (e.g., 'the power of the crowd')

Second, across all collective prosumer initiatives analysed, collaboration and networking played an important role, for example in facilitating the development of local projects, in crowdfunding investments, or in sharing new knowledge gained. This was reinforced by the fact that initiatives are either collaborations (BE1; DE3) or networks (DE2; NL2), or because they are members of formal or informal networks of like-minded initiatives (DE 1; NL1; PT3; PT4). For instance, NL1 and PT4, both eco-villages, are members of the Global Ecovillages Network. Eco-village Aardehuizen (NL1) has a global outreach with more than 1000 + international volunteer collaborators in the past. Tamera (PT4) equally receives every year hundreds of international visitors, who attend short courses at the eco-village. The São Luís community (PT3) is member of the global Transition Network, while Coopérnico cooperative (PT1) and Buurtwarmte (NL2) are members of the European Federation of Renewable Energy Cooperatives (REScoop.EU). Not surprisingly and considering that decarbonisation comes with the decentralisation of energy systems, initiatives focus on local and regional scale activities. This localisation is complemented by networking and collaboration activities across local to continental and even global scales, thus indicating that these initiatives are shaping transnational collaborative prosumer networks.

We specifically see those initiatives who are frontrunning in their national context to cooperate with and support others who are interested to walk a similar path. For instance, by 2020, Portugal's first renewable energy cooperative, Coopérnico (PT1) had realised a total production of renewable energy of 1.9 MW through crowdfunding investments. Coopérnico has been also assisting other local communities by providing technical support (e.g., in dimensioning photovoltaic installations), legal advice and funding. The São Luís community (PT3), for example, has benefitted from such technical and legal assistance provided by Coopérnico. We see a similar move in the Netherlands, where a group of heat cooperatives united themselves under the umbrella of Buurtwarmte (NL2), as part of the cooperative network organisation EnergieSamen. Each heat cooperative had been working on citizen-owned neighbourhood heat systems in their respective cities. Yet together, they help others make a head start through process support, developing a community of practice and political lobbying. These collective prosumers thus foster collaboration rather than competition, both in narrative and in practice, between like-minded initiatives in working towards a shared goal by building support structures across

Table 5
Social relations – Results of 13 collective prosumer initiatives.

Initiative	Understanding and enactment of relations between and roles of actors
BE1	All **regional and local administrations** are relevant to achieve the desired future, including **regional bodies** responsible for landscape management. **Residents and municipal buildings** will be the key beneficiaries of affordable, renewable, and locally produced energy.
HR1	The **residents** of Silba are key beneficiaries. Supporters include environmental protection and cultural heritage **organisations**. The **regional government** and the **water supply company** are critical for achieving the vision but have not been yet sufficiently involved. Transparency and active **community participation** are crucial for the process to benefit the community and locality.
DE1	The cooperatives' most relevant actors are its **members and shareholders:** they finance projects, discuss process, and bring in new ideas. **Regional inhabitants** will become important as consumers of regionally produced energy through a regional electricity product. The exchange with **other cooperatives and local actors** plays an important role in achieving this vision.
DE2	The most relevant actors are the **regional inhabitants**, who are members of the cooperatives and thus work to increase the share of renewable energy in the region. Some are also **customers**. The network also involves **local municipalities**, which work together with cooperatives and other initiatives led by local citizens on energy efficiency and PV projects.
DE3	The desired energy systems future can only be achieved collaboratively by **citizens, policy makers and local businesses**. The more people engage, the more democratic and successful the community will be.
IT1	**Municipalities** play a key role in the transition to more inclusive and green energy in cooperation with **NGOs** and **local citizens;** specifically, through financial and administrative support.
NL1	Each **person** individually and as part of a community has a responsibility to contribute to the shared future vision through their everyday activities, in how they build, work and live.
NL2	**Dutch citizens** are to drive the heat transition (especially the development and implementation of sustainable heating systems in their neighbourhoods) supported by **national and local government** through suitable legal frameworks and financial resources.
PT1	**As cooperative members and shareholders** citizens crowd-invest in renewable energy installations. These are situated on rooftops of **charities** (e.g., **schools, non-for-profit associations**). **National and local governments** are to provide information and incentives, while **distribution system operators** are expected to collaborate with **cooperatives** (e.g., quickly activating new installations). Interactions with other (incumbent) energy system suppliers (i.e., large fossil fuel-based energy companies) are piecemeal and often avoided.
PT2	**Wine producers** are becoming prosumers, supported by **local governments** and **associations of wine producers**. Local environmental protection associations are also found to be important in supporting and facilitating the development of collaborative (energy sharing/peer-to-peer) projects.
PT3	The **local community groups**, local **Parish administrations, municipalities** and **local businesses** actively collaborate to implement the desired future. The main beneficiaries are **residents**, including **lower income families,** as well as the **municipality**. The community sees **large utility companies** as an opposing force.
PT4	Cooperation with **nature** is essential to achieving the desired energy system future. **Residents** drive this future by developing new technologies at experimental sites. Main beneficiaries are the **settlements** adopting modular technologies. International networks (e.g., **Global Ecovillages Network or the Blueprint 200 project)** are expected to help spread knowledge.
UK1	**Municipalities** as key actors in this energy system future with an important role for **energy system regulators**.

different levels and scales of agency.

Third, there are a number of relations that are hardly thematized or that are outstanding. On the one hand, marginalized, and disenfranchised communities and citizens are nearly not mentioned in the context of the desired energy system transformations of the 13 initiatives. One exception is eco-village Tamera (PT4), which explicitly aims to the develop new solar energy 'modular solutions' that can be adopted in poor settlements across the globe. Moreover, incumbent actors in the current centralised energy systems (i.e., energy system utilities; fossil fuel companies), are seldom mentioned, and are mainly perceived as opponents (e.g., PT3; PT4) or as being difficult to involve and engage with (HR1; PT1). Striking is that two initiatives introduce nature as a key non-human agent into the discourse on energy system futures (PT4; NL1). Both initiatives are eco-villages, and thus are already ecologically driven experimental spaces. Also, environmental heritage and cultural heritage organisations are important for two initiatives (HR1; PT2) which are being confronted with critical environmental problems (i.e., land degradation and water scarcity).

5. Discussion

The results of our meta study highlight how the framings, activities, and social relations engaged in by collective prosumer initiatives have important overlaps and synergies. In this section, we further elaborate and relate these insights to existing literature, specifically focusing on three tensions in the engagement of collective prosumer initiatives for energy system transformation: 1) decarbonisation through the production of renewable energy without taking account of the broader environment, 2) involvement of certain people at the expense of others, and 3) building eco-systems but not relating to incumbency.

5.1. Producing renewable energy – What about the environment

Previous research suggests that contributions to energy transitions and to the decarbonisation of economies is a key motivation for collective prosumer initiatives [17]. Our results show that the production of renewable energy is indeed central to the framings and activities of collective prosumer initiatives. In fact, energy production is one of their main contributions to energy system transformation, delivering renewable energy from often smaller scale production facilities making use of a diversity of locally available sources (e.g., biomass, wind, solar). This reinforces the relevance of prosumerism in the scope of a fast decarbonisation and their potential to help achieving the needed emission reduction targets [7,50].

Comparing their activities with their discursive framings, each of the studied initiatives appears to 'walk the talk' in that they implement activities that they consider important for reaching their desired future. For some of the initiatives this is very straightforward, where a strategy of renewable energy production is translated into the installation of solar, biomass or wind systems (e.g., DE1; NL1; PT1; PT2; PT3; PT4; UK1). Cooperatives seem to be especially successful in advancing with actual renewable energy production. Municipalities are more indirectly involved in these activities, such as in the case of the Suburban Heat Transition initiative (DE3) where the municipality of Weyhe supports the development of a citizen-owned low temperature heating grid, or Getesnipper (BE1) where Belgian municipalities collaborate to set up a value chain for biomass residuals, and Bristol Energy (UK1) who offer power purchase agreements to local energy cooperatives.

A tension arises when relating decarbonisation to broader environmental sustainability, since only a few of the studied initiatives focus on the intersection of environmental sustainability and social justice issues. For example the need to minimize potential negative impacts that are associated with the development of decentralized energy systems, such as the use of batteries and their requirements for lithium mining [73]. Three initiatives of our sample showed an explicit concern with broader environmental impacts and benefits. However, their motivation may have been pre-existing, as they are based in communities situated in regions already facing significant environmental problems, such as lack of water (i.e., the island of Silba, HR1 and Tamera Ecovillage PT4) and land degradation and biodiversity loss (i.e., the Alentejo region in Portugal, PT2, PT4). Two of the initiatives (NL1; PT4) are also ecovillages and therefore guided by strong sustainability principles. Since they also take a more holistic approach to the sustainable development of their locality, energy system transformation is only one of their aims. By comparison, the concern with other environmental sustainability

aspects (e.g., protection of biodiversity, sustainable land, and water management), was not obvious for other collective prosumer initiatives. This may indicate that unless there are pre-existing motivations, prosumer activities will not necessarily consider action related to broader environmental problems. Furthermore, their rootedness in a specific locality also means that scaling of renewable energy production, necessary for broader energy system transformation, is often not their aim. This relates to broader scepticisms about collective prosumerism, namely whether such initiatives can and want to scale renewable energy production (and thus decarbonisation) to the extent that is considered necessary by policy [74], despite their potential [27].

5.2. Involving citizens – What about justice

Our research suggests that, compared with other projects, the greatest value of community energy projects lies in generating social outcomes that are shared across communities, necessitating the involvement of people, such as empowerment, capacity building, energy justice and democracy [25]. Our results show that the discursive framings of the studied initiatives put the involvement of citizens as a cornerstone of their energy system futures. Here initiatives diverge between self-focused projects (e.g., PT2 and PT4) to projects seeking to influence broader societal change (e.g., IT1, NL2) and thus enacting their prefigurative action through strategies for a wider and more varied citizens involvement in energy system transformation.

Discursive framings, which co-developed with broader societal discourses on energy democracy and justice, are central to involving citizens and their needs in energy systems [54]. However, these narratives and broader societal discourses still must align with mainstream practices of energy production and consumption. Tending towards broad-brushed orientations, the discursive framings of the studied initiatives often remain silent on the specificities, such as: who benefits from prosumer-led change, what does involvement mean in practice or who can participate. While this means that, on a discursive level, the extent to which they enable participatory citizen deliberation and affordable energy for all (cf. energy justice, energy democracy) remains unclear, they offer space onto which other actors, such as policymakers can project their wishes and desires related to such staging of citizens in future energy systems [cf. 74,75].

Turning then to what collective prosumer initiatives do, provided us with a more differentiated understanding of six different mechanisms of how individuals get involved (as customers, recipients of knowledge, participants in deliberative meetings, members of a cooperative, volunteers or collaborators). For some mechanisms of involvement, the difference with current ways of involvement lies in the nuances: as *customer* of regional energy cooperative rather than (multi-)national energy company (DE1); as *recipient of knowledge* regarding the installation of renewable energy sources rather than regarding the cheapest energy source (DE2); or as *participant in deliberative meetings* regarding i.e. the provision of heat based on residual wood rather than a fossil-based installation (BE1). The other three mechanisms of involvement provide roles to individuals and citizens that they have hardly taken on in centralized energy systems. As *members of cooperatives*, citizens have decision making power through the 'one member one vote' system (PT1) and of other delineated group through consent-based (or similar) decision-making mechanisms (NL1). While this increases direct democracy within cooperatives and communities, accessing these groups can be difficult and they are often unwillingly exclusionary in practice. One common criticism includes that people need to be able to invest financially to become a member in the first place, and to be interested in and to be able to take the time to getting involved in self-governance [76,77]. As *volunteers and collaborators*, citizens shape or direct the implementation of the collective prosumer initiatives. The latter is often highly dependent on them to operate properly [17,78]. Such voluntarism means that initiatives are de facto excluding all those without acknowledged resources that afford them to become a volunteer in the first place – amongst others time, network, or knowledge [62].

Thus, collective prosumer initiatives offer more than one way to involve and get involved and do so for a variety of different social groups. In answering the question, who participates and how, such a differentiation between mechanisms of involvement is important for clarifying how collective prosumers contribute to procedural justice on a systems level, or may even reproduce embedded power dynamics and inequalities [25]. However, it also sheds some light on distributional justice in that it allows us to partly answer the question of who benefits and how. Looking at broader social outcomes, we take Brown et al.'s [22] differentiation of social and institutional changes as structuring device, to highlight that our results point towards 1) a greater role for civil society through different ways of involvement (deliberative, financial, etc.) but also through capacity building (IT1) and increased awareness (DE1), 2) greater municipal involvement in a diversity of ways (i.e., implementing a help desk that facilitates the development of local prosumer projects, IT1) 3) as well as a greater role for actors other than traditional energy suppliers (e.g., schools, non-for-profit associations, farmers, platforms). Taking this lens shows that collective prosumer initiatives are based on and governed by different and hybridised value logics – including community, state and market logics [22]. Adopting one or another (combinations) of these logics has been shown to lead to different directions for and dynamics in energy system transformation , with consequences for procedural and distributional justice [22,32]. While studied initiatives governed by state or community logic (aim to) address energy or fuel poverty and thus to distribute benefits more widely – the explicit mentioning of marginalized or vulnerable groups related to ethnicity, race, faith, or age – is an exception (i.e., IT1 and PT4). This may point to the pre-existing concerns of these initiatives and indicate that collective prosumer initiatives are not deeply concerned with resolving wider societal problems, such as poverty, unless they emerge in communities already dealing with such problems. Here local authorities have a greater responsibility in facilitating community energy projects that are as inclusive as possible, and thus prevent reproducing exclusionary practices [25].

Critically engaging with the performative nature of involvement [79] means to question what it means to be inclusive and democratic and to rethink 'slogans' such as 'energy for all' or 'putting citizens at the heart': Who is 'all'? Who is a citizen? How to involve them, by whom, in what way and why? And similarly, whom to benefit, in what way and why? In this respect, it seems important to appreciate collective prosumer initiatives for what they can do, providing multiple ways for different kinds of people to get involved in diverse ways in energy systems, while also acknowledging that they are not a 'natural' involvement mechanism. They thus can contribute to procedural and distributional justice in that they open up the involvement in energy systems and its benefits to new groups, but they also reproduce existing inequalities through requiring specific resources (financial, network, knowledge) for participation and involvement.

5.3. Building eco-systems – What about incumbency

In line with previous research [34,44,76,80], our broad take on who is involved in collective prosumerism brings to the fore that the production of renewable energy is not happening in isolation. Our analysis of the roles and relations that collective prosumer initiatives accord to themselves and others, shows that they appreciate the relevancy of collaborating and networking with different actors for realising their respective desired energy system futures.

First, our comparative approach of diverse collective prosumer initiatives shows the many adjacent, facilitating and necessary, activities for the production of renewable energy, such as new digitalised energy infrastructures (see also [81]), new organisational and governance arrangements (see [22,82], BE1, UK1), networking and lobbying (see [44], PT1, NL2) as well as educational activities related to renewable energy production and consumption (see [59], DE2, IT1).

Second, our results show that networking and collaboration comes in many disguises. While some studied initiatives were actual collaboration or network organizations, others were members of formal or informal networks of like-minded initiatives or were individually busy with establishing multiple collaborations with other stakeholders (e.g., other collective prosumer initiatives, local governments or crowdfunding initiatives). Active collaboration and networking focuses often on like-minded initiatives, or local governments as important stakeholders [59,83]. Such networking and collaboration of initiatives – often within broader prosumer ecosystems – has been shown to support the growth and development of such initiatives [34,44] and empower them to persist in challenging dominant institutions [67,84]. Thus, collective prosumer initiatives are co-developing their activities and their positioning through their continuous interactions with other energy system actors [cf. 76].

The tension lies here in that most of the studied collective prosumer initiatives do not actively engage or liaise with larger utility companies and energy system operators – neither as part of their discursive framing nor as part of their activities. While acknowledging the multi-actor nature of societal change, the initiatives seem to leave the role and relationships with 'incumbent' actors mostly untouched [85]. This seems problematic since most of their framings also did not identify problematic incumbency in the current systems, such as related to power relations, or continued extraction of fossil-fuels. More importance is thus accorded to building a new system – rather than to building counter-hegemonic discourses and practices or to pragmatically engage with incumbency. Recent research seems to suggest that combinations of these strategies are desirable to support energy system transformation. In their research into French and Dutch cooperatives, Vernay and Sebi [34] showed that only competing with incumbents harbours the risk to remain a small niche, while engaging with them has the potential to significantly contribute to energy system transformation. Such contribution often lies in developing institutional arrangements that challenge current institutional logics, combining for example a for-profit orientation with social and environmental goals [32,77] or the institutional hybrid forms that alliances between cooperatives and commercial energy suppliers take [44]. Thus, while they have the potential to make conflict and competing interests visible [45], most of the framings, activities and relations of the studied initiatives focus on building new system (elements) rather than to explicitly critique or engage with what is problematic in the current system. Focusing on prefigurative work and thus the building up of the new, might entail the risk to turn a blind eye towards the underlying problems of the old.

6. Conclusion

The goal of this article was to understand how collective prosumer initiatives engage in energy system transformation through their prefigurative work. To this end, we analysed their new ways of thinking (i.e. discursive framings), doing (i.e. activities) and organising (i.e. roles and relations to others). We found that their desirable energy system futures include renewable energy production, the promotion of a more egalitarian society and the creation of local social and economic value. Their activities mainly focus on renewable energy production and adjacent activities, with a focus on the involvement of citizens in a variety of ways. Standing out is the acknowledgement of societal change as a multi-actor process and the high degree of desired and actual collaboration and networking of collective prosumers in prosumer ecosystems.

Framing collective prosumerism as a social movement allowed us to discuss its engagement in energy system transformation as a double-edged sword in the following three ways. Firstly, renewable energy production is central for decarbonisation pathways and therefore an important contribution by collective prosumer initiatives. However, a discourse solely centred on decarbonisation misses out on other critical environmental problems and specifically the feedback loops and rebound effects, which can be exacerbated also by decentralised energy systems. Therefore, future research could more thoroughly consider various levels of environmental and interrelated social impacts in relation to local and decentralised energy production, making use of e.g., the socio-metabolic approach [86], to understand the impact of decentral energy systems on the broader environment (including biodiversity loss and local social and ecological heritage).

Secondly, collective prosumer initiatives open up the participation and involvement in energy systems to a much wider array of people. They also allow for a whole pallet of actors to take on new roles with increased responsibility and engagement in activities in the energy system. However, such involvement is not a panacea – rather to further both procedural and distributional justice in energy system transformation, such involvement needs to not reproduce existing inequalities. This also relates to existing value logics (state, market community), some of which are more transformative than others. Therefore, research could analyse when, how, to what end, and who is involved by whom in energy system transformation and scrutinize the potential benefits (e.g., increased social cohesion, alleviating energy poverty, increased civic participation in the transition) and costs of this involvement for both the prosumer ecosystem and those that are left outside of these societal dynamics.

Thirdly, collective prosumer initiatives engage in collaboration and networking, building thriving prosumer ecosystems – however the focus on the building up of the new might go at the expense of identifying the elements of the old system that need to go. The approach seems rather non-confrontational – in not engaging much with incumbency, whether this refers to ongoing fossil fuel extraction or the role of incumbent energy suppliers. It seems to beg the question on the relation between collective prosumer initiatives and more activist initiatives that focus on conflict and confrontation in voicing the need to break down existing system elements, such as Fridays for Future or Extinction Rebellion. Through collaboration, such conflict could become generative. Future research could focus more explicitly on the extent to which and how prosumer-led decentralised energy systems, although triggered by critical decarbonisation and energy democracy goals, may perpetuate embedded social and environmental inequalities, if they do not sufficiently consider incumbent powers and the need for phasing these out. This includes the role of conflict in energy system transformation.

In line with the finding that collective prosumer initiatives are embedded in broader prosumerism ecosystems, much of this research could be done in a transdisciplinary or action-oriented manner, engaging both scientists and initiatives in addressing these questions as interesting for scientific knowledge creation but also for guiding practical framings and energy activities.

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.

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