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Original research article

Energy communities in Sweden: Challenging established ideas of aim, place and engagement

Anna Bergek [a,*], Jenny Palm [b]

[a] Department of Technology Management and Economics, Chalmers University of Technology, SE-412 96 Gothenburg, Sweden
[b] International Institute for Industrial Environmental Economics (IIIEE), Lund University, P. O. Box 196, SE-221 00 Lund, Sweden

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ABSTRACT

This paper contributes to the discussion about the importance of different energy community (EC) characteristics. Based on a questionnaire to the members of solar ECs in Sweden, it investigates (1) to what extent EC members agree with the established view of the "ideal" energy community, as described in previous literature, and (2) to what extent the studied ECs match the characteristics of such an "ideal" energy community, according to their members. The analysis addresses six dimensions: process, outcomes, place, interest, organization, and social interaction. The results show that EC members confirm the importance of member involvement (process), shared interests (interest), and a sense of togetherness (social interaction) but do not find either geographical proximity (place) or spending time with other members (social interaction) particularly important. The studied ECs score low on both actual and desired member participation in management (process), decision-making (organization), and other community-related activities (social interaction). Based on the results, we argue that ECs with environmental aims are less dependent on member engagement and social interaction than socially motivated ECs and also less likely to create conflicts of interests with local communities than economically motivated ECs; that allowing non-local membership does not necessarily interfere with securing local benefits; that local anchoring matters but does not necessarily require geographical proximity; and that a sense of community can be based on a common mission rather than on social interaction. Overall, this indicates that a more nuanced view on aim, place and engagement is warranted.

1. Introduction

The energy sector needs to manage a rapid transition to contribute to the mitigation of climate change. Within the European Union, consumers have been put forward as key actors in the energy transition, and energy communities (EC) have been introduced as a solution to engage citizens in the increasingly decentralized energy market [1]. The European Commission defines ECs as "collective actions of citizens coming together to participate in the energy system, taking ownership of their energy consumption" [2], and sees them as a means to not only accelerate a transition to a low-carbon energy system, but also democratize the energy system.

In essence, ECs bring citizens together to invest in, own and maintain renewable energy technology [3]. However, the academic literature is still struggling to find a more specific common understanding of the key characteristics of an EC [4]. Nevertheless, there is a tendency among both researchers and policymakers to advocate an "ideal" EC, which, according to descriptions in academic literature as well as policy documents, is owned by its members, involves and gives decisive power to individual citizens in setting up and running the EC, provides benefits to a broad set of stakeholders, is based on social relationships, and is bound to a particular geographical location [4,5, cf. also 10,11,14] (for a more elaborate discussion, see Section 2.3).

However, ECs can, in practice, take different forms, for example as energy cooperatives owning wind power plants, independent market aggregators, and neighborhoods jointly owning battery storage [6]. They can also have different organizational and decision-making structures [4]. In this context, earlier research discusses the importance of recognizing national variations and considering the historically and geographically conditioned character of energy communities

* Corresponding author.
E-mail addresses: anna.bergek@chalmers.se (A. Bergek), jenny.palm@iiiee.lu.se (J. Palm).

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[7–10]. This implies that what is ideal in one setting might not be ideal in another setting, even within the same country. However, while there are case studies describing what ECs might look like in different countries, for example Germany [11,12], Italy [9,13,14], Spain [15] and the UK [16,17], there is a lack of empirical studies investigating the perceived relative importance of different characteristics in different national settings. Consequently, we do not know to what extent conclusions and policy recommendations from earlier literature apply to other contexts. This might have produced a bias in the current understanding of what an energy community could and should look like.

Moreover, while there are previous studies of ECs in Sweden [18–23], none of these explicitly target EC members. Instead, they are based mainly on interviews with EC board members or representatives of public organizations engaged with the studied ECs [18,20,23] or on questionnaires addressed at general citizens [24,25]. Thus, the current understanding of which EC characteristics Swedish EC members value is limited.

Against this background, the overall aim of this paper is to provide a complementary and possibly contrasting view on energy communities by presenting new empirical evidence from a study of solar ECs in Sweden. More specifically, we use data from a questionnaire to the members of three solar ECs in Sweden to answer the following research questions:

(1) To what extent do EC members in Sweden agree with the established view of the "ideal" energy community, as described in previous literature?
(2) To what extent do the studied ECs match the characteristics of such an "ideal" energy community, according to their members?

In the following section, we describe our research design and data collection methods. We also describe and operationalize the framework we used to analyze the data. This consists of six key dimensions that summarize how seminal contributions to the EC literature have described the ideal energy community. We then present the results along these six dimensions. Finally, we discuss the implications of the results, stressing the need for additional perspectives on aim, place, and engagement in relation to energy communities.

2. Methods and data

This paper is based on cross-sectional survey research, using quantitative data from a questionnaire sent to the members of three solar ECs in Sweden. Complementary data were collected for other parts of the project through interviews, document studies (primarily EC statutes), and gathering of information from the communities' web sites. These data are in this paper mainly used to provide context to the questionnaire results.

The choice to study solar communities in Sweden can be described in terms of a "maximum variation" logic [cf. 26], in which the addition of new cases in a field of study is seen to make useful additions to the total stock of knowledge. In line with this, the study aims to provide a complementary – and potentially contrasting – view on energy communities as compared with previous studies rather than findings that are generalizable to other empirical settings.

In this regard, Sweden is an interesting empirical context for studying energy communities, considering the co-existence between cooperative and individualistic tendencies in Swedish society. On the one hand, Sweden has a long tradition of cooperative action, for example evidenced by producer and consumer cooperatives in the agriculture, forest, housing, finance, IT infrastructure, and education sectors [27]. A study of European citizens' preferences and attitudes towards, among other things, different EC designs also showed that respondents from Sweden were more likely than the average respondent to think that other people would try to be fair and helpful [24], indicating a high degree of trust in others. It would, therefore, not be surprising to find cooperatives (and other forms of communities) in the energy sector as well. On the other hand, Sweden is one of the most individualistic countries in the world according to the World Value Survey[1], which could indicate a limited interest in actually doing things together with others. A few studies also seem to indicate that Swedish citizens might be less interested in joining energy communities than citizens of other countries [24,25]. Moreover, most papers on solar energy communities are based on US cases [for some recent examples,see 5,28,29,30], making this study a potentially valuable contribution to the existing stock of empirical cases on this specific technology. While three earlier studies from Sweden (partly) concern solar ECs [19,20,23], none of them discuss the issues covered in this paper.

2.1. Target group selection

The study was originally designed as a total survey, intended to cover all members of solar ECs in Sweden. However, as there is no national registry of members of energy communities, we had to define and identify the target population ourselves. This was done by the authors in another work package in the same research project. We first compiled a list of active solar ECs based on the Swedish firm registry and databases on green electricity certificates and guarantees of origin provided by the Swedish Energy Agency. This resulted in the identification of 13 solar ECs.

As a second step, we needed to identify the members and get their contact information to be able to send out the questionnaire. This proved to be difficult. Since the member registries of the identified ECs were not openly available, we had to rely on the cooperation of the EC boards. During a previous interview study, we asked board representatives of all the identified ECs if they would be willing to send out the questionnaire to their members on the project's behalf. Those that agreed were included in the study. As discussed further in Section 2.6, this self-selection approach is a potential limitation of the study. Within the self-selected target group, we did not do any further sampling but asked the boards to send the questionnaire to all members.

The final selection included three ECs (see also Table 1):

- *EC1* was initiated in 2008 by a municipally owned energy company, which asked its customers if they wanted to form a solar community and invited them to information meetings. There was a large interest, and the EC was formally founded in 2009 with the objective to invest in solar power in the region. The municipal energy company helped set up the EC and build the first plant but has had a more passive role after that; it is a member and buys the electricity from the plants. So far, the EC has built seven plants with a total installed capacity of 620 kWp, which are owned by the EC and funded through member investments (share ownership) and reinvested profits from electricity sales. The plants are located in different parts of the municipality, some on roofs and others on the ground. Until 2019, all profits were reinvested in new solar plants. Now, members either receive an annual dividend or an electricity price discount.
- *EC2* was also initiated by a municipally owned energy company with the purpose of expanding solar power and, more specifically, contributing to achieving the municipality's political goal to have at least 10 % solar power in the electricity mix. The municipal energy company first considered building its own solar park but could not match its owners' profit margin requirements. It therefore decided to set up a solar community and sent out a prospect to citizens offering them to buy shares. Since the shares did not sell quickly enough, it was decided to

[1] See the Inglehart-Welzel World Cultural Map - World Values Survey 7 (2023). URL: http://www.worldvaluessurvey.org/) (accessed. 2023-03-20).

Table 1
Information about the three solar communities that are included in the study.

	EC1	EC2	EC3
Year of foundation	2009	2014	2020
No. of members	250	291	140
No. of plants and total installed capacity	7 (0.6 MW_p)	2 (0.5 kW_p)	1 (2.7 MW_p)
Ownership model	Share ownership (individuals and companies)	Share ownership (individuals and companies)	Share ownership (individuals and companies)
Number of shares	ca 600	ca 1500	ca 11,000
Member investment	SEK 5000/share	SEK 3000/share	SEK 1100/share
Economic model[a]	*2009–2019* *Re*-investment *>2019* Annual dividend (SEK 350/year; SEK 500/year from 2021) or Electricity price discount (SEK 0.07/kWh in 2019)[b]	Annual dividend (SEK 350/year)	Cost price (ca SEK 0.22/kWh at the time of writing, as compared with a consumer electricity price of ca SEK 0.75/kWh; each share gives ca 100 kWh per year)

[a] *Re-investment* implies that all profits are retained within the EC and used for investments in new solar plants. Members do not receive any financial benefit. Annual dividend implies that members get a yearly payback per share. The amount is normally proposed by the board and decided by the annual meeting (i.e. the members). *Electricity price discount* implies that members can buy electricity from the energy company that buys the electricity from the EC's plant(s) at a lower price than the normal consumer price for electricity. There can be restrictions on how much electricity a member can buy based on the member's share ownership, its total electricity consumption or both (although that is not the case with EC1). *Cost price* implies that members can buy solar electricity from the EC's plants at cost price, which typically is lower than the standard consumer price for electricity. There can be restrictions on how large a share of the total consumption a household can cover by this arrangement, typically 80 %.

divide the project into stages, and the municipal energy company also bought shares (as a member) to make sure that the first stage could be realized. The first plant (250 kWp) was built in 2017 on a landfill, which was not possible to use for other purposes. A second plant (280 kWp) was finalized in 2020. The plants were fully funded by member investments (share ownership) and are owned by the EC. The development and construction of the plants was managed by people from the energy company. The economic model is a dividend per share, both for tax reasons and to make it possible for anyone anywhere to buy shares.

- *EC3* was also initiated by a municipally owned energy company, which had received a directive from its owner to develop solar power. It first considered building its own solar park, but the payback time was considered too long. Later, the management team did a study visit to an established EC and copied its organizational model and statutes. The EC was founded in 2020, and the plant (2.7 MW) was built the same year on land acquired from the municipality, which is located on the outskirts of the town, close to a motocross arena. The plant was funded by member investments (share ownership), and plant ownership was transferred from the municipal energy company to the EC when the plant was taken into operation. At the point of writing, the permit process is underway for a second plant. The members pay the cost price for the solar electricity their shares generate, which is lower than the normal consumer price for electricity.

2.2. Questionnaire and respondents

Data was collected through self-completion of a web-based, structured questionnaire. We piloted the questionnaire on some people who work with solar parks and some members of ECs that were not included in the study. This increased the validity of the study by ensuring that the respondents would understand the questions the way we intended. The questionnaire was then distributed through the boards of the three ECs. A link to the questionnaire was forwarded by them via email to all the community members at that time (ca 680 people). The potential respondents were informed about their rights, that participation was voluntary and anonymous, how their responses would be managed, and who they could contact if they wanted more information or wanted to withdraw from the study. After sending out one reminder, we received 366 responses, after which we closed the questionnaire.

As Table 2 shows, the overall response rate was about 54 % (with some variations between the three ECs). The respondents were predominantly men, which corresponds well with the information the boards provided about their members. Overall, almost 75 % of the respondents were >50 years old (EC1: 81 %; EC2: 64 %; EC3: 69 %). A

Table 2
Questionnaire respondents with demographic information.

Name	Responses (response rate)	Gender	Age	Housing	Investment (SEK)
EC1	104/250 (41 %)	F: 26 % M: 77 %	18–29: 1 % 30–39: 2 % 40–49: 13 % 50–59:16 % 60–69: 27 % 70+: 42 %	House: 83 % Apartment: 15 % Other: 2 %	Min: 1000 Max: 300000 Median: 10000
EC2	181/291 (56 %)	F: 27 % M: 72 % n.a.: 1 %	18–29: 4 % 30–39: 11 % 40–49: 21 % 50–59: 20 % 60–69: 22 % 70+: 22 %	House: 67 % Apartment: 32 % Other: 1 %	Min: 1000 Max: 500000 Median: 12000
EC3	81/140 (57 %)	F: 11 % M: 87 % n.a.: 1 %	18–29: 0 % 30–39: 6 % 40–49: 14 % 50–59: 16 % 60–69: 20 % 70+: 33 %	House: 66 % Apartment: 34 % Other: 0 %	Min: 1000 Max: 250000 Median: 17000
Total	*366/681 (54 %)*	*F: 25 % M: 75 % n.a.: 1 %*	*18–29: 2 % 30–39: 7 % 40–49: 17 % 50–59: 18 % 60–69: 25 % 70+: 31 %*	*House: 72 % Apartment: 27 % Other: 1 %*	*Min: 1000 Max: 500000 Median: 10000*

majority of them live in houses (especially EC1). The median investment ranged from SEK 10,000 (EC1) to SEK 17000 (EC3), with large variations within each EC. No statistical analysis was made to determine if responses differed between demographic groups.

The questionnaire contained three sets of questions: (1) general information about the respondent, (2) questions about the respondent's current and desired future involvement in management tasks and community events, and (3) questions about the respondent's perception of what an ideal solar community would look like (e.g. preferred organizational models). In this paper, we primarily use the responses to four of the questions:

a) How important were the following motives for your decision to become a member in a solar community and/or buy shares in a solar plant through a solar community? (Several sub-questions that covered different types of economic, societal, technological, social, and environmental motives.)
b) How important do you think the following aspects are for a solar community to work well? (Several sub-questions that covered a variety of different aspects.)
c) To what extent have you done the following in the solar community you are a member of? (Several sub-questions that covered different types of engagement.)
d) To what extent would you like to do the following in the future? (Several sub-questions that covered the same types of engagement as in question c.)

The replies to question (b) provided data to address RQ1, i.e. the members' views on the characteristics of an ideal energy community as described in previous literature. Questions (a), (c) and (d) addressed RQ2, i.e. to what extent the studied ECs match these characteristics. In the following section, we elaborate more in detail on how we used these questions, and some additional data from the questionnaire,[2] to analyze different dimensions of an ideal EC (as described in previous literature).

2.3. Framework and operationalization of key dimensions

The survey results were analyzed using a framework that draws on previous literature on energy communities and solar communities. The included dimensions capture most of the ways in which previous literature has understood the concept of 'community' in relation to energy systems, as described in the comprehensive review conducted by Bauwens et al. [4].[3]

We took our departure in two seminal contributions to the literature, which considering their citation impact seem to have had a decisive influence on the current understanding of what an 'ideal' EC should look like. First, Walker and Devine-Wright [32] highlight the importance of considering both procedural justice and outcome (distributional) justice. Consequently, their framework includes a *process* dimension, which focuses on who initiated and manages the EC, and an *outcome* dimension, which accounts for who the beneficiaries are in economic and social terms [32]. Second, Walker et al. [33] distinguish between Communities of Place and Communities of Interest. From this distinction, we adopted a *place* dimension, focusing on geographical proximity, and an *interest* dimension, focusing on the importance of common interests. To these four dimensions we added an *organization* dimension, focusing on aspects such as ownership and decision-making model, which are highlighted in the literature as defining characteristics of both solar energy communities and ECs in general [5,15,34]. We also included a *social interaction* dimension, considering the emphasis put in the literature on social capital and trust [cf. 4].

In the following, we elaborate more on the six dimensions and describe how previous literature has described what an ideal EC would look like in relation to each of them. We draw especially on Walker and Devine-Wright [32], Walker [35] and Hicks and Ison [31], which are seminal papers that express clear views on the characteristics of "ideal" (or "strong") energy communities. We also describe how we operationalized each dimension in the questionnaire. The dimensions and their operationalization are summarized in Table 3 (for more details, see the Appendix).

2.3.1. Process

Walker and Devine-Wright [32] define their process dimension in terms of who the (renewable) energy project is developed and run by and argue that an ideal energy community project would be characterized by "a high degree of involvement of local people in the planning, setting up and, potentially, the running of the project" (p. 498). Similarly, other authors emphasize that participating in planning and developing an energy project indicates a deeper kind of involvement than just being a member or co-investor [5,31,36]. For example, in the framework developed by Hicks and Ison [31], early and extensive community engagement is one of the attributes of an ideal energy community. In this regard, Bauwens et al. [4] describe how understanding 'community' as a process highlights "a distinctive way of acting characterized by a high degree of voluntary and collaborative involvement in energy projects by ordinary people" (p. 2).

To operationalize the process dimension, we looked to the literature to identify different types of engagement that community members can display apart from making an investment. Some authors mention plant installation and other types of direct work as a possible form of involvement in setting up an EC [15,37]. However, since our previous interviews with board members had revealed that almost all Swedish solar energy communities had used project developers or other intermediaries (most notably municipal energy companies) to plan and build their solar plants, this was not a relevant question in this particular context.[4] Instead, we focused on the management of an EC once it has been established, distinguishing between members with managerial functions and members without such functions [12]. To address RQ1, we asked the respondents how important they think it is for members to participate in the organization and leadership of the community (e.g. through board or committee work). To address RQ2, we asked them whether they had been part of the board (as a chairperson, member or alternate) or taken on other management task(s) in the community (e.g. meeting organization or other activities), and to what extent they would like to take on such management tasks in the future.

2.3.2. Outcome

The outcome dimension refers to who the project is for or how the economic and social benefits are distributed, spatially and socially [32].[5] Walker and Devine-Wright [32] state that for an EC project to be considered ideal, it should come with "collective benefits to the local community (p. 498) [cf. also 4,17,39]. Similarly, Hicks and Ison [31] consider "communal" distribution of financial benefits a key characteristic of a strong community [29].

[2] Additional data that were used were opinions about different economic models, different types of company co-ownership, and different types of decision-making models as well as postal code data provided by the respondents.

[3] Most notably, our framework does not cover Bauwens et al.'s [4] technology dimension, i.e. the "sharing of a technological device that materially connects members" (p. 4), since this is connected mainly to local distribution grids or shared storage, which is not in focus in our cases. Similarly, we exclude Hicks and Ison's [31] technology scale spectrum, which refers to how the energy plant aligns with the local community's needs and motives, considering the relative small scale of solar installations (as compared with wind, which is their main focus). We also do not explicitly consider Bauwens et al.'s *actor* dimension, i.e. "explicitly named individuals, groups or organizations that comprise the desired 'community'" (ibid.), since we did not find research discussing this from an 'ideal EC' point of view.

[4] In addition, previous research has shown that one reason for engaging with an EC can be to avoid any effort related to system installation [5].

[5] Other authors define energy justice in terms of both benefits and "burdens" [cf., e.g., 38].

Table 3
Summary of framework dimensions and their operationalization.

Dimension	'Ideal' as described in previous literature	Operationalization[a]
Process	▪ High degree of member involvement in EC planning and management	Perceived importance of member participation in organization and leadership (RQ1) – questionnaire Actual and desired future participation in board or other management tasks (RQ2) – questionnaire
Outcome	▪ Fair distribution of benefits between members ▪ Value creation for local society ▪ Collective benefits rather than individual benefits	Opinions about five different economic models (RQ1) –questionnaire Perceived importance of creating value for the local community (RQ1) – questionnaire Importance of economic (individual) motives vs societal/environmental motives (RQ2) – questionnaire
Place	▪ Geographical proximity between members ▪ Geographical proximity between members and plant (incl. Local ownership) ▪ Plant location with local connection	Perceived importance of member-member proximity, member-plant proximity, and plant location (RQ1) – questionnaire Opinions about local/non-local company co-ownership (RQ1) – questionnaire Actual proximity and plant location (RQ2) – postal codes (from questionnaire) and information from the boards
Interest	▪ Shared values and interests ▪ Transformative-collective (rather than instrumental-individual) motives	Perceived importance of similar values and shared interests (RQ1) – questionnaire Motives to become members in an EC (RQ2) – questionnaire Expressed interest in solar energy, renewable energy, and energy in general (RQ2) – questionnaire
Organization	▪ Member ownership	Opinions about company co-ownership (RQ1) – questionnaire Ownership model (RQ2) – information from the boards
	▪ Inclusive/democratic decision-making principle	Perceived importance of member involvement in strategic and operative decisions (RQ1) – questionnaire Opinions about two different decision-making principles (RQ1) – questionnaire Actual and desired future participation in decision-making (RQ2) – questionnaire
Social interaction	▪ Sense of unity or joint identity	Perceived importance of a sense of togetherness (RQ1) – questionnaire Importance of social motives (RQ2) – questionnaire
	▪ Member interaction	Perceived importance of joint EC activities and spending time with each other (RQ1) – questionnaire Actual participation in joint EC activities (RQ2) – questionnaire

[a] For more details (including questionnaire items and scales), see Appendix.

Our operationalization includes both the internal distribution of benefits within the EC and the distribution of benefits between the EC and other stakeholders. Regarding internal distribution, the literature on solar communities distinguishes between two main economic models for distribution of profits (hereafter referred to as "economic models" for short) (or "payment structures" [40]) that determine what kind of benefits members get: electricity models, where members get electricity from the solar plant, and investment models, where members get a financial return on investment [5,41].[6] To these main models can be added a reinvestment model, where revenues are kept by the EC and can be used to build new plants [47]. While the literature does not seem to have any clear preference for any of these models, as long as they result in a fair distribution of benefits between the members, the investment model comes closest to the ideal of collective benefits, as described above, considering that individual members receive no financial benefit from their investments. To investigate the members' views on the relative advantage of different models (RQ1), we asked them about their opinions about two electricity models (price discount vs. price premium), two investment models (monthly bill discount vs. yearly dividend), and one re-investment model.

The literature considers it important that the benefits generated by an EC are shared with local people and organizations beyond the EC members [29,32,33,48–50]. For example, ECs can engage local companies to build or operate the plant or provide other employment opportunities [15–17,32,33,35,39,47,51], or a community fund can be set up to be used for various purposes [4,31]. It is also considered beneficial if the EC makes use of sites that cannot be used for other purposes (e.g. "brownfield" sites) [39]. To investigate whether this view was supported by the members (RQ1), we asked them whether they think it is important for an EC to work well that the solar plant creates value for the local community as a whole (and not only for the members). To study their actual interest in providing communal values (in relation to RQ2), we asked them to assess the importance of different motives for them to become EC members. We here assumed that a dominance of economic motives would indicate a preference for individual benefits, whereas societal/environmental motives (including a wish to contribute to the local community) would indicate a preference for collective benefits.

2.3.3. Place

As stated by Peters et al. [39], "[l]ocation is a critical feature of any community solar project" (p. 361). This puts place at center stage. In both academic literature and policy documents, geographical (or spatial) proximity is, implicitly or explicitly, considered an important EC characteristic. Indeed, most EC definitions include the connection to a specific geographical area [4], and this is also common in literature on solar energy communities [5,29,36,40].

While Hicks and Ison [31] mainly focus on the engagement of local actors in general, we operationalize the place dimension by looking at three different aspects that the literature has described as important features of ECs. First, some literature assumes that members live or work in the same place or in other ways are connected to a specific area [4,12,29,33,36,44], which is seen as a precondition for a high degree of engagement and social interaction [11]. Second, some literature stresses the location of the members in relation to the EC's plant(s) [4,29,33,40,46], arguing that the involvement of local people will create a sense of ownership and control and, thus, increased legitimacy and project acceptance [32,35,39,52]. Some ECs even formally restrict

[6] In electricity models, members get electricity from the solar plant, either at a discount price as compared with the normal electricity price (sometimes at no cost) or at a price premium [15,17,40,42]. In investment (or revenue-based) models, the electricity from the plant is sold to the grid, either at the spot market or through power-purchasing agreements [17]. Based on these revenues, members get a financial return on investment that is proportional to their shareholding, either in the form of a discount of the electricity bill (sometimes referred to as "virtual net metering" [43]) or as an annual dividend [17,42–46].

membership to people living close to the plant [46]. Here, local ownership is considered especially important [31,33,53], as it means that people in the local community have a direct financial stake in the project [4]. Third, some suggests that it is an advantage if the EC's plant is built on a piece of land or a building that has a clear local connection, for example a school or another public building) [11,17,39,43].

To understand the importance of this characteristic (RQ1), we asked the members how important they think it is for a solar community to work well (a) that members live close to each other (in the same town or similar), (b) that members live close to at least one of the community's solar plants, and (c) that the plant is located on a land/building with a clear connection to the local community (e.g. a school or a municipally owned property). To capture the importance of local ownership, we included a question about company co-ownership, asking the respondents whether different types of local and non-local companies should be allowed to own shares (and, thus, become members) in an EC or not.

To study to what extent the ECs aligned with the first two proximity-related characteristics (RQ2), we asked the respondents to provide their postal codes, which we compared with postal code maps (available via Google maps) and the actual location of the plants (identified via satellite images in Google maps). To determine whether the plant had a clear local connection, we used information provided by the boards.

2.3.4. Interest

The literature suggests that the concept of a community implies that members to some extent share values, interests, or "ways of thinking and living" [4; cf. also 18,39]. This applies even if an EC is started by an external organization, such as a municipality, since it is then considered important to make sure that citizens' interests are integrated in the EC [54,55]. Moreover, when members participate in shared activities within the EC, this is likely to result in shared, internalized interest and values over time. In line with this, Bauwens et al. [4] make a distinction between instrumental and transformative notions of community, where the former is composed of "aggregates of self-interested economic actors" (p. 12) and the latter by societal motives and a collective community interest.

To operationalize this dimension in relation to RQ1, we asked the members how important they think it is for a solar community to work well that members have (a) similar values and (b) a shared interests that make them engage in the community. In order to study the alignment between this expressed ideal and the ECs' actual characteristics (RQ2), we looked at the members' motives to become members in an EC (as discussed under the outcome dimension). We both investigated to what extent members had similar motives (as this could be seen as a sign of shared values and interests) and looked at the relative importance of individual economic (instrumental) motives versus more transformative societal and environmental motives. As we assumed that people engaging in ECs might be especially interested in energy issues, we also asked the respondents several questions to gauge their interest in renewable energy and solar energy: if they owned their own solar plants, if they had an electricity contract dedicated to solar or another renewable energy source (e.g. wind power), and whether they had ever had an energy-related employment.

2.3.5. Organization

ECs come in many different organizational forms and governance types [5,11,37,56]. One aspect of this is ownership, where the literature argues that ECs should, preferably, be owned by their members rather than by utilities or "third parties" (such as project developers) [5,15,28,36,41,44,45]. However, it is considered even more important that ECs are characterized by broad empowerment and democratic control. This implies that the decision-making process should be transparent [51,57] and enable active member involvement [4,11,15,40,47]. In Hicks and Ison's [31] framework, strong communities are characterized by a decision-making model where each member has one vote, regardless of how much they have invested, to ensure decisions are taken in a democratic way [cf. also 5,11,12,15,47].

To operationalize this dimension in relation to RQ1, we asked members how important they think it is that members are involved in strategic and operative decisions. We also asked them what they thought about two different decision-making principles: one in which each member gets one vote regardless of how many shares they own (i.e. everyone has the same influence over decisions) and one in which each share corresponds to a vote (i.e. people who own more shares have a larger influence over decisions). As mentioned under the place dimension, we also asked the members whether they thought different types of companies should be allowed to own shares in ECs. Regarding RQ2, we gathered information from the statutes and the boards about how the ECs were owned. We also asked the members about their actual participation in decision-making, in terms of the extent to which they had (a) participated in annual meetings (where all main decisions are made) and (b) proposed decisions to the board and/or the other members. We also asked them to what extent they would like to be involved in these forms of decision-making in the future.

2.3.6. Social interaction

Finally, the literature emphasizes social relationships and interaction as important aspects of ECs [4,39,42]. The community concept is based on the general idea of member involvement and interaction [11,15,31], which requires close social relationship and trust [4]. More specifically, the literature argues that ECs can bring people together and create a sense of unity or joint identity for their members [33,36,42,51], and that some people find this an important motive for joining an EC [12]. The building of social relations and local trust can also be a reason why people support, and are willing to pay more for, local renewable energy projects [58,59]. Taken together, these aspects seem to indicate that a high degree of communal collaboration and unity is seen as a success factor for ECs [42].

Our operationalization of this dimension focuses on members' motives and their view on engagement and interaction. In order to address RQ1, we asked the members how important they think it is (a) that the community creates a sense of togetherness, (b) that members meet and spend time with each other, and (c) that the community arranges different types of activities for the members (e.g. study visits or seminars). In order to address RQ2, we used the question about motives to understand how important "doing something together with others" was for the members' decisions to become EC members. We also asked them to what extent they had participated in any of the activities that their EC had arranged (apart from the annual meetings), visited any of the EC's solar plants, or participated in installation or maintenance of the plant (s). We also asked to what extent they would like to participate in these kinds of activities in the future.

2.4. Data analysis and case comparison

Data were analyzed using a descriptive rather than hypothesis-testing approach to match the explorative nature of the purpose. Results were first compiled for each question in the questionnaire after which the sub-questions related to each analytical dimension were compiled and discussed in relation to each other to form a composite picture.

Although we do not present a separate analysis for each EC in this paper, such an analysis was made as a service to the boards of the participating ECs. As shown in Table 2, there are some differences between the three respondent groups in terms of response rates and demographics. Despite these differences, we were not able to identify any major differences in their questionnaire responses that could affect the overall results of this paper. The most notable difference concerned the share of respondents who owned their own solar plant, where EC1 had a much larger share than the average (50 % as compared with 25 %), possibly because a larger share of EC1 respondents live in their own

houses. EC1 also had a larger share of respondents who had participated in annual meetings and other activities and/or considered it important for an EC to arrange such activities. This might be due to the fact that EC1 is the oldest of the three ECs, which implies that there have been more opportunities and activities for members to engage in. There were also small differences in the respondents' preferences for different economic models, where EC3 respondents had a clearer preference for one of the economic models, whereas the survey as a whole indicated that all models but one were equally acceptable. Finally, while the overall results pointed at a preference for one of the investigated decision-making models, EC3 respondents considered both models almost equally acceptable.

2.5. Limitations

Although we have not observed any fundamental differences between the three ECs that are included in the study and the other ten solar ECs we identified, for example regarding member composition or organizational models, we cannot completely rule out potential biases due to self-selection. Most importantly, the three selected ECs were all initiated by municipal energy companies. These are resourceful actors that provide much-needed technical and institutional knowledge to the planning and installation process and, thus, reduce the risks for the ECs as well as the need for member engagement in early development phases. Members of citizen-initiated ECs might very well have other preferences and perspectives on what an ideal EC would look like, which this study cannot capture. Consequently, it would have been valuable to include at least one citizen-initiated solar EC for comparison.

Since we were not able to obtain any information about the non-responders, we do not know if there are any biases in the data due to over-representation of some groups (e.g. men vs. women or older vs. younger). This might have influenced the results (although it is difficult to know to what extent and how when we do not know what the total population looks like). Previous literature has suggested that different groups might prefer different economic or governance models [12,46,60], but the empirical evidence is so far limited. While we have not done any statistical analyses so far to explore if such differences are present in our group of respondents, that would be an interesting line of investigation to pursue in the future.

As noted above, we have chosen to present the data from all cases instead of designing the research as a comparative case study. The main reason for this was that a preliminary analysis revealed few differences in responses between the three ECs. However, a more detailed statistical analysis could potentially reveal interesting differences that could be explored further in future research.

Finally, the study is based entirely on the opinions of the members of the ECs about what an EC should look like to work well. This implies that we have not studied the actual performance of the ECs in economic, social, or environmental terms. While we know that all the three ECs have successfully built working solar plants, have high member retention and have survived for some years, we do not know whether their investments have been profitable (some Swedish solar parks are not, at least not under a merchant business model [61]). We also do not know if they are environmentally or socially sustainable, for example in the sense of contributing to cohesion in the local community (or at least not creating conflicts). Investigating these issues further could be an interesting line of research for the future.

3. Results

In this section, we will report the findings for each of the six dimensions of the analytical framework. To simplify the presentation, we have created four figures that we will refer to in all sections. Fig. 1 shows the importance of different motives for becoming a member and/or investing in an EC. Fig. 2 shows how important the respondents think that different aspects are for a solar community to work well. Fig. 3 shows the extent to which respondents have engaged themselves in specific types of activities related to the EC, and Fig. 4 the extent to which respondents would like to engage more with these activities in the future. In addition, some dimension-specific figures will be presented in the respective sub-sections.

3.1. Process

A clear majority of the respondents (60 %) stated that it is important that members are involved in organization and leadership (Fig. 2:a). However, their actual involvement seems highly limited. About 20 % said that they had participated in starting up their solar EC, but this seems like a high figure considering the central role of the municipal energy companies in all three ECs. Our interpretation of this result is, therefore, that they meant that they had been members from the start. Furthermore, <10 % of the respondents stated that they had ever been board members or taken on other formal tasks in the EC (Fig. 3:a-b). Their interest in participating more actively in such tasks in the future was also low: the share of respondents who would prefer to be less involved in the future, as compared with now, was higher than the share who wanted to be more involved (ca 20 % compared with ca 5 %) (Fig. 4:a-b). In light of these responses, it is interesting to note that the three studied ECs are totally dependent on volunteer labor in terms of governance and organization of activities for the members (plant operation and maintenance is outsourced).

3.2. Outcome

As expressed in the statues, the EC's goals emphasize the promotion of renewable energy. This was reflected in the questionnaire, where it was clear that doing something good for the environment and contributing to the energy transition were important motives for the respondents to become members in an EC (ca 90 % of the respondents described these two motives as important, see Fig. 1:a-b). This was also expressed in the free-text comments provided by some respondents:

"[I]t is important that solar parks are built to develop a sustainable energy supply."

"The only thing that matters is to increase the share of solar electricity."

"I see it as only positive the more we are who contribute to the energy transition."

Contributing to the local community and to a safe and secure energy supply were also common motives (70 % and 77 % of the respondents described these motives as important, see Fig. 1:c-d). This indicates a wish to create benefits for society and not only for EC members themselves (see also Fig. 2:b). In comparison, to do something with others and to reduce cost/make money were less important motives according to the respondents (see Fig. 1:f, h-i). Of the economic motives, reducing energy costs was the one most stressed (roughly 40 % of the respondents described this as important), but at the same time a similar share found it unimportant (Fig. 1:i).

That economic motives were less important than societal and environmental motives may seem like a contradiction, considering that all the studied ECs generated some kind of economic benefit for their members at the time of study. However, as highlighted by Hicks and Ison [31], motives and benefits do not always coincide – there can be unintended outcomes as well as unrealized benefits.

When asked about preferred economic models, the respondents preferred the models where they got some kind of economic benefit over a model where they could buy solar electricity at a slightly higher price (Fig. 5).[7] However, the fact that the reinvestment model was almost as popular as a model where the member can buy solar electricity at a

[7] In contrast to the overall results, EC2 respondents slightly preferred the yearly dividend model above the other models, whereas EC3 respondents clearly preferred the solar electricity at a lower price model.

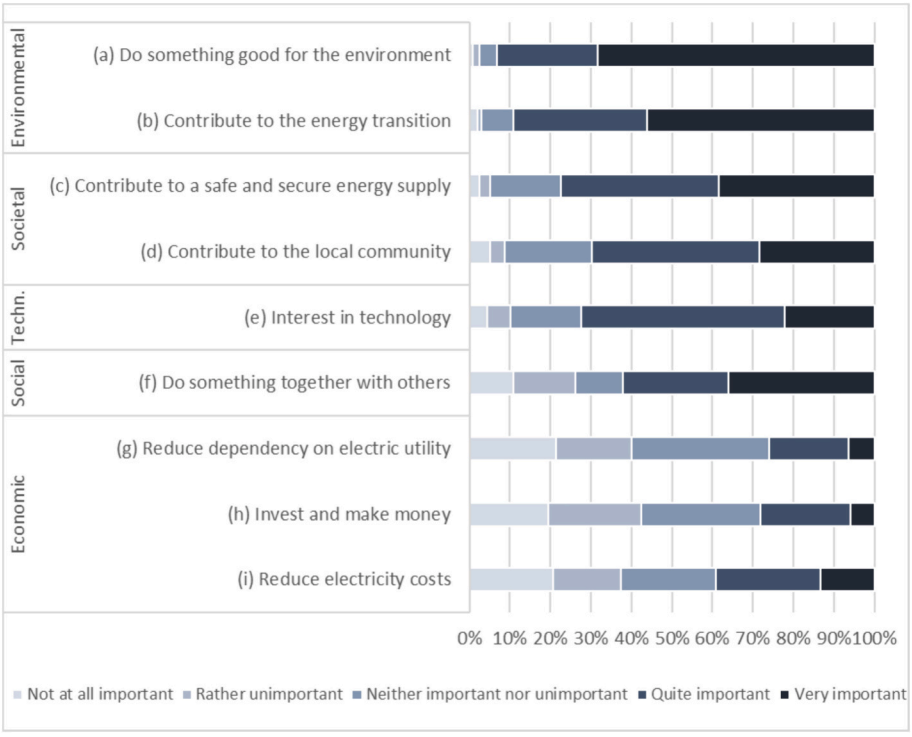

Fig. 1. The importance of different motives for becoming involved with an energy community.

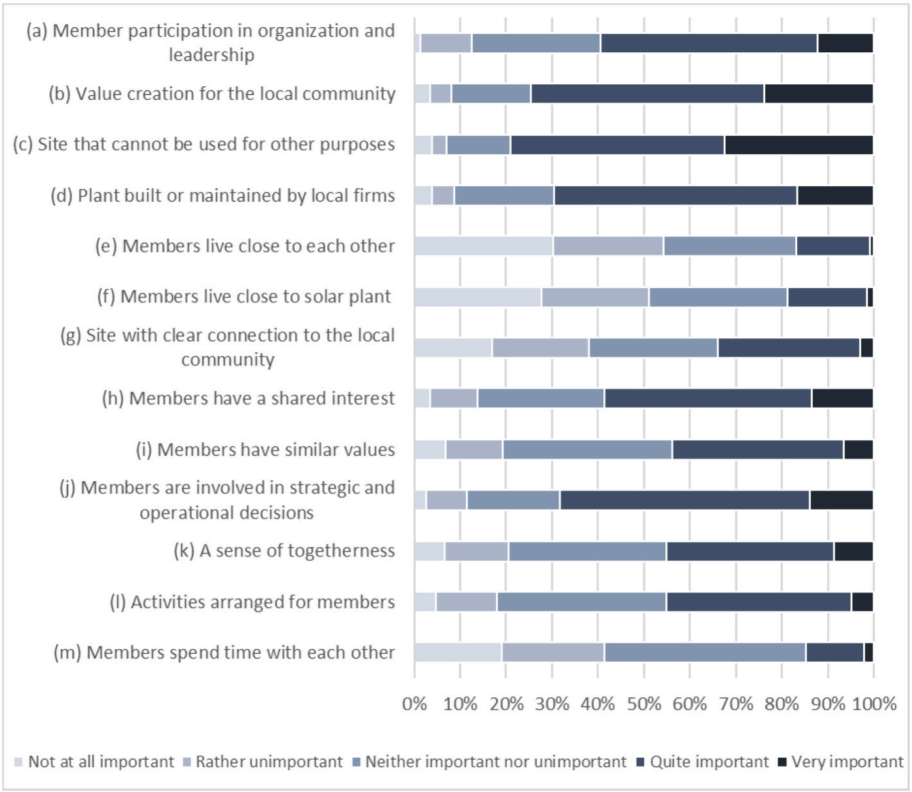

Fig. 2. The importance of various aspects for a solar community to work well. Note: In this context, "other activities" refers to activities apart from annual meetings (which the communities are required by law to arrange), for example seminars or study visits.

lower price than the regular electricity price (78 % and 79 % of the respondents describe the respective model as a good option) still suggests that their own economic benefit was not in focus – they just did not like a model where electricity became more expensive. Here it should also be noted that the members have already made an initial investment. At the same time, it should be noted that EC1 changed its economic model, from reinvestment to yearly dividend or electricity price discount, following discussions among members. This might indicate a

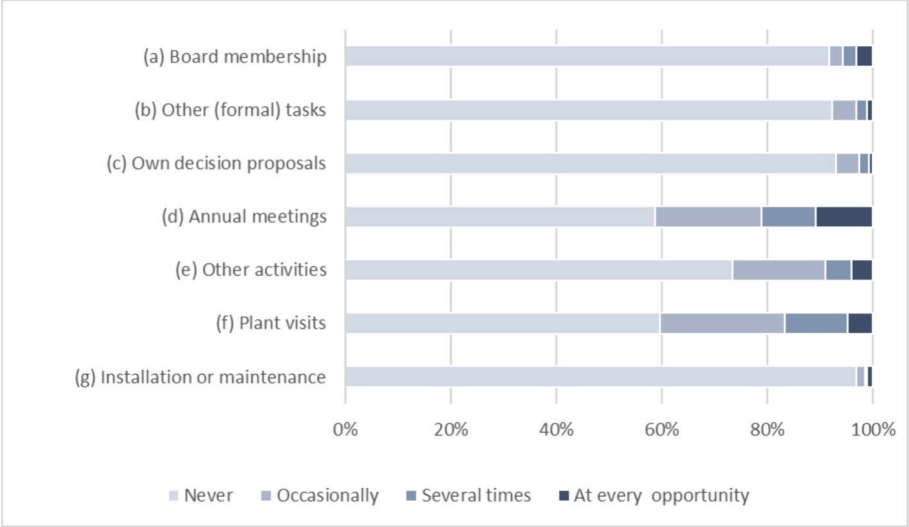

Fig. 3. The extent to which respondents have engaged themselves in specific types of activities. Note: In this context, "other activities" refers to activities apart from annual meetings (which the communities are required by law to arrange), for example seminars or study visits.

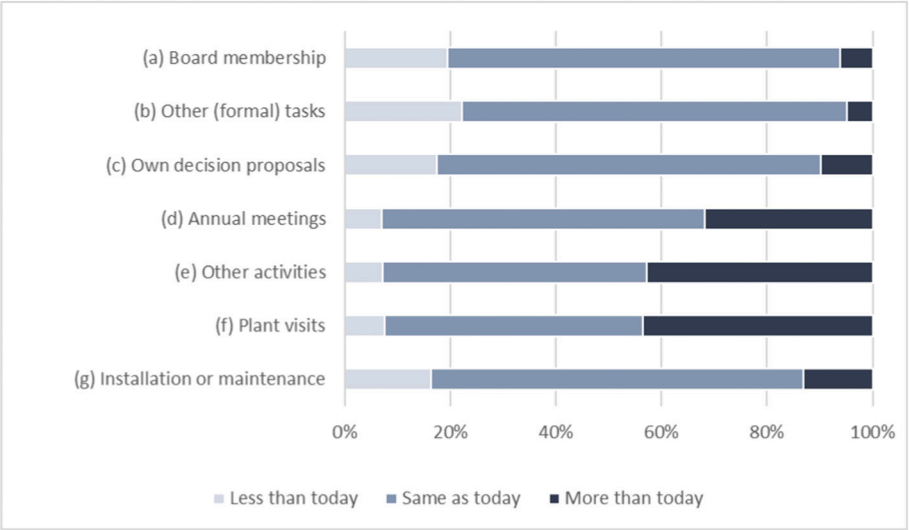

Fig. 4. The extent to which respondents would like to engage in specific types of activities in the future.

change in perspective over time, or a difference in opinion between older and newer members.

3.3. Place

A majority of the respondents (54 % and 51 % respectively) considered it unimportant for member to live close to each other or close to the EC's plant(s) for an EC to work well, and <20 % considered it important (see Fig. 2:e-f). This corresponds well to where they are located themselves. According to our analysis of the respondents' postal numbers, less than half of them (37 %) live in the town or city where the respective plants are located; those that live in the same town or city live in different neighborhoods; and the plants tend to be placed several kilometers away from any of these neighborhoods. The respondents also did not consider it important that the plant was built on land or buildings that have a clear connection to the local society (for example a school, a church, a town hall, or a municipally owned piece of land) (34 % considered it important and 38 % considered it unimportant, see Fig. 2:g). This could be contrasted with the importance they gave to the site not being possible to use for other purposes (see Fig. 2:c).

Nevertheless, almost 70 % of the respondents described that contributing to the local society was an important motive for them to become a member and/or investing in the EC (see Fig. 1:d). As mentioned earlier, a clear majority also found it important that the plant creates value for the local society and not only for the members (ca 75 %, see Fig. 2:b), and it was important to them that the plant is built or maintained by local companies (ca 70 %, see Fig. 2:d). That place matters also shows in the responses to the question about whether different types of companies should be allowed to own shares in jointly owned plants, where the acceptance of municipally owned energy companies and other local companies as co-owners was much higher than of other companies (see Fig. 6).

3.4. Interest

More than 40 % of the respondents stated that it is important that members have similar values (Fig. 2:i). Although the questionnaire did not include any questions specifically targeting the respondents' values in a broad sense, it can be noted that environmental and societal motives, as described earlier, were much more important for them to

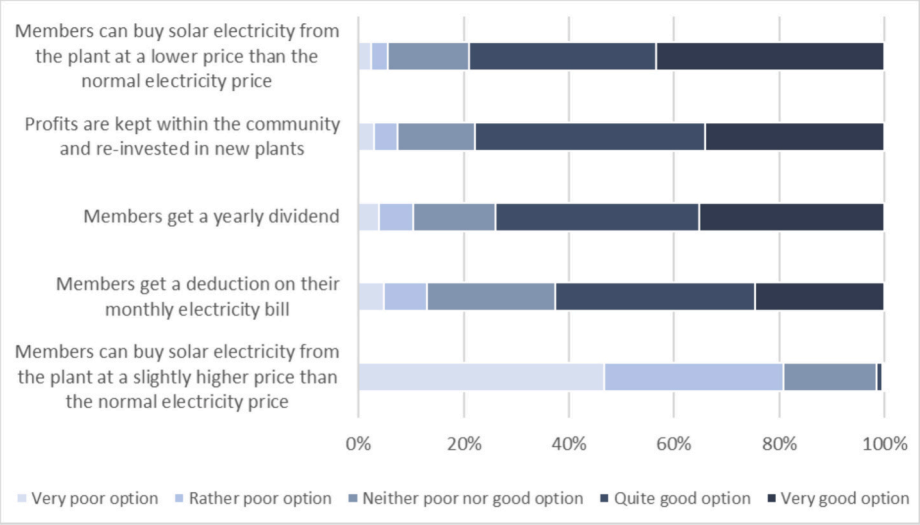

Fig. 5. Respondents' opinions about different economic models.

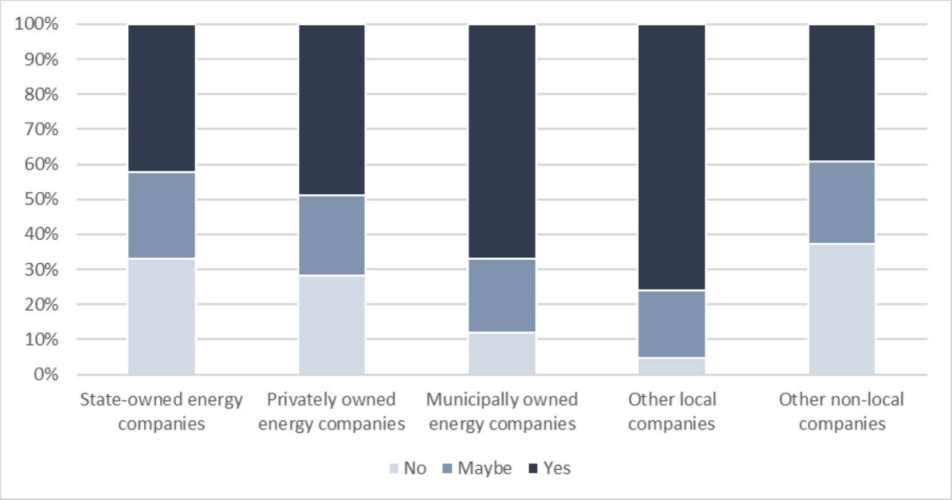

Fig. 6. Opinions about whether different types of companies should be allowed as co-owners in ECs.

become EC members than individual economic motives (see Fig. 1). This indicates that members have similar values related to the importance of working for the common good rather than their own personal interests.

In addition, a clear majority of the respondents (almost 60 %) considered it important for members to have a shared interest (which is what brings them together in the EC) (see Fig. 2:h). Judging by the responses to some of the other questions, the respondents are more interested than other citizens in solar PV as well as energy in general. For example, 26 % of the respondents said that they have a solar plant of their own (e.g. a rooftop plant on their house),[8] 6 % have a dedicated solar electricity contract, and 23 % have (or have had) an energy-related employment.

3.5. Organization

All the ECs studied are owned by their members. They all have what we would describe as an open membership model: to become a member, you have to buy at least one share but there are no other major formal membership requirements. Individuals, companies, and municipalities are all allowed as members, and members do not have to be located close to the plant(s) (not even in the same municipality).[9]

The respondents thought it was important for members to be involved in strategic and operational decisions (almost 70 % considered this important, see Fig. 2). Ca 60 % thought that a decision-making model where each member has one vote, which is the model all of the three ECs currently have in place, was a good option, as compared with 40 % for a model where votes are connected to the number of shares (Fig. 7).[10]

In practice, however, the members do not seem to exert much real influence as only 40 % have attended an annual meeting and <10 % have put forward any proposals of their own (Fig. 3:c-d). About a third of the respondents (32 %) had ambitions to participate more in annual meetings in the future (Fig. 4:d), but a smaller share wanted to become more involved in making proposals than the share who wanted to

[8] The average was influenced upwards by EC1, where the share of respondents who owned a solar plant was over 50 %. The corresponding numbers for EC2 and EC3 were 18 % and 10 % respectively, which is most likely higher than the Swedish average [cf. 62].

[9] Because of its economic model, EC3 requires its members to buy their electricity from the municipal energy company that set up the EC (to get the cost price). Similarly, if members of EC1 want to access the electricity price discount, they need to become customers at the municipal energy company (but that is not a membership requirement).

[10] EC3 respondents found both models almost equally acceptable.

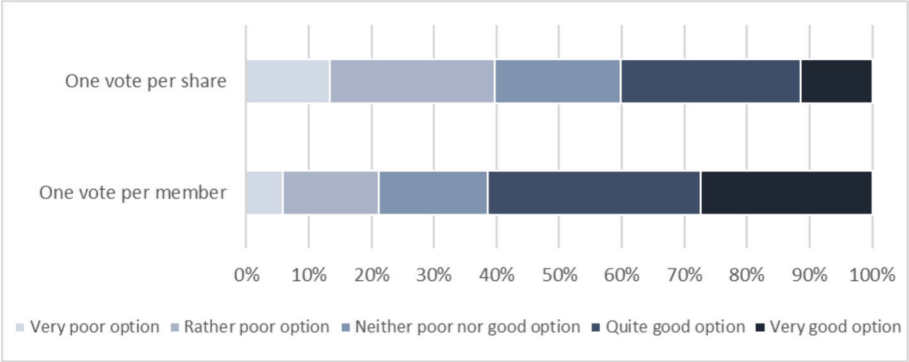

Fig. 7. Opinions about different types of decision-making models. Note: As explained in Section 2.3, "one vote per member" means that each member has one vote, regardless of how many shares they own (as in a cooperative), whereas "one vote per share" means that members who own more than one share get a corresponding number of votes (as in a share-owned company).

become less involved (10 % and 17 % respectively) (Fig. 4:c).

3.6. Social interaction

The results regarding social interaction were somewhat unclear. About 60 % of the respondents said that "doing something together with others" was an important motive for them to become EC members (see Fig. 1:f), and about half of the respondents (45 %) stated that it is important that there is a sense of togetherness for an EC to work well (see Fig. 2:k). At the same time, several other motives – especially environmental and societal ones – were described as more important for becoming a member (cf. Fig. 1a-e), and <20 % of the respondents thought that it is important for members to spend time with each other (Fig. 2:m) or even live close to each other (Fig. 2:e).

About half of the respondents (45 %) considered it important for ECs to arrange other activities than annual meetings for their members (e.g. seminars or study visits) (Fig. 2:l). According to board member interviews, activities such as seminars, site visits and solar park inauguration events have been arranged,[11] but a large majority of the respondents stated that they had never participated in any of these activities (70 %), visited the EC's solar plant(s) (58 %), or participated in installation or maintenance of the plant(s) (93 %) (Fig. 3:e-g). About 40 % would, however, like to participate in activities and visit plants more in the future (Fig. 4:e-f).

4. Discussion

The results presented in the previous section are summarized in Table 4 along with the "ideal" EC characteristics according to previous literature. As shown there, the members of the three solar ECs studied in this paper agree with the literature on several of the key characteristics of an ideal EC [cf. 4,31,32]. Most notably, they consider it important that members are involved in planning, development, and management (Process) and included in decision-making (Organization); that an EC is characterized by shared member interests (Interest) and a sense of togetherness (Social interaction); and that the EC benefits the local community and not only the members (Outcome).

Even so, the studied ECs score low on several of these characteristics, according to the members' responses to the survey. Interestingly, these are the ones connected to member participation in management, decision-making, and other types of community activities. This seems to suggest that members consider these characteristics important in principle rather than in practice, which is an important complement to earlier findings. Moreover, in stark contrast to the literature, EC members do not find either geographical proximity (Place) or member interaction (Social interaction) very important. It is therefore less surprising that the ECs score low on these characteristics, but the misalignment with the literature on ECs in general [cf. 4,31,32] and solar ECs specifically [cf. 5,39] in this respect is nevertheless

Table 4
Summary of results in relation to the "ideal" EC characteristics described in previous literature.

Dimension	'Ideal' as described in previous literature	Members' perceptions
Process	High degree of member involvement in EC planning and management	Member involvement is important, but their actual involvement is very limited.
Outcome	Fair distribution of benefits between members Value creation for local society Collective benefits rather than individual benefits	Collective environmental and societal benefits are stressed over individual economic benefits. Reinvestment is a highly accepted model alongside economic models that provide individual economic benefits to the members.
Place	Geographical proximity between members Geographical proximity between members and plant (incl. local ownership) Plant location with local connection	It is important to contribute to and generate value for local society, but neither geographical proximity (members or plant) nor local connection (plant) is important.
Interest	Shared values and interests Transformative-collective (rather than instrumental-individual) motives	Shared values and interests are important, and members have similar, mostly collective motives and seem to share an interest in solar PV and energy in general.
Organization	Member ownership Inclusive/democratic decision-making principle	Member involvement in decisions is important but so far limited. The one-member-one-vote model is slightly preferred over the one-share-one-vote model.
Social interaction	Sense of unity or joint identity Member interaction	Doing something together with others is important, as is a sense of togetherness. However, spending time with each other is not important, and actual participation in EC activities is limited.

[11] EC3 was established during the Covid-19 pandemic. This influenced its possibility to host events and activities apart from digital meetings.

noteworthy.

Taken together, we would suggest that these inconsistencies warrant a reconsideration of – or at least a more nuanced approach to – some of the key assumptions in the literature regarding how we understand the role of *aim, place,* and *engagement* in relation to energy communities. In the following, we will discuss each of these in more detail.

4.1. Aim

Previous literature has observed that ECs can be motivated in different ways [54,63] and can have different economic, environmental, social, and political aims [4]. The empirical evidence is, however, limited [51,54,64], and this study makes a contribution in this regard. When analyzing the Swedish solar ECs' statues and the responses from the questionnaire sent to the member of three ECs it was clear that they aim at contributing to the deployment of solar energy, regionally and/or nationally, and this was also reflected in the respondents' environmental and societal motives to become members as well as in the importance they gave to the EC contributing to the local society in different ways.

These findings provide some nuance to the idea that interest-driven communities tend to further their own individual interests in conflict with the interests of the local societies in which they build their plants [cf. 33]. We propose that ECs aiming at contributing to the energy transition rather than only promoting their members' economic interests are stressing collective rather than individual benefits. This is supported by the relatively high acceptance of the reinvestment model alongside models providing an economic benefit to the members, and is in line with the findings of, for example, Hackbarth and Löbbe [64], who found that regionality could be more important than individual benefits. Whereas Walker et al. [33] describe communities of interest as "robbers", we would therefore suggest describing environmentally oriented ECs as "princes of thieves"; their members invest their own private funds to create value for society at large, including the local community where their plants are based, but do not necessarily require any economic benefit in return. This connects to the concept of 'place', which will be discussed further in Section 4.2.

The findings also challenges widespread assumptions in both research and policy that ECs are tools to achieve social and political aims, such as energy justice, citizen participation and empowerment, local job creation, education and capacity building, and social cohesion [51,65, cf. also 4,22,34]. Consequently, some of the ideal characteristics, which are connected to such aims, might be less important for ECs that aim at contributing to the energy transition. This concerns the proposed role of ECs as arenas for social relationships, highlighting the need for social interaction among members [4,11,15,31,39,42], which our study contradicts, thus confirming the results of some earlier studies that found that EC members are less motivated by community-building opportunities than often expected [31]. It also concerns member participation and engagement in EC governance, which will be discussed further in Section 4.3.

4.2. Place

The most prevalent understanding of energy communities is communities defined by geographical boundaries which engage citizens living within these boundaries [4,33,66,67]. In contrast, the studied solar ECs have an open membership model, where anyone who can buy a share is welcome as a member regardless of where they are local or non-local (see Section 3.5). Moreover, according to our study their members do not care much about their own location in relation to each other or to the plant. However, this does not mean that local aspects are unimportant to them. Rather it emphasizes a need to revise our understanding of the importance of place as an ideal EC characteristic in at least two respects.

First, previous literature has argued that memberships should be restricted to local citizens to ensure that revenues stay in the local area [68] and that those who are exposed to the potential negative consequences of an energy project can also benefit from it [66]. Our findings instead show that ECs with a large share of non-local members can be quite invested in local value creation. The studied ECs were also entirely open to local membership, making it possible for local citizens to influence and benefit directly from the ECs activities. Moreover, while much of the previous studies have focused on large-scale wind power, which tends to be characterized by local conflicts, the studied ECs' solar PV plants were built on existing roofs, landfills or other land defined as non-usable. This indicates that the ideal EC characteristics might to some extent be technology specific. The members also found it important that plants were not placed on land that could be used for other purposes, indicating that they saw the importance of actively mitigating local conflicts of interest.

A second concern related to open membership is that it risks giving actors outside the local community an unjust influence [32,33,69]. However, in our study all the ECs were initiated by local energy companies, which are owned by the municipalities and, thus, by the citizens (albeit indirectly).[12] They tend to be highly committed to the local community [47]. The important role of municipal energy companies for creating and sustaining energy communities over time has been noticed in earlier studies from Sweden and elsewhere [18,71–74]. Such actors have the resources and operational experience to design and implement projects that would be too difficult for community actors to manage successfully [30,42,44]. They can also be important partners when crafting an attractive economic model for the members (e.g. electricity price discounts). Our study confirms this and, furthermore, shows that both municipal energy companies and other local companies are well-accepted by the members as co-owners of EC plants [see also 53]. Based on this, we would argue that the involvement by municipally owned energy companies gives these ECs a strong local anchoring, possibly offsetting the potential negative effects of allowing non-local members.

Taken together, this means that our findings align well with an understanding of place that goes beyond geographical location and proximity and branches out to other types of local anchoring and embedding [cf. 75]. In that, we join a growing group of researchers who question the focus on communities-of-place as the norm [cf. 10].

4.3. Engagement

When it comes to citizen engagement, the ideal model, as described by for example the European Commission, implies an organization model which actively engages the members. In contrast, our study shows that whereas EC members might like the idea of active member involvement, they are not necessarily interested in engaging themselves in management, decision-making, or other EC activities. This is in line with some previous studies, which found a low interest by the members to participate and engage in different activities [9,64,76], but challenges the commonly expressed normativity in portraying the ideal EC member as an active member that does more than simply own a share.

This discrepancy might be partly due to the environmental aims of the studied ECs, as described in Section 4.1. If members are not aiming at democratization and social inclusion but solar diffusion and an energy transition, they might be content with being represented by other people (as long as they can have a say if they want to, which the one-member-one-vote decision-making model ensures). However, low participation can also be due to lack of time or knowledge on how to best contribute [e.g. 18,77,78]. This relates back to the involvement of municipal

[12] In this context, it should be noted that ECs are often initiated and organized by other actors than citizens. For example, Candelise and Ruggieri [9] found that only 24 % of their 17 studied ECs had been developed by citizens or by grassroot organizations – the rest were initiated by a government authority or private company. This also applies to solar ECs, not least in the US [44,70] and is, thus, not a unique Swedish phenomenon.

energy companies, as discussed in Section 4.2. While the involvement of professional actors can provide ECs with capital and knowledge, thereby driving the process forward, increased influence by such actors can also increase the barriers for citizen involvement even further by decreasing member incentives to engage and educate themselves [18,79].

Our results also show that the members have a low interest in meeting and socializing with each other in their EC. This is most likely related to their motives to become members, which are environmental and societal rather than social (cf. the discussion in Section 4.1). However, national characteristics might also be at play. In previous research on energy communities, trust has been highlighted as important both as a pre-requisite for and an outcome of ECs [58,80,81]. Sweden has been identified as a country with a relatively high level of trust in general [82], which on the one hand creates good conditions for starting ECs but on the other hand might reduce the need for members to interact with each other to strengthen their mutual trust. In that context, joint ownership by citizens might be enough for the members to build trust and feel a sort of engagement even if they are not very active. Furthermore, the limited interest in social interaction might be an indication that EC members have other meeting arenas. For example, studies show that Swedes would rather engage themselves actively in sport organizations than in ECs [22].

The drawback with favouring more individual and tangible forms of engagement as an ideal EC characteristic is that it overlooks other forms of participation, which can be as important for the citizens depending on the purpose of the engagement [83,84]. Indeed, there are a broad range of participative forms in the energy system, and the meaning of participation and citizen engagement is open to interpretation [85]. In this regard, our study shows that a sense of community does not have to be based on social interaction and participation in the initiation and governance of an EC. Instead, the members of the three studied cases have found a sense of togetherness in investing together with others and jointly contributing to the energy transition, i.e. they are connected by a common mission rather than by social ties.

5. Conclusion and implications

The overall aim of this paper was to provide a complementary view on energy communities by presenting new empirical evidence from Sweden. More specifically, we used data from a questionnaire to the members of three Swedish solar ECs to investigate (1) to what extent EC members in Sweden agree with the established view of the "ideal" EC, as described in previous literature, and (2) to what extent the studied ECs match the characteristics of such an "ideal" EC according to their members.

Regarding the first of these research questions, we found that the members of the studied ECs confirm the importance of member involvement in planning, development, management and decision-making as well as shared interests and a sense of togetherness. In contrast, they did not find geographical proximity or social interaction important at all. Regarding the second question, we saw that the studied ECs deviated from an "ideal" energy community in several respects. Most notably, they scored low on member participation in management, decision-making, and other types of community activities as well as on geographical proximity. Despite acknowledging the importance of these characteristics, actual involvement thus remained low, highlighting a critical gap between aspiration and practice with regard to member engagement.

These results provide a more nuanced view on what constitutes an ideal EC in different contexts. First, the lack of emphasis on geographical proximity and social interaction among EC members challenges traditional notions of communities-of-interest as less ideal than communities-of-place. We argue that the studied ECs' focus on environmental and societal aims makes it less likely for their interests to clash with the interests of local communities. It also makes the ECs less dependent on social interaction and member engagement.

Second, that members can be rather uninterested in geographical proximity but still care about creating value for the local community indicates that open membership models do not necessarily interfere with securing local benefits. Considering the important role played by municipally owned energy companies in the studied cases, we also suggest that local anchoring can be achieved in other ways than through geographical proximity, in this case through initiating organizations that are locally owned and have high local legitimacy.

Third, that members showed little interest in either governance or social interaction with other members suggests that a sense of community does not have to be based on social interaction. Our study instead highlights the importance of having a common mission. The results show that Swedish ECs prioritize environmental outcomes over social objectives and local engagement, indicating that the essence of Swedish solar ECs is neither geographical proximity nor social relationships but a shared commitment to the energy transition. This calls for a more balanced conceptualization of ECs, which recognizes the multifaceted motives behind EC membership as well as the diverse contexts ECs exist in.

Regarding implications for further research, more empirical work is needed to further disentangle the defining characteristics of energy communities in different geographical and technological settings. Such studies should, in particular, focus on identifying how contextual differences influence the way ECs should be set up and managed to serve their members' interests and contribute to the energy transition and other societal goals at both local and national levels. Another avenue for further research could be to explore the identified gap between member aspirations and practice in terms of engagement and involvement in management and decision-making, which is important from the point of view of energy justice and democracy.

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CRediT authorship contribution statement

Anna Bergek: Writing – review & editing, Writing – original draft, Visualization, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Jenny Palm:** Writing – review & editing, Writing – original draft, Methodology, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors have not declared any potential competing interests.

Data availability

The data that has been used is confidential.

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Appendix A

Table A. Operationalization of the dimensions in the analytical framework.

Dimensions		Questions and sub-questions	Response scale
Process	Initiation (general)	Did you take part in starting up the solar community that you are now a member of?	Yes – No
	Management	How important do you think the following aspects are for a solar community to work well? ■ The members participate in the organization and leadership of the community (e.g. through board or committee work) To what extent have you done the following in the solar community you are a member of? ■ Been part of the board (as chairperson, member or alternate) ■ Taken on other task(s) in the community (e.g. organized meetings or other activities) To what extent would you like to do the following in the future? ■ Be part of the board ■ Take on other task(s) in the community	Not at all important – somewhat important – neither unimportant nor important – quite important – very important Never – occasionally – several times – at every available opportunity More seldom than today – same as today – more often than today
	Motives	How important were the following motives for your decision to become a member in a solar community and/or buy shares in a solar plant through a solar community? ■ Do something good for the environment ■ Contribute to the transition of the energy system ■ Contribute to a safe and secure electricity supply ■ Contribute to the local community ■ Interest in technology ■ Do something together with others ■ Make the household less dependent on the electric utility ■ Invest and make money ■ Reduce the household's electricity costs	Not at all important – somewhat important – neither unimportant nor important – quite important – very important
Outcome	Economic models	What do you think about the following aspects that concern shareowner benefits and conditions? ■ Members can buy solar electricity from the plant at a lower price than the normal electricity price ■ Members can buy solar electricity from the plant at a slightly higher price than the normal electricity price ■ Members get a deduction on their monthly electricity bill ■ Members get a yearly dividend ■ Profits are kept within the community and re-invested in new plants	Very poor option – somewhat poor option – neither bad nor good option – quite good option – very good option
	Local value creation	How important do you think the following aspects are for a solar community to work well? ■ The solar plant creates a value for the local community as a whole (and not only for the members) [also used in Place]	Not at all important – somewhat important – neither unimportant nor important – quite important – very important
Place	Proximity and local connection	How important do you think the following aspects are for a solar community to work well? ■ Members live close to each other (in the same town or similar) ■ Members live close to at least one of the community's solar plants ■ The solar plant is located on a piece of land or a building with clear connection to the local community (e.g. a school or municipal land) ■ The solar plant is built or maintained by local firms. ■ The solar plant creates a value for the local community as a whole (and not only for the members) [also used in Outcome]	Not at all important – somewhat important – neither unimportant nor important – quite important – very important
	Local ownership	Do you think that the following types of organizations should be allowed to own shares in jointly owned solar plants? ■ State-owned energy companies ■ Privately owned energy companies ■ Municipally owned energy companies ■ Other local companies ■ Other non-local companies	Yes – No – Maybe – No opinion
	Shared values and interests	How important do you think the following aspects are for a solar community to work well? ■ Members have similar values ■ Members have a shared interest, which is why they are engaged in the solar community	Not at all important – somewhat important – neither unimportant nor important – quite important – very important
Interest	Motives	*See Outcomes*	
	Similar interests (solar, renewables. energy)	Does your household own its own solar plant? Does the household have an electricity contract dedicated to a specific energy source? ⇨ If yes, which energy source? Does your current or previous employment have anything to do with energy issues?	Yes – No – Don't know Yes – No – Don't know Solar – Wind – Hydro – Nuclear – Other Yes – No
Organization	Member involvement in decision-making	How important do you think the following aspects are for a solar community to work well? ■ Members are involved in strategic and operative decisions To what extent have you done the following in the solar community you are a member of?	Not at all important – somewhat important – neither unimportant nor important – quite important – very important Never – occasionally – several times – at every available opportunity

(*continued on next page*)

(*continued*)

Dimensions		Questions and sub-questions	Response scale
		■ Participated in annual meetings [where all main decisions are made] ■ Put forward own suggestions for decision	
		To what extent would you like to do the following in the future? ■ Participate in annual meetings ■ Put forward own suggestions for decisions	More seldom than today – same as today – more often than today
	Decision-making principles	What do you think about the following ways to govern a solar community? ■ Members have one vote each, i.e. everyone has the same say regardless of how many shares they own ■ Every share corresponds to one vote, i.e. people who own more shares have a larger say	Very poor option – somewhat poor option – neither bad nor good option – quite good option – very good option
	Motives	How important were the following motives for your decision to become a member in a solar community and/or buy shares in a solar plant through a solar community? ■ Do something together with others	Not at all important – somewhat important – neither unimportant nor important – quite important – very important
		How important do you think the following aspects are for a solar community to work well? ■ The community creates a sense of togetherness ■ Members meet and spend time with each other ■ The community arranges different types of activities for the members ■ Members live close to each other (in the same town or similar) [also used in Place]	Not at all important – somewhat important – neither unimportant nor important – quite important – very important
Social interaction		To what extent have you done the following in the solar community you are a member of?	
	Engagement and interaction	■ Participated in other activities* arranged by the community ■ Visited one of the community's solar plant(s) ■ Participated in installing or maintaining the community's solar plant (s)	Never – occasionally – several times – at every available opportunity
		To what extent would you like to do the following in the future? ■ Participate in other activities* arranged by the community ■ Visit one of the community's solar plant(s) ■ Participate in installing or maintaining the community's solar plant (s)	More seldom than today – same as today – more often than today

* In the questionnaire, "other activities" were specified as activities apart from annual meetings (which the communities are required by law to arrange), such as seminars or study visits.

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