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# Scaling up community wind energy: the relevance of autonomy and community

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## Abstract

**Background** Renewable energy, especially wind power, is expanding rapidly in Sweden and elsewhere and has left the "niche" to become part of the mainstream energy socio-technical "regime". However, the *social* innovation of community-owned wind energy is not expanding alongside. Despite its potential for an inclusive energy transition and for alleviating conflicts, community energy remains a niche phenomenon. In this article, we explore the conditions for community energy to scale up. Upscaling is sometimes regarded as alien to the spirit of community energy, but we argue that it can be positive and, assuming the existence of a "community wind energy trap"—increased market competition and decreased governmental support—even necessary for the long-term survival of community wind energy. We particularly study how two variables relate to upscaling: autonomy and community, the latter divided into communities of interest and place.

**Results** A case study on four wind cooperatives and their main partners, municipal energy companies, based in western Sweden is conducted to generate a theory of how autonomy and community are related to their ambitions and capabilities to scale up their operations. The results indicate that for scaling up, autonomy is a more important factor than community, while communities of interest are more likely to scale up than communities of place. A provisional theory on possibilities for community energy to scale up is developed based on the case study results.

**Conclusions** Even when upscaling is the will and ambition of a community energy initiative, neither autonomy nor community alone is a guarantee for it to happen—yet in combination, the likelihood increases: with autonomy as a prerequisite for action, and community as a motivation for action. Both communities of place and of interest can act as a motivational force and mobilise resources. Yet local rootedness can be difficult to combine with upscaling beyond a certain point, while a community of interest lacks physical borders. If regulators are keen on counteracting the community energy trap, our research suggests that they need to intervene and support these initiatives—yet without intruding on their autonomy.

**Keywords** Renewable energy, Wind power, Sweden, Energy cooperatives, Governance modes

## Background: reasons for scaling up

A wind energy boom has hit Sweden, where onshore production is on its way to increase from 20 TWh in 2019 to 50 TWh in 2024 [1]. The investors are predominantly international and private, such as venture capital, pension funds and foreign utilities. By 2024, foreign companies are expected to own two-thirds of Sweden's wind energy capacity [2]. As elsewhere, conflicts are common. Appeals against wind power development come from both local campaigns and from national organisations,

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such as *Svenskt landskapsskydd*, founded in 1999 as a counterweight to largescale wind power development [3, 4]. The conflicts seem to align with other patterns of indignation, such as over rural depopulation and centralization of community services [4], and local discontent is not likely to be dampened when profits from wind farms leave the region, while only moderate benefits remain.

Community energy (CE) has the potential to be considerate towards local opinions, enhance local acceptance of wind energy and to facilitate the ongoing energy transition [5–9]. Yet, the boom has not led to a corresponding increase of community wind energy (CWE) in Sweden. An important reason is that while the wind energy industry has employed an economy of scale, where efficiency has increased significantly by ever larger turbines on towers now commonly reaching far over 100 m, clustered together in farms consisting of tens or even hundreds of entities, community-owned wind energy initiatives are still mostly small-scale and local [10].

Wind energy cooperatives seem trapped between the local context that is their origin and from where they draw their legitimacy, and the increasing scale imposed by the energy market. The most difficult and risky period after the initial phase, especially for smaller associations which run 1–2 turbines, comes after 20–25 years when operation and maintenance costs are closing in on incomes and new investments are needed. To be competitive, actors must then be able to invest several million euros in land access, building costs, legal fees for the often long and complicated permit processes, and turbine costs that have increased many times over. Walsh [11] reports of scepticism regarding the future of community wind energy in Ireland due to financial and other challenges, also other authors worry about the future of grassroots initiatives in a changing energy market [12, 13].

The difficulties are aggravated by changes in regulatory systems. In Sweden, the compensation from the electricity certificate system, once introduced to support investments in renewable energy, is gradually reduced. From the point of view of the lawmaker this makes sense, since new investments in renewable energy are now considered profitable without state support. However, for small-scale actors that are not able to benefit from the increased efficiency of ever larger turbines, this has led to problems. It follows an international pattern, where feed in-tariffs and community compensation schemes are being phased out [14–17], even if new support schemes are now developed across Europe following the implementation of the European Commission's 2018 Clean energy for all Europeans package [18], including the Renewable Energy Directive [19] and the Internal Electricity Market Directive [20]. The directives aim to create an enabling framework and a level playing field for renewable and citizen energy communities [21]. The impact on the future development of CE in Sweden remains to be seen, as the implementation of the directives into Swedish legislation [22] and policy so far has been very limited.

In the terminology of the multilevel perspective (MLP), wind power for long developed within a "niche", aside of the hegemonic energy "socio-technical regime". Inside the niche, protected from the fierce market competition by government subsidies, CWE initiatives could thrive [23–26]. Yet, while the general idea with subsidising niche technologies is that they will become competitive and enter and reshape the regime, the same development cannot be expected for social innovations, such as CE [27]. They tend to have an 'alternative' identification and practice that makes integration into the mainstream difficult or even unwanted. Elements of social innovation might be adapted into the capitalist market, often through appropriation, but the core ideas remain marginal [28]. Therefore, when government support is phased out this is likely to negatively affect niche social innovations, even when the niche *technology* they have fostered is mature for commercialization. This, and the increased market competition, leads us to hypothesise harder times for wind energy cooperatives: the community energy trap.

The CE sector can grow either through replication (*more* initiatives), upscaling (*bigger* initiatives) or translation ('mainstreamification' of its core principles) [28]. CE traditionally has grown through replication, in alignment with the original ideas of community embeddedness, and this will continue to be possible for scalable solar energy. Yet for wind energy, which is more suitable for colder climates, where peak energy needs to coincide with least sun hours, replication will be more difficult due to the community energy trap. As shown, there are also reasons to believe that alternative, social innovations such as CE will not easily integrate into the incumbent regime through translation.

A remaining strategy for CWE to survive and contribute to the renewable energy transition is to scale up activities. This strategy is contested, since it risks hollowing out the foundations of CE, their attachment to local communities, decentralised decision-making, and prioritisation of social and environmental benefits over profits [29, 30]. This is especially the case if they enter partnerships with commercial or public utilities which reduce autonomy. Yet besides that the alternatives seem few, we argue that the social and environmental benefits of CWE are greater than the risks of scaling up. Research also points to that while scaling up can be a threat to the autonomy and legitimacy of energy cooperatives, there are examples of where it has not [31]. The present article thus builds on

the assumption that as the wind turbines are getting bigger, their owners will have to get bigger, too.

CE is usually interpreted as an umbrella term encompassing various forms of energy initiatives, where communities are involved in both process and outcomes [32], spanning a wide range of energy activities [33–35]. Examples of projects include wind, solar, and biogas cooperatives [36–38], eco-villages [10], transition towns [39], and campaigns for public and participatory ownership of energy infrastructure [40]. Both research on and examples of CE in Sweden remain scarce. Complex regulations, unfavourable tax rules, and a lack of long-term financial incentives constitute barriers to CE in Sweden [10, 13, 41]. Sweden lacks the targeted policy schemes that have enabled CE in the UK [26, 42, 43] or regulations, such as the Danish wind farm co-ownership scheme [44]. Furthermore, the Swedish energy system has been characterised by a stable, affordable, and almost fossil-free electricity provision built on large-scale, centralised hydro, nuclear power, and increasingly also wind power [45], and dominated by a handful of multinational energy actors, leaving little space or incentives for CE initiatives to enter the market [13].

Despite this "hostile" institutional setting [10], CE exists, driven by dedicated citizens and public officials. In their overview of CE in Sweden, Magnusson and Palm [10] found 140 active and 20 discontinued initiatives, where wind cooperatives were the most common form with 78 active ones. Most wind cooperatives are small, with 200–300 members owning only one plant. While some cooperatives are concentrated to a specific locality, most welcome members from anywhere and there are also examples of cooperatives owning several wind turbines at different locations [10, 45].

While the influence of CE initiatives on the Swedish energy system is modest in quantitative terms, authors highlight their importance in terms of diversifying and decentralising ownership and acting as a source of inspiration [8], and that a clear regulatory framework and supportive intermediary actors are needed to keep the CE movement alive [46]. The current implementation of the Clean energy for all Europeans package with its supportive framework for energy communities [18, 21], the protracted inquiry into a tax deduction for micro-producers [47], and the proliferation of new interest organisations promoting cooperative and customer-owned energy production [48, 49] points to an ongoing interest in CE in Sweden.

Our focus in this study is neither on structural or external factors (at the socio-technical regime or landscape level), nor on individual performance, such as leadership qualities. Both are important determinants but largely pre-given from the perspective of CE initiatives. Instead, we focus on "entanglement"—the relations between the actor and its environment—which we divide into two broad variables: autonomy and community. The aim of the paper is to enhance our understanding of how CWE initiatives can survive, expand, and contribute more to the renewable energy transition. The research question posed is how autonomy and community, as defined in the methods section, influence the ability of CWE initiatives to scale up. Through a case study design, a provisional theory of how the variables relate is developed.

This research contributes to the existing research in several ways. First, through the assumed existence of a CE trap, that, second, creates an urge to scale up; although there is a lot of research on how CE initiatives can thrive and develop, it is only seldom linked to scaling up. Furthermore, the operationalization of autonomy and community and the exploration of how they relate to upscaling has not been investigated previously. Finally, the empirical case studies contribute to the still meagre body of research of Swedish CE.

## Methods

The study and comparison of a small number of cases is suitable for developing theories and exploring causal mechanisms, since it allows for analysis of complex causality, including several variables, which statistical tests on many cases seldom do [50, p. 18]. On the other hand, the validity of theories drawn from case studies remain lower because of lacking representability. Therefore, the ambition here is to develop a provisional theory and identify potential causal mechanisms, understood as the processes under certain conditions (independent variables) through which agents operate to generate certain effects (dependent variables) (cf. [50], p. 137).

To put it in terms of variables, the research is designed to see if and how, in the selected cases, upscaling (dependent variable) is caused by autonomy and community (independent variables). The variables and causal mechanisms are identified deductively from literature, while their relative importance is discussed inductively based on the cases.

To decrease influence from omitted variables, the cases are concentrated in time and space, within the same institutional and legislative area. Any institutional bias then affects all cases similarly, which increases generalizability. Within the mentioned restrictions, we selected cases that, to our pre-understanding, represented variations on the dependent variable. In a pre-study of the webpages of initiatives, secondary literature, initial interviews, etc., two of the cases appeared as stagnant in the sense that they had not expanded their productive capacity since their initial phase, while the two other cases appeared as expansive in the sense that they had continuously

increased capacity. To select cases on the dependent variable is legitimate in case studies when the aim is to explain particular outcomes [50, p. 23].

### Size and upscaling

A simple heuristic for analysing how CE initiatives can scale up is to divide intervening factors into three main categories: internal, external, and those related to entanglement. Internal factors include availability of skills and resources [51–53], time constraints and community mobilisation [11, 29, 52], leadership qualities [53, 54], ideological commitment [51, 54, 55], and ability to develop new strategies under changing conditions [14, 17, 56]. External barriers and enablers discussed in the literature include changing market regulations [14, 15, 17, 23], political change [14, 53], and government support or lack thereof [9, 18, 29, 51, 54, 56, 57]. Increased market competition, technical development and economies of scale also affects CE operations [11, 14, 51, 55]. The third category regards entanglement [34] or interaction [54] and bridges the internal/external division. Here, the level of cooperation and integration with or influence over external actors (such as intermediaries, competitors, decisionmakers) is valued, which is related both to (internal) ability and prioritizations, and the readiness and interest of (external) actors to interact. Examples are the degree to which CE initiatives cooperate and network with partners [30, 56], their geographical rootedness [51, 55], their ability to work with social movements [31], and the pros and cons of entering direct partnerships and joint operations [29, 30, 56].

In this study, we are primarily interested in this dimension of entanglement, which is simultaneously a result of strategic choices (internal factors) and the receptivity of the surroundings (external factors). We identify two broad variables related to the level of entanglement—autonomy and community—which capture many of the factors claimed to influence the upscaling possibilities of CE initiatives described.

In their mapping of Swedish CE initiatives, Magnusson and Palm [10], regarded those with one turbine and 200–300 members as small, while the three largest have several turbines and 760–4000 members. In between, we have medium-sized initiatives. More than sheer size, we are interested in the expressed ambitions to scale up; whether the cooperative has the will and ability to grow, whether it plans to remain in roughly the same size, or to dissolve after its current turbine or turbines is/are dismantled. The cooperatives included in the case study will thus be divided into small, medium, or large-sized, but also into growth-oriented, steady state-oriented, and temporary. Note, however, that size and growth orientation are characteristics, while actual upscaling—e.g., an increase in productive capacity—is the dependent variable.

### Autonomy

Ownership and the involvement in control, management, and decision-making are discussed in the CE literature [30, 58–65]. Cooperatives are owned by its members and are in that sense autonomous, although it is common that municipalities or private companies own shares. Ownership does not equal full independence, however. Partnerships with other organisations or companies limit autonomy, and dependencies in the institutional landscape more generally are crucial for understanding the emergence and development of CEs [10, 13, 14, 36, 42, 66].

Local governments are frequently highlighted as playing an important role in the development of CEs [34, 57, 67–70]. Regions and municipalities contribute to shaping the institutional setting in which CE initiatives are embedded, for example, through land-use planning, strategies, policies and goals for the production and use of energy, and ownership of energy infrastructure and utility companies. In addition, there are numerous examples of municipalities taking a more active role in supporting CE projects, for example, by initiating or being members of energy cooperatives [10, 57, 67, 70].

The literature also points to the risk that the municipal support creates dependency relations [70, 71]. In discussing the interaction between civil society and governments, Frantzeskaki et al. [72] highlight the difficulties for many initiatives in balancing between independence from and involvement with governments, as well as the tensions that might arise as these initiatives are looking to scale up and face the dilemma of adapting to dominant institutional logics or risk being left without governmental support. To some extent, an energy cooperative and a municipal energy utility are competitors. Therefore, a certain degree of autonomy for CE groups is emphasised by Wade et al. [73], who mean that "the method of engagement needs to be owned and co-developed by the community organisations".

From the literature, we deduce two counter directed causal mechanisms that link autonomy and upscaling. On one hand, autonomy could support scaling up, since it increases the formal ability of CE initiatives to make *independent decisions* according to their will, including decisions on upscaling (positive impact). On the other hand, there is a risk that real, material abilities to scale up are impeded by the same autonomy because of a *lack of resourceful close allies*, such as municipalities (negative impact).

All four wind cooperatives included in this study have collaborations with municipal energy companies, which

sell electricity, since 1996 on an open market, but often also supply electricity and sometimes own the local grid. Because of the influence of these collaborations, we suggest that they constitute the most important determinant for the cooperative's level of autonomy. To analyse the empirical material and enable a conceptualisation of the collaboration structures between the cooperatives and the utilities, we use an analytical framework built on typologies of governance modes [74–79]. The framework (see Table 1) distinguishes between three modes of collaboration: governing by provision, co-production, and self-governance.

In the first mode, the municipal company initiates the CE and governs it by provision, providing citizens with the support and resources needed to form and run a cooperative. Bulkeley and Kern [74] describe governing by provision as "the shaping of practice through the delivery of particular forms of service and resource". In this case, it includes services and resources such as acting as an intermediary towards the municipal government to secure financial investments, land access, and environmental and planning permits, navigating local opposition, managing construction and grid connection, and administrating distribution and sales of electricity. This mode of governance places the cooperatives in a relation of dependency on the company, as their opportunity to become engaged is conditional on the company's will to initiate and facilitate a cooperative.

In the co-production mode, energy cooperatives and municipal companies collaborate on relatively equal terms. Here, the municipal companies take the role of enabler, described by Bulkeley and Kern [74] as "the role of local government in facilitating, coordinating and encouraging action through partnership with private- and voluntary sector agencies, and to various forms of community engagement". Thus, the municipal companies enable the cooperatives by supporting them with, e.g., grid connection, general administration, energy market advice, and technical maintenance. In return, the cooperatives provide the companies with a steady and long-term customer base and the legitimacy and credibility of supporting CEs. The relationship is one of co-dependency and mutual benefits.

In the self-governance mode, the energy cooperatives are largely autonomous vis-à-vis the companies; they self-organise in networks capable of governing through private efforts and investments and thus resist government interference [76, 77]. Here, the cooperatives are initiated by the members themselves, and they are frequently the sole owner of the wind turbines. The role of municipal companies is reduced to that of an administrator, supporting the cooperatives with day-to-day administrative tasks related to, for example, sales and customer support. However, as this mode also means that the cooperatives lack the companies' support in various ways, it places higher demands on the cooperatives' internal capacities and resources, which potentially makes them more vulnerable.

### Community

Community is an important yet disputed concept in the CE literature. It is commonly mapped against Walker and Devine–Wright's two dimensions: first, "a process dimension concerned with who the project is developed and run by", and second, "an outcome dimension concerned with how the outcomes of a project are spatially and socially distributed", with the 'ideal' form of community energy being one "that is both by and for local people" [32]. Hicks and Ison [37] differentiate between these various forms of CE based on contextual and motivational factors, resulting in assessments of CE as either "strong" or "weak". Stronger forms are informed by normative and social motivations over individual economic gain, produce local benefits, such as community ownership and income, empowerment, and education, are scaled to local energy demand, and have little participation from business, government, or people elsewhere [37].

Many authors emphasise the importance of place-based communities as a shared identity and that sense of belonging to a particular place can motivate collective action [80, 81], while others stress that place and community are not the same thing. Seyfang et al. [33] regard community as either "of place or interest", while Becker and Kunze [82] propose another ideal type of CE projects based on the variables of collective ownership and

**Table 1** Levels of autonomy. Analytical framework for conceptualising the collaboration between energy cooperatives (EC) and municipal companies (MC)

| Mode of governance | Role of municipal company | Relationship between EC and MC | Implications for cooperative |
|---|---|---|---|
| Governing by provision | Initiator | Dependency | Dependent on MC for support and resources |
| Co-production | Enabler | Co-dependency | Co-governance, mutual benefits |
| Self-governance | Administrator | Autonomy | Free to choose partner, higher demands on internal capacities and resources |

political aspiration. The complexity of the meaning of community in relation to CE is also confirmed by empirics, as there are numerous examples of CE projects with members and infrastructure spread out across areas [10, 83] or based online [84].

Again, we identify two counter directed causal mechanisms. On the positive side, a strong community base could facilitate CE scaling up, since it provides the initiatives with *legitimacy*, *motivation*, and *resources*. On the negative side, strong community could dampen CE expansion if it is regarded as a *threat to other community values*, such as over dimensioning compared to local needs. Economic gain could also be a motivating force yet is associated with weak community. While the positive mechanism should apply both to communities of place and of interest, the negative should be more emphasised for place-based communities.

Crucial factors are covered if we identify two varieties of the community concept. We differ between community as a socio-spatial property related to local identities and local production, and community as an environmental–political property referring to common "political aspirations" [82] or "interests" [33] which are decoupled from geographical place but were local side effects of operation are alleviated or compensated. Both varieties are described in their strong form in Table 2. Since there are two criteria for each category, mixed results are possible.

Strong socio-spatial community draws on a localist identity formation, where 'community' is regarded as related to place and, community benefits is more emphasised than the tangible economic interests of the members. It also draws on the spatial concentration/dispersal of members and of the vicinity/remoteness of the wind turbines from the community of members. Strong environmental–political community draws on the political identity formation—the degree to which the cooperative and its members is motivated by environmental concern over personal gain. Although not localist, it should be considerate of local side effects and have strategies for compensating or mitigating them. It should be noted that the two types of community partly overlap, since localism is also political, not the least within certain green discourses. To clarify, the environmental–political communities intended here advocate supralocal strategies for tackling environmental problems, such as climate change.

**Table 2** Socio-spatial and environmental–political community

| Socio-spatial community | Environmental–political community |
|---|---|
| Localist identities over economic gain | Political identity over economic gain |
| Spatial concentration of members and closeness of members and turbines | Measures for compensating or mitigating local side effects of operations |

### Case studies

The case study draws on both primary and secondary sources. To gain insights into the collaboration structures between the energy cooperatives and the municipal companies, qualitative interviews were conducted with representatives from each of the cooperatives and municipal energy companies in the study, as well as with three independent experts. The interviews were conducted online using Zoom between November 2021 and April 2022 (see further Appendix 1). The interviews were transcribed, coded and analysed, and the data from the interviews were complemented and triangulated with data from documents and other written source, such as relevant legislation and policy documents on national and EU level; governmental reports and investigations; governmental ownership directives for the municipal companies; the cooperatives' organisational by-laws; and information from the cooperatives and companies' websites.

Three of the cases are geographically based on or close to the west coast of Sweden, while Sveriges Vindkraftskooperativ ekonomisk förening (SVEF) is collaborating with the municipal company Gislaved Energi located in the southwest of Sweden and have wind turbines and members dispersed across the country. The Lysekil case consists of three closely cooperating associations that were all dissolved in 2020 (after our initial selection), the others are still active. The cases are presented in Table 3.

The four cases were selected because of (a) their preassessed variation on the dependent variable, and (b) their geographical proximity, which decrease the risk for bias caused by external omitted variables. Four cases were deemed suitable for a study with the ambition to explore the cases in depth and detail for developing provisional theories. More cases would have necessitated a larger geographical spread.

Varberg is a coastal municipality 70 km south of Gothenburg. In connection with the establishment of three wind turbines in Värö in 1998, the municipally owned Varberg Energi took the initiative to found an energy cooperative that could buy shares in one of the turbines. The cooperative, Varbergsvind, was set up as an economic association and transferred to its members. The cooperative would later expand, as Varberg Energi invited them to buy parts of the Munkagård wind farm in 2006 and the Gummararåsen wind farm in 2010. Today, Varbergsvind owns one turbine in the Munkagård wind farm and 50% of a turbine in the Gummaråsen wind farm.

**Table 3** Overview of cases

| EC | MC | Founding year of EC | Initiator of EC | Members, ca | Number, capacity of WT | Location of WT | Spatial concentration of members |
|---|---|---|---|---|---|---|---|
| Varbergs-vind | Varberg Energi | 1998 | MC | 530 | 1.5 à 2000 kW | Varberg | Varberg |
| Västan-vind | Göteborg Energi | 2010 | MC | 670 | 1 à 2300 kW | Dals-Ed | Gothenburg |
| Lys-Vind, Si-Vind, Sivik III[a] | LEVA i Lysekil | 1995; 2000 | EC | 500 (in total) | 4 à 490–750 kW | Lysekil | Lysekil |
| Sveriges Vind-krafts-kooperativ ekonomisk förening (SVEF) | Gislaved Energi | 1998 | EC | 1950 | 10 à 800–2000 kW | Ulricehamn, Kungsbacka, Simrishamn, Övertorneå, Gotland, Sölvesborg, Berg, and Aneby | – |

*EC* energy cooperative, *MC* municipal company, *WT* wind turbine(s)

[a] These three cooperatives were initiated and managed by the same founder

By the end of 2020, the cooperative had 467 members owning a total of 6050 shares. A share gives the owner a right to buy 1000 kWh/year for a fixed price, decided by the board. In addition to citizens, the cooperative also has local companies and tenant owner associations as members.

Västanvind ekonomisk förening was established in 2011. A wind farm of 21 turbines was planned in Töftedalsfjället, Dals-Ed, 120 km north of Gothenburg. A private company invested in 10 turbines, the municipally owned company Göteborg Energi in another 10, and Göteborg Energi set up Västanvind that became the owner of the 21st. The Västanvind cooperative has a total of 42,000 shares divided among circa 650 members. Each share gives the owner the right to buy 100 kWh of electricity per year at a pre-set price. Around two-thirds of the electricity produced by the cooperative is sold to members, and one-third is sold on the open market to build capital for future investments and to secure the long-term value of the shares. Two of the total seven board members are representatives of Göteborg Energi.

In Lysekil, 70 km north of Gothenburg, four wind turbines were established in 1995 and 2000, three of which owned by the energy cooperatives Lys-Vind, Si-Vind, and Sivik III, and the fourth by a limited company called Vindinvest i Lysekil AB. All four were initiated and managed by the same person, who also acted as chairman of the board of the three cooperatives. All four companies were discontinued in 2020. As the municipality owned the land, where the turbines are located, on the town's dump, it bought shares in the cooperatives corresponding to the cost of the lease. The three cooperatives worked closely together and are here treated commonly. Together, they had between 400 and 500 members and each member owned on average 8–10 shares corresponding to 1000 kW. In contrast to the Varbergsvind and Västanvind cooperatives, the shares did not permit the purchase of a certain amount of kWh at a fixed price. Instead, the electricity was sold on the market, and the income minus operating and maintenance costs was distributed to the members as dividends.

Sveriges Vindkraftkooperativ Ekonomisk Förening (SVEF) was founded in 1998 as an economic association on the initiative by a group of people working within the wind power sector. In 2000, the cooperative bought its first production facility, a turbine located in a wind farm in Falkenberg, 95 km south of Gothenburg, and it cooperated with the municipally owned Falkenberg Energi for many years until it changed to Gislaved Energi in 2015. SVEF never aimed to be a local actor in Falkenberg but attracted members from all over Sweden and has also expanded their production beyond Falkenberg. By either buying parts of or building its own wind turbines in collaboration with various partners, the cooperative owns 11 turbines across Sweden, and a solar park inaugurated in 2021. In May 2022, SVEF had 1950 members. A share gives the member the right to buy 100 kWh of electricity per year at a fixed price.

## Results

In the following, the variables are related to the empirical data collected. After reporting the size and growth of the four cases, their levels of autonomy and community (socio-spatial and environmental–political) will be assessed.

### Size and upscaling

Three out of four cases are medium-sized, while SVEF stands out as one of Sweden's largest energy cooperatives. Varbergsvind and Västanvind are regarded as foremostly steady state oriented. After an initial growth period, Varbergsvind is now in a stalemate. Future expansion

is discussed, but the predominant position is to invest in financial assets with the aim to secure resources for both maintenances, the eventual dismantling of current turbines and for investing in new turbines of roughly the same capacity as the current. Västanvind's production has not grown since its inception in 2011, although it has more members now, since Göteborg Energi continuously has sold its shares to new owners. Since the winter of 2021–22, all shares are sold and thereby, the net influx of new members has stopped. One-third of the production is sold on the market, and the surplus is invested in financial assets with the long-term aim of being able to substitute the current wind turbine once it is retired, around 2035. Depending on how their own capital grows and how the industry evolves—they expect that a new turbine in 2035 will be both bigger and more expensive than the current one—they plan to either build a new turbine of their own or partner up with another actor and build it together. As for Varbergsvind, the strategy is to re-invest on a similar scale.

The Lysekil cooperatives were pioneers and expanded fast during the first years. The ambition was to build even more turbines, but they did not get the permissions needed by local authorities even after several attempts. The reasons why their applications were denied is not clear. The older turbines became unprofitable in the late 2010s because of increasing maintenance costs, but also due to low electricity prices. When a buyer reached out, they decided to sell all four turbines, and the cooperatives were discontinued in 2020. Thus, even though the cooperatives were in the end temporary, their ambition was growth-oriented; they expanded fast but were stopped after external drawbacks. Focusing on their initial phase we regard the Lysekil cooperatives as cases of upscaling, but we also bear in mind to the final analysis that the expansion was later halted.

SVEF has grown steadily since its founding, both in terms of membership and production capacity. The statute says that the association "should not limit the number of members" but work to allow all who want to become full members. It aims to "build up a capital that secures the running, maintenance and dismantling" of their wind turbines, as well as to ensure a continuous update and enlargement of their installations [85]. SVEF has an active management strategy, where old turbines are sold, and new investments are made continuously. The operation is not exclusively targeted at energy production. SVEF is now "dreaming" of "40-foot containers filled with hydrolysers, fuel cells and batteries", so that they can take part in the new markets for energy balancing (Interview, Nov 29, 2021). SVEF's ambition is clearly not only to survive but to adapt, grow and thrive in a changing world. "We simply want to build as much as possible", our respondent said (Ibid.).

#### Autonomy

Varbergsvind and Västanvind were both initiated by municipal energy companies and have retained close collaborations with them. Their turbines are administered by the municipal company, who also act as the balance responsibility party for the production and take care of most of the administrative and financial tasks of the cooperatives. The members of the cooperatives are obliged to be customers of the respective energy company. These collaborations were initially in the first mode of the analytical framework, governing by provision. For Varbergsvind, the support of Varberg Energi took the shape of start-up measures such as taking the financial risks of investments, securing permits, navigating possible opposition from the local community, managing construction, connecting to the grid, and ongoing operations related to the distribution and sales of electricity, including balance responsibility. With time, however, this dependent relation has moved towards a mode of co-production, as the cooperative has grown more independent, and the company is less involved. There are even tendencies in the collaboration structure pointing to a shift towards self-governance. Varbergsvind has expressed an interest in partnering with other actors than Varberg Energi for a future reinvestment, which suggests that the cooperative is not dependent on Varberg Energi for its future development, pointing to a higher degree of autonomy and self-governance.

The collaboration structure between Västanvind and Göteborg Energi follows a similar path. Initiated by the company, their collaboration started in a governing by provision mode, where the company provided members with the support and resources needed to form and run the cooperative. Still, as the initiative's success depended on citizens willing to get engaged and invest in shares, there were elements of co-dependency. With time, the collaboration moved towards a mode of co-production. Göteborg Energi has a greater engagement in the cooperative's development than Varberg Energi, and the relation is, therefore, closer to a relation of co-dependency and mutual interest in the cooperative's success. This commitment entails less autonomy for the cooperative, yet, as it recognises the need for an energy company partner "to have your back" and perceives the relationship as one of transparency and trust, this is not necessarily something that the cooperative is striving for (Interview, Nov 16, 2021).

The Lysekil cooperatives had more limited collaboration with the local municipal energy company. As they had chosen a model, where members received the

proceeds from the electricity production as dividends and their members were thus free to choose any electricity supplier they wanted, the cooperatives only contracted the municipal energy company, LEVA i Lysekil, to manage grid connection and transformer stations. In contrast to Varbergsvind and Västanvind, the Lysekil cooperatives handled everything from applying for building and environmental permits and the construction of the turbines to ongoing financial and member administration. For technical operations and maintenance of the turbines, the cooperatives had a service deal with a wind turbine company, but minor repair work was done by the founder. He did not see any disadvantages with their relative independence from company partners. The local energy company too had a positive view of the cooperatives and was keen on finding ways to help them within their limited collaboration structure. While this model entails little administration and cost for the energy company, it also presents fewer incentives for it to support the cooperative as they do not benefit from an increased customer base or sales of complementary electricity. The collaboration structure was clearly in a mode of self-governance. The cooperatives demonstrate a high degree of autonomy in relation to the company, which had the role of an administrator rather than enabler or initiator.

The Lysekil cooperatives had the capabilities and engagement needed to emerge, develop, and survive for more than two decades. The independence from company partners and strong engagement from the members were also in line with the cooperative's ideological core and "do it yourself" spirit. Yet, less support from the municipality might have made them more vulnerable. While the founder mentioned low electricity prices, high service costs, and the challenge of finding people willing to engage as board members as contributing factors to the decision to sell the turbines, the determining factor was the rejected building permits. He suggested that the decision to deny the permits was politically driven and influenced by a general negative debate on wind power:

> *We never really got any clarifications from the municipality. From the political side, they claimed to want to build housing in this area, but it is impossible to build there [...] I think it came down to the political view, that they saw this with nuclear power as prevailing (Interview, Nov 12, 2021).*

When the new owners applied for a permit to replace some parts of the turbines and upgrade them from 500 to 660 kW, the application was approved, which the founder commented by stating that "it is always hard to be a prophet in your own municipality" (Ibid.).

Until 2014, SVEF collaborated with Falkenberg Energi who acted as a balance responsibility partner, provided administrative services, and contributed to developing the cooperative's business model [86]. Over time, SVEF experienced that the company's interest in the cooperative dwindled and decided to find a new partner, eventually teaming up with Gislaved Energi. Today, Gislaved Energi supports the cooperative with administrative and customer support services, such as helping members transfer shares, handling contracts and invoicing, and managing balance responsibility through a third party. Members of SVEF must be customers of Gislaved Energi and buy any additional electricity not covered by their shares from it. Both SVEF and Gislaved Energi expressed that they are satisfied with the collaboration. Yet, the SVEF representative also made clear that they "do not belong" to an energy company but were free to leave Gislaved Energi should they wish so (Interview, Nov 29, 2021).

The fact that SVEF managed to change partner points to a high degree of self-governance. This places the collaboration structure between SVEF and Gislaved Energi in the third mode of the analytical framework, where the company takes the role of administrator. While SVEF is dependent on an energy company partner, they are not dependent on Gislaved Energi per se. Similarly, while the collaboration with SVEF provides Gislaved Energi with a larger customer base and the credibility of supporting citizen participation in electricity production, the company does not have any historical or personal ties to the cooperative and is only obliged to keep up the cooperation if they find it valuable. SVEF is not dependent on the company for expanding their production but manages everything from applying for permits to handling construction and grid access on their own or with other partners. This weakens the co-dependency characterising the co-production mode, giving their collaboration a more business-like and professional character compared to the Varbergsvind and Västanvind cases.

#### Socio-spatial community

The membership and the operations of Varbergsvind and the Lysekil cooperatives are concentrated in one municipality. The wind turbines are located within the municipal borders, and while the cooperatives are open to members from all Sweden, most of them either live in or have a connection to the town. It should be considered, though, that the wind farms in Varberg are situated 12–15 km from the city, so the town dwellers that own shares in Varbergsvind are not affected by them in their daily lives. The Lysekil turbines were closer to the town but placed in the city dump, where no one lives. Both initiatives also have at least semi-strong localist identities. While both cooperatives found it increasingly difficult

to recruit board members, their annual meetings have attracted quite many members, 50–60 in the case of Varbergsvind. We know of no examples of the cooperatives financing common, local causes, but the respondent in Lysekil stated that they as far as possible engaged local suppliers, which he believes strengthened their connectedness to the town (Interview, Nov 12, 2021).

Västanvind's turbine in Dals-Ed is far from Gothenburg, where most members live, and the cooperative has no collaboration with Dals-Ed municipality. The connectedness between the cooperative and the actual place of operation is, therefore, weak. Both Västanvind and Varbergsvind have had the ambition of recruiting members close to the places of production. The statues of Västanvind says that it shall act to attract "people living close to the turbines as well as municipalities and local businesses" to become members. It does not keep track of how many members that live close to the wind farm, but it is supposedly a small number (Interview, Nov 16, 2021). During the establishment of the Gummaråsen wind farm, shares in Varbergsvind were offered to neighbours. According to its representatives, this way of increasing social acceptance was successful. "In the end, I believe that those who resisted the wind farm [in Gummaråsen] are today members of Varbergsvind", our respondents claimed (Interview, Nov 22, 2021).

SVEF has no spatial connection at all between places of operation and membership concentration—both are dispersed across Sweden. This might be a drawback in terms of anchoring and gaining acceptance for their production, yet SVEF is not unconcerned by local opinions. It has lobbied for "wind rights"—a lease paid to everyone within an area defined as 5 times the diameter of the rotor blades. In a recent contract, landowners within the '40 decibel area' were automatically compensated, "whether they liked it or not" (Interview, Nov 29, 2021). This policy is not always accepted by other actors, who are only interested in compensating the landowner, where the turbine is standing. The SVEF respondent commented: "You can do that if you sit in Stockholm and don't need to talk to people out in the countryside. All we want is people to say hello to each other" (Ibid.).

#### Environmental–political community

Regarding community of interest, the answers from all initiatives are varieties of the same tune: the members are environmentally concerned, but also interested in an economic gain. The statues of Västanvind, for example, says that the cooperative should "promote the members' economic interest … as well as contribute to a sustainable society". Most of their members are Gothenburg dwellers living in apartments, with small energy bills and primarily motivated by environmental concerns. However, the sense of community is rather weak, with low rates of attendance in the meetings organised by the board.

While the first cooperative founded in Lysekil in the mid-1990s attracted mostly local wind power "enthusiasts" interested in "producing their own green energy", the second and especially third cooperative drew relatively more members for economic reasons and more members from outside of Lysekil (Interview, Nov 12, 2021). While the original membership was diluted with members who were more interested in economic gains, the initiator is clear that at least for him, the environmental aspects came first. "That was the primary aim. To produce green, clean energy. … Then, secondary, it was also a good economic investment for those who joined" (Ibid.).

SVEF is the most politicised of our four cases. It was started by people interested in renewable energy and has an informal relation to Sweden's green party. There are also indications that SVEF hosts a kind of 'alternative' culture. One example is that our respondent believes that none of their members would buy electricity from 'the monopolists' (exemplified with Eon, Fortum and Vattenfall), and this was an important reason for why SVEF chose to cooperate with a small, municipal company (Interview, Nov 29, 2021). The aim expressed in the statute's balances private economic gain with the promotion of renewable energy, but it also aims to promote the "environmental interest" as well as the "conservation of electricity" of their members. According to our respondent, the members of SVEF have traditionally been rather 'ideological', but because of the increasing electricity prices during 2021 they have also got members that "we normally wouldn't attract, and we are very happy about that too" (Interview, Nov 29, 2021).

## Discussion

How the ability to scale up CWEs is related to their autonomy and community in our four cases are summarised in Table 4. Treating upscaling as the dependent variable, we primarily consider SVEF, and second the Lysekil cooperatives. What stands out as common for them are high levels of autonomy and of environmental–political motivation.

Both SVEF and the Lysekil cooperatives are self-governing and highly autonomous. As opposed to Varbergsvind and Västanvind, they are not dependent on the investment decisions of their partners but have the competence and capital to decide on and carry through investments on their own. The less autonomous cooperatives in this study only expanded when invited to new projects by their municipal partners, as for Varbergsvind during the first years. Once those invitations ended, so did their growth. Autonomy thus seems to be important for initiatives that want to keep expanding.

**Table 4** Summary of results

| | Varbergsvind | Västanvind | Lysekil coop's | SVEF |
|---|---|---|---|---|
| Upscaling |  |  |  |  |
| Autonomy |  |  |  |  |
| Socio-spatial community |  |  |  |  |
| Environm.-political community |  |  |  |  |

The dots signify weak (red), medium (yellow) or strong (green) modes of respective variables

Autonomy does not alone spur motivation for expansion, however. Motivation can be economic gain, as for private companies, but for CE initiatives socio-spatial and/or environmental–political concerns are likely as strong or dominating motives. In this study, environmental–political community is more closely related to upscaling than socio-spatial community. While the latter varies unrelated to upscaling, the environmental–political community covaries with it: it is assessed as stronger for the more growth-prone Lysekil and SVEF cooperatives. SVEF is simultaneously the most politicised and the least localised cooperative. The strong socio-spatial community in Varbergsvind has not led to further expansion.

Of the causal mechanisms relating autonomy and upscaling, our case study indicates that the positive impact is stronger than the negative: the formal ability to make independent decisions, granted by autonomy, outweighed the risk of lacking resourceful partners. Partnerships can certainly lead to growth, as it did during Varbergsvind's initial years, but once the partner stopped invite to further projects, expansion came to a halt.

The positive mechanism relating strong community to upscaling—that it provides CE initiatives with motivation, support, and resources to grow—was more emphasised in communities of strong environmental–political interest, than in strong socio-spatial communities. The most politicised initiatives were the most growth prone. We have seen no clear examples of the negative impact mechanism, that growth was hindered by place-related conflicts.

## Conclusions

Even when upscaling is the will and ambition of a CE initiative, neither autonomy nor community alone is a guarantee for it to happen—yet in combination, we hypothesise, the likelihood increases: with autonomy as a prerequisite for action, and community as a motivation for action. Both of the two types of community discussed can act as a motivational force and mobilise resources. Yet local rootedness can be difficult to combine with upscaling beyond a certain point. As mentioned, other local interests can collide with expansionary plans. It will, further, simply be increasingly difficult to find enough local resources, including suitable sites for windmills, within a limited geographical setting. Since the technology and business logic of wind energy has scaled up, it is becoming less compatible with localism.

A community of interest, on the other hand, has no physical barriers. An environmental–political community is not bound to operate its turbines within geographical limits and can also draw members and other resources from wider areas. It is, therefore, more compatible with upscaling. At the same time, it can generate as strong motivational emotions, perhaps even stronger, than communities of place.

On the other hand, attachment to place contributes to legitimization of wind turbines and might dampen local protests and has been considered one of its major advantages. Detachment from place is, therefore, likely to make CE initiatives more vulnerable to local opinions. Yet, also the interest-based initiatives in our study seem to have been more considerate than commercial operators, so the problem need not to be overwhelming.

An alternative to both senses of strong community is an emphasis on the private economic gains of community energy, e.g., weak community. Judging from our cases, private gain can strengthen CE initiatives. Our respondents point to the importance of both environmental and economic motivations, and also members that are mainly economically motivated are welcomed, since they contribute to the pool of resources needed. Yet for the cooperatives to function also requires personal, voluntary or

semi-voluntary engagement, which in turn requires non-economic motivation.

On a final note, if regulators are keen on keeping or expanding CE and counteract the "trap" outlined in the introduction, our research suggests that they need to intervene and support these initiatives. If autonomy is more closely correlated with upscaling than dependence or co-production but at the same time increases vulnerability, ways of supporting cooperatives with, e.g., legal and financial counselling without entering strong partnerships could be initiated on municipal, regional, or state level.

## Appendix 1: list of interviewees

| Role of interviewee | Respondent of informant interview | Interviewer | Date of interview |
|---|---|---|---|
| Founder of the Lys-Vind, Si-Vind, Sivik III cooperatives | Respondent | Warlenius | 12 Nov 2021 |
| Board member of VästanVind | Respondent | Warlenius | 16 Nov 2021 |
| Board member of SVEF | Respondent | Warlenius | 29 Nov 2021 |
| Representatives of Varbergsvind | Respondent | Warlenius | 22 Nov 2021 |
| Representative of LEVA i Lysekil | Respondent | Nettelbladt | 23 Feb 2022 |
| Representative of Varberg Energi | Respondent | Nettelbladt | 24 Feb 2022 |
| Representative of Göteborg Energi | Respondent | Nettelbladt | 28 Feb 2022 |
| Representative of Gislaved Energi | Respondent | Nettelbladt | 7 Mar 2022 |
| Independent expert, representative of wind energy interest organisation | Informant | Nettelbladt | 15 Mar 2022 |
| Independent expert, employee of public body and member of a wind power cooperative | Informant | Nettelbladt | 15 Mar 2022 |
| Independent expert, representative of solar energy interest organisation and chairman of the board of a wind power cooperative | Informant | Nettelbladt | 22 Mar 2022 |
| Founder of the Lys-Vind, Si-Vind, Sivik III cooperatives | Respondent, complementary interview | Nettelbladt | 7 Apr 2022 |

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**Author contributions**
RHW collected the data on the cooperatives and analysed the "community" category, while SN collected the data on energy companies and analysed the "autonomy" category. Both contributed equally to the writing of the manuscript and approved the final version.

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**Availability of data and materials**
Not applicable.

## Declarations

**Ethics approval and consent to participate**
This study was approved by The Swedish Ethical Review Authority (ref. 2020-03469).

**Consent for publication**
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**Competing interests**
The authors declare that they have no competing interests.

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