Plant the Seeds, then Tend the Garden: How to Incentivize and Coordinate Energy Communities

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Abstract

Energy communities are expected to deliver a variety of benefits, such as increased uptake of renewable energy, flexibility for overall system or grid optimization, and improved system resilience. Mechanisms to incentivize energy communities and align them with the overall system needs often include direct support schemes, agreements for grid use and connection, decentralized access to markets for flexibility and residual generation, and other administrative requirements. Initially, the focus both in policymaking and research has rightfully been on the enabling factors within the regulatory framework. As energy communities slowly but steadily gain traction across Europe, this focus is expected to shift more toward the coordinating power of the framework. Our article discusses qualitatively which (combinations of) mechanisms are more suitable, depending on the actors involved, the technologies adopted, and the policy objectives to further.

1. Introduction

With the "Clean Energy for all Europeans" package (European Commission and Directorate-General for Energy 2019), the European Commission introduced energy communities to strengthen the active role of consumers in the energy system. Legally, energy communities are of two types. One of the activities they are expected to perform is energy sharing.[1] Following the taxonomy of Rossetto, Verde, and Bauwens (2022), in the context of this article, we want to shed light on Energy Sharing Communities (ESCs), that is, virtual communities with distributed generation and storage assets that can produce, use, store, and sell electricity or energy using the public grid and therefore not only limiting themselves to behind-the-meter applications. Their geographical scope can reach from local to regional.

Energy communities are often "internally oriented", that is, they exist for the benefit of their members, be it economic or social (Vogler and Kump 2023). However, since they also interact with the "external" world of the wider electricity and energy system and are oftentimes incentivized using economic instruments, in this article, we discuss how those incentives can be used to coordinate energy sharing communities to align them with the goals for the system at large.

2. Policy and Objectives

In its proposal for the improvement of the EU's electricity market design, the European Commission (2023) states several technical and social objectives for energy communities. Some of them are quantifiable and others rather qualitative. The social goals are an increased acceptance of renewable energy and the energy transition and the democratization of the transition through a better inclusion also of less affluent and vulnerable customers. In this article, we focus on the more technical goals: (1) Energy communities primarily support the uptake of **renewable energy production** by making use of, for example, private rooftop areas for solar PV; (2) in addition, they can provide the needed **flexibility to the overall system** for the inclusion of fluctuating renewables; and (3) they can contribute to **system resilience** through the uptake of a more decentralized system.[2] While (1) is the initial goal requiring incentives that enable the community in the first place, (2) and (3) are complementary goals that require incentives that coordinate the communities.

Energy communities can be categorized using different characteristics. Rossetto, Verde, and Bauwens (2022) develop a general taxonomy of energy communities. Schwidtal et al. (2023) provide a theoretical overview of the possible business models for the different actors in a community, while Kubil and Puranik (2023) have reviewed 90 real-life energy communities and their business models.

Building on those reviews, we can distinguish the following three characteristics. Firstly, the **communities' assets** can include non-dispatchable (solar PV, wind) or dispatchable (biogas, hydro) generation, storage units (batteries, heat storage), and dispatchable demand (heat pumps, electric vehicles). Secondly, the **type of actors** involved in the community, ranging from small individual actors to large commercial ones, can characterize it. Those can be asset owners like prosumers, pure generators, or flexible consumers. Still, they can also include purely passive consumers as well as facilitators of the community like aggregators, market/platform operators, or suppliers of other services. Lastly, and building on the composition of the energy sharing community, different internal **economic objectives** can arise, leading to several possible business models for the community:

— *Reducing the cost of energy supply within the community*
An energy community that establishes cheap local production and employs local flexibilities to maximize the local usage of the community production, will be viable mostly via revenues from internal sales and services.

- *Marketing excess generation outside the community*
  Energy communities that find lucrative options to market local production outside the community can subsidize their local supply via revenue from bilateral sales or trading on energy markets.
- *Marketing flexibility outside the community*
  Energy communities that find lucrative options to leverage their flexibility outside the community can subsidize their local supply via revenue for example from balancing and redispatch markets and from other flexibility mechanisms.

Other occasionally relevant characteristics include the size and geographic scope, which can differ between close proximity via a common (distribution) grid level up to a larger region – or even no specific scope can be applied.

3. Discussion of coordination mechanisms

Energy communities develop and operate within the larger energy system and its regulatory framework. Many aspects of this framework affect which types of energy communities can flourish and how they align with the system at large. Importantly, this is irrespective of whether these regulatory aspects are intentionally designed with energy communities in mind or simply historically continued. Based on currently existing frameworks in Europe (Energy Communities Repository 2024b) and the experience with mechanisms applied to renewable energy generators, energy efficiency and demand response, we assess in the following what mechanisms are suitable to align the overall policy targets with the objectives of different types of energy communities.

The selection of mechanisms for this assessment is by no means exhaustive; the analysis focusses on those mechanisms that can coordinate energy communities with the overall energy system in a tangible and potentially quantifiably manner. By and large this includes (1) direct support schemes, (2) agreements for grid use and connections, (3) market access rules, (4) agreements for the use of smart meters and the related data and services, and lastly (5) administrative requirements to qualify as an energy community and benefit from dedicated agreements and support schemes.

Table 1 sums up the main features of the mechanisms which are discussed in more detail.

Direct support schemes include mechanisms such as grants for initial investments, as well as special tenders and production premiums for energy generation in energy communities. Ireland and Denmark, for example, offer direct investment support for renewable energy communities; Lithuania awards a bonus to communities when participating in public tenders for RES support (Energy Communities Repository 2024a). These mechanisms typically address the asset owners within a community, particularly renewable energy generators but potentially also flexible assets such as batteries, electric vehicles, and heat pumps. Italy for example implemented a per kWh extra-remuneration for locally shared renewable generation (Energy Communities Repository 2024c). From the internal perspective of the community, these mechanisms serve mostly to reduce the cost of energy supply within the community. In so far as investments in excess generation or flexible assets are supported, they can also facilitate revenues from excess generation and from flexibility services outside the community. From a policy or overall system perspective, direct support schemes mostly foster the target of increasing the uptake of renewable energy generation, yet by raising the level of local and distributed generation they also contribute to improved system resilience. Insofar as flexible assets are included, support schemes can also lay the foundation for energy communities to provide flexibility to the overall system or to the grid if this is incentivized by other complementary mechanisms. The Energy Community Repository[3] highlights the relevance of dedicated support schemes for energy communities. They observe that the support levels found appropriate for the average profit-oriented investment may not be sufficient for collective actors with a varied set of objectives; and that communities do not perform well in tenders where they compete with purely profit-oriented and professional actors.

Agreements for grid use and connections encompass grants for grid connection cost or priority access to limited connection capacity, as well as proximity- and time-related reductions of tariffs for withdrawal and feed-in, and collective (rather than individual) billing and metering. Several European states, such as Ireland, Greece, and Spain reserve part of their scarce grid connection capacity specifically for community projects (Energy Communities Repository 2024c). Austria offers a proximity-based reduction of use tariffs. Mechanisms linked to connection and location address primarily the owners of assets, especially generators and consumption devices requiring additional capacity. Time-varied mechanisms, on the other hand, are relevant for all dispatchable and flexible assets, so long as the tariffs are not limited to feed-in or withdrawal. From current practices for example in the Netherlands and Germany, we can see how priority access may exhibit restrictions regarding location and use times as well.[4] Unlike connection agreements, time-varied tariffs also regard facilitators such as aggregators and asset managers. Collective billing and metering even involve the passive consumers within a community. Agreements for grid use and connections often support communities in their internal goal to reduce supply cost. From the system perspective, they lay the foundation for capacity buildup of renewable generators and flexible asset. If the mechanisms involve a time-varied feature they additionally serve to coordinate these assets with the system and provide flexibility. Proximity-related tariffs on the other hand benefit system resiliency by promoting distributed capacities.

Access rules for different types of markets also set the scene for the uptake and coordination of energy communities. The relevant mechanisms include suitable prequalification for collective sellers in wholesale and balancing markets, as well as the inclusion of collective actors in redispatch markets or mechanisms.

Table 1: Assessment of coordination mechanisms.

Types of Mechanisms		Link to Policy Target Asset	Link to Types of Communities		
			Asset	**Objective**	**Actors**
Direct Support Schemes	grants for initial RES investments	renewables, resilience	generation	reduce supply cost, revenue from excess production, revenue from flexibility	asset owners
	grants for initial investments in flexible assets	flexibility, resilience	storage, flexible demand	reduce supply cost, revenue from flexibility	asset owners
	special tenders for energy generation in energy communities	renewables, (resilience)	generation	reduce supply cost, revenue from excess production	asset owners
	production premiums for energy generation in energy communities	renewables, (resilience)	generation, storage	reduce supply cost, revenue from excess production	asset owners
Agreements for Grid Use and Connections	grants for grid connection cost	renewables, (resilience)	all	all	asset owners
	priority access to limited connection capacity	renewables, (resilience)	all	all	asset owners
	proximity-related tariff reduction	renewables, flexibility, resilience	all	reduce supply cost	asset owners
	time-variable tariffs for withdrawal and feed-in	renewables, flexibility, resilience	all	reduce supply cost	facilitators
	collective billing and metering	renewables, flexibility	all	reduce supply cost	all
Market Access Rules	suitable prequalification for collective sellers in wholesale markets	renewables, resilience	generation, storage	revenue from excess production	asset owners, facilitators
	suitable prequalification for collective sellers in balancing markets	renewables, flexibility, resilience	dispatchable generation, storage, flexible demand	revenue from flexibility	asset owners, facilitators
	inclusion of collective actors in redispatch markets and mechanisms	(renewables), flexibility, resilience	dispatchable generation, storage, flexible demand	revenue from flexibility	asset owners, facilitators
Agreements for Use of Smart Meters, Data, and Services	grants for / provision of smart meters	flexibility, resilience	flexible demand	revenue from flexibility	asset owners, facilitators
	access to smart meters data for the community and for third-party aggregators	flexibility, resilience	flexible demand	revenue from flexibility	asset owners, facilitators
	balancing and forecasting responsibilities outside the community	flexibility, resilience	all	reduce supply cost	asset owners, facilitators
Administrative Requirements to Qualify as an Energy Community	requirements regarding the share of renewable energy supplied	renewables	generation	reduce supply cost	all
	requirements regarding self-consumption	flexibility	dispatchable generation, storage, flex demand	reduce supply cost	all
	limitations regarding assets size	resilience	all	reduce supply cost	asset owners
	limitations regarding geographical proximity of assets	flexibility, resilience	all	reduce supply cost	all
	exclusion of certain technologies and energy vectors	depends	depends	reduce supply cost	asset owners

It is mostly the facilitators, in the form of both aggregators and market operators, that are addressed with these aspects of the regulatory framework. To a lesser degree they can also concern the asset owners themselves; in the case of wholesale markets owners of generation assets in general, and in the case of balancing and redispatch mostly owners of dispatchable generators, flexible demand assets, and storage. Internally, for the community, these mechanisms enable revenues from excess generation as well as from flexibility provision. From a policy perspective, market rules are vital to harvesting energy communities' flexibility for the overall energy system and for grid optimization. Especially with regards to balancing and redispatch they also benefit the short- and mid-term resilience of the energy system. As market participation provides additional revenues for distributed generation, it also indirectly supports the policy target of increasing renewable generation capacity. Collective access and suitable prequalification particularly benefit small actors who otherwise individually often are not allowed to participate or face too high transaction costs.

Agreements regarding smart meters and the related data and services are a further aspect of the relevant framework for aligning energy communities with the needs of the energy system. They include grants for or the provision of smart meters, access to smart meter data for the community and third parties, and the assignment of balancing and forecasting responsibilities outside the energy community, for example with suppliers and network operators. Belgium, in the Brussels region, for example, has established a limited supplier license shielding energy communities against some of the complexities of commercial, large scale energy supply (Energy Communities Repository 2024a). These mechanisms address the facilitators within the community, for example aggregators and service providers, as well as potentially the owners of flexible assets, such as electric vehicles, heat pumps, and batteries. Smart meters enable energy communities on the one hand to reduce supply cost internally but also potentially to generate revenues from providing flexibility outside the community. Shielding communities from the complexity of electricity supply, that is, from balancing and forecasting requirements, furthermore enables them to provide flexibility without incurring unproportionally high transaction costs. From a system perspective, access to smart meters and the related data is essential for many ways in which communities contribute to system flexibility and resilience as well as for grid optimization. Importantly, smart meters unlock these benefits mostly in combination with dedicated grid tariffs and access to the relevant markets.

Lastly, we observe a number of **administrative requirements to qualify as an energy community** and thereby benefit from dedicated agreements and support schemes. These include requirements regarding the share of renewables supplied or the self-consumption within the community and the respective matching period. It also encompasses limitations regarding the capacity or the geographical proximity of assets in the community, as well as the exclusion of certain technologies or energy vectors. Spain, Austria, and Portugal for example prescribe a maximum radius or limit the activities to a subsection of the distribution grid. Matching periods for communities currently range between 15 minutes for among others Portugal, Belgium, and Austria, and up to the entire year in the case of Greece (Energy Communities Repository 2024c). The qualification as an energy community by itself has relatively little implications. The benefit from complying with these administrative requirements lies in the eligibility for other dedicated mechanisms, such as special tenders for support of collective assets or dedicated grid tariffs. Thus, these mechanisms are mostly relevant in combination with or as a specification of the mechanisms already discussed above. These mechanisms often concern primarily the asset owners and serve to reduce supply cost by unlocking support or savings potential. Thus, at least indirectly they affect all actors in the community. From a system perspective, administrative requirements can serve to finetune the mechanisms above to balance between the targets of system flexibility provision and improved system resilience, and supporting the uptake of renewable energy.

4. Conclusions

Mechanisms to incentivize energy communities are expected to deliver in at least two dimensions: enabling energy communities in the first place and coordinating them with the overall energy system. Initially, the focus both in policymaking and research has rightfully been on the enabling factors within the regulatory framework. As energy communities slowly but steadily gain traction across Europe, this focus is expected to shift more toward the coordinating power of the framework. This article qualitatively discusses which (combinations of) mechanisms are suitable to coordinate communities and their different actors and technologies with the overall energy system and with the overarching policy targets.

We focus on direct support schemes, agreements for grid use and connections, market access rules, agreements for the use of smart meters and the related data and services, and lastly administrative requirements to qualify as an energy community and benefit from dedicated agreements and support schemes.

In many respects, energy communities seem to merit a dedicated regulatory framework. This is because collective generation and flexibility provision is not necessarily well-established and coordinated by the same rules and mechanisms as individual actions. Similarly, communities delivering on a varied set of objectives do not perform well in competition for tenders with purely profit-oriented actors. Furthermore, the specific characteristics of mechanisms are critical to the alignment of an energy community with the needs of the system. Mechanisms with time-varied and proximity-related features seem particularly promising to coordinate flexibility and improve system resilience. Lastly, from a system perspective, administrative requirements can serve to finetune the reviewed mechanisms to balance between the targets of system flexibility provision and improved system resilience, and supporting the uptake of renewable energy.

This article offers a brief and qualitative overview, for further research this topic certainly merits quantitative assessment of the effects to help improve future co-ordination efforts. Another issue for further dedicated research concerns the interaction of these coordinating mechanisms with rather soft and inherently qualitative goals set at European level, such as for example inclusion of vulnerable consumers and promoting the acceptance of the energy transition.

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References

Energy Communities Repository. 2024a. "A Roadmap to Developing a Policy and Legal Framework That Enables the Development of Energy Communities." https://energy-communities-repository.ec.europa.eu/roadmap-developing-policy-and-legal-frameworks-energy-communities_en.

———. 2024b. "Barriers and Action Drivers for the Development of Energy Communities & Their Activities." https://energy-communities-repository.ec.europa.eu/report-barriers-and-action-drivers-development-energy-communities-their-activities_en.

———. 2024c. "Energy Sharing for Energy Communities - a Reference Guide." https://energy-communities-repository.ec.europa.eu/energy-sharing-energy-communities-reference-guide_en.

European Commission. 2023. "Proposal for a Regulation Amending Regulations (EU) 2019/943 and (EU) 2019/942 as Well as Directives (EU) 2018/2001 and (EU) 2019/944 to Improve the Union's Electricity Market Design." COM(2023) 148 final. Strasbourg, France.

European Commission and Directorate-General for Energy. 2019. *Clean Energy for All Europeans*. Luxembourg, Luxembourg: Publications Office of the European Union. https://doi.org/10.2833/9937.

Kubli, Merla, and Sanket Puranik. 2023. "A Typology of Business Models for Energy Communities: Current and Emerging Design Options." *Renewable and Sustainable Energy Reviews* 176 (April): 113165. https://doi.org/10.1016/j.rser.2023.113165.

Rossetto, Nicolò, Stefano F. Verde, and Thomas Bauwens. 2022. "1 - A Taxonomy of Energy Communities in Liberalized Energy Systems." In *Energy Communities*, edited by Sabine Löbbe, Fereidoon Sioshansi, and David Robinson, 3–23. Academic Press. https://doi.org/10.1016/B978-0-323-91135-1.00004-3.

Schwidtal, J. M., P. Piccini, M. Troncia, R. Chitchyan, M. Montakhabi, C. Francis, A. Gorbatcheva, et al. 2023. "Emerging Business Models in Local Energy Markets: A Systematic Review of Peer-to-Peer, Community Self-Consumption, and Transactive Energy Models." *Renewable and Sustainable Energy Reviews* 179 (June): 113273. https://doi.org/10.1016/j.rser.2023.113273.

Vogler, Andrea, and Barbara Kump. 2023. "(Too) High Hopes? How Austrian Energy Community Actors Construct Their Roles in the Energy Transition." *Sustainability Science*, December. https://doi.org/10.1007/s11625-023-01433-x.

Footnotes

[1] Different manifestations of the concept exist in the literature, ranging from Peer-to-Peer trading (P2P) to Transactive Energy (TE) and Collective Self Consumption (CSC). The European legislation distinguishes between Renewable Energy Communities (RECs) and Citizen Energy Communities (CECs).

[2] Goals (2) and (3) translate for example into a reduced need to build new transmission lines or a reduced dependence on imported primary energy respectively.

[3] https://energy-communities-repository.ec.europa.eu/.

[4] C.f. connection restrictions in different grid areas of the Netherlands and time-dependent and interruptible grid access for controllable assets in Germany.