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Energy communities with grid benefits

A quest for a blueprint

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Introduction

Energy communities are one of the showcases of the Clean Energy for all Europeans legislative package. These communities come in many shapes and colours, but at the end of the day they are organised groups of energy consumers that together try to have a bigger say in their energy choices, save money or just help each other.

European Union Member States have already begun implementing ways to support energy communities and the benefits those communities may deliver. There is value in enabling individuals to become more proactive and powerful players in the fast-paced energy world. Energy communities are looked to for increased energy democracy, alleviated energy poverty through broader access to money saving projects and easier deployment of decentralized renewable energy.

Energy experts and regulators should, however, not underestimate how energy communities are — for their participants — first and foremost about facilitating social cohesion and innovation. Energy services are a vehicle for the pursuit of those primary goals.

Do energy communities also deliver real-world benefits to the operation of the electricity grid? And how are they different from commercial aggregators offering similar services? In this paper, the Regulatory Assistance Project gathers insights from community energy business models and pilot projects. The goal is to understand which

[1] I would like to thank the following for their expertise and insights while review this paper: Donal Brown (University of Leeds), Guillermo Ramo (Client Earth), and Roland Tual and Stavroula Pappa (Rescoop EU). I would also like to thank my RAP colleagues: Megan Anderson, Andreas Jahn, Zsuzsana Pató, John Shenot and Tim Simard.

elements bring tangible grid and system benefits so as to distil a blueprint for system positive energy communities.

We will first lay the groundwork by positioning energy communities in the European energy framework. We will then build the case for the energy system benefits of energy communities and business models within those communities.

It will not be easy to make general statements about the magnitude of grid benefits or whether they will, in and of themselves, be sufficient to build a business case for the energy community. Energy communities can undertake a variety of activities with very different business models across a diversity of grid situations. Key success factors for delivering grid benefits include having a large and diverse portfolio of customers to help balance the grid or members from a geographically focused area to support the local distribution network.

Energy communities bring the strength of their informal network but have to face the rules and requirements of the energy market. Regulators and authorities have an opportunity to unlock decentralised resources through smart capacity building and adjusting market conditions while maintaining fair contributions by all consumers to the common resource that is our energy system.

Energy communities in Europe

Energy communities are one of the vehicles to "help consumers save money and be actively involved in the energy system by providing them a role as a producer as well as consumer of electricity."[5] Active participation of consumers is a core focus. For this reason, the Clean Energy for All Europeans (CE4ALL) package and its implementing legislation aim to support individuals or groups of consumers to generate electricity for their own consumption, store it, share it and consume it or sell it back to the market. More specifically, it's the Internal Market Directive (IMD II) and

There is no time to waste

The Internal Market Directive[2] and the Renewable Energy Directive[3] must already be transposed by the Member States by 2021. In particular, for the articles on energy communities: 30 June 2021 in the case of the RED II (RED II, Article 36), and 31 December 2020 (IMD II, Article 71). Regulation (EU) 2019/943 on the internal market for electricity[4] is directly effective.

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[2] European Parliament and of the Council of the European Union, Directive (EU) 2019/944 on common rules for the internal market for electricity and amending Directive 2012/27/EU. (2019, June 5 a). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019L0944

[3] European Parliament and of the Council of the European Union, Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources. (2018, December). https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L2001&from=EN

[4] European Parliament and of the Council of the European Union, Regulation (EU) 2019/943 on the internal market for electricity. (2019, June 5 b). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019R0943

[5] European Commission. (2019, April). *The state of the Energy Union explained.* https://ec.europa.eu/commission/presscorner/detail/en/MEMO_19_1875

the Renewable Energy Directive (RED II) that drive the attention for consumers.

About self-consumers and consumer communities

In order to understand energy communities, it's important to clarify some terminology. We will, however, not attempt to produce an exhaustive lexicon of prosumerism and energy communities.

Final consumers are entitled to consume and store electricity they have produced within their premises. This is how the RED II defines the important concept of **self-consumption**. Those consumers are also allowed to sell their produced electricity, including through power purchase agreements.

Renewable self-consumers can only use renewable sources. **Active consumers**, on the other hand, can also use natural gas to generate heat or power and have rights beyond generation (such as involvement in flexibility or energy efficiency services).

The model of **renewable self-consumers acting jointly** in building complexes or apartments is an interesting one. Member States have to ensure that renewable self-consumers in the same building, including multi-apartment blocks, are entitled to engage **jointly** in these activities, and that they are permitted to arrange sharing of renewable energy (RED II, Article 21).

Renewable self-consumers, individually or through aggregators, are entitled to sell their excess production directly on the spot market through Power Purchase Agreements, via electricity suppliers and **peer-to-peer trading** (RED II, Article 21). Peer-to-peer trading is the next step up from the classic prosumer with photovoltaic panels (PV) on the roof. It is the sale and purchase of electricity between anyone connected to the grid (RED II, Article 2.18).

On top of "jointly acting" active customers or "jointly acting" renewable self-consumers, the CE4ALL introduces the possibility for local actors to organise themselves collectively to perform energy activities. The definition of **Citizen Energy Communities** (CEC) in the Internal Market Directive (IMD II, Article 2.11) specifies that they are a legal entity that provides energy services for environmental, economic or social community benefits to its members (see Table 1). A related but not identical concept is that of **Renewable Energy Communities** (REC) of the RED II**.** These are energy communities with renewable energy generation.

Going forward we will use **energy communities** referring to both RECs and CECs.

Energy communities may act as a supplier, as a service provider or — if allowed by the relevant Member State — as a grid operator (IMD II, Article 16.4; RED II, Article 22.4e). We will not go into detail here. Instead we will just note that there are several regulatory issues involved with the different roles. Examples include network cost sharing, balancing obligations and consumer rights.[6]

Although there are big overlaps, CECs and RECs do differ on points. The key regulatory difference lies in the nature of the directives from which they emerge.

Table 1. Overview of main characteristics of energy communities

Citizen Energy Communities (CEC)	Renewable Energy Communities (REC)
IMD II: Electricity Market Directive creates level playing field in the electricity market	RED II: Renewable Energy Directive establishes enabling framework
No limitation on geographical scope, cross-border Citizen Energy Communities allowed	Limited geographical scope to the proximity of the renewable energy projects
Electricity generation, distribution, consumption and/or system services; technology neutral	Renewable generation and consumption (both electricity and heating/cooling) and/or energy services, including access to suitable markets
Provide environmental, economic or social benefits rather than financial profits	
Open to natural persons, local authorities or small enterprises and microenterprises	

CECs are formally recognised as a market actor in the recast Electricity Market Directive (IMD II, Article 16). The goal is to create a level playing field for them in the energy market. Several general consumer rights are relevant for CECs. Suppliers with more than 200,000 final customers have to offer **dynamic electricity price contracts** as of 2021 if smart meters are installed (Article 11). Customers also need to get access to **aggregation**, mainly to participate in **demand response** (Articles 13 and 17). Prosumers have financial responsibility for the imbalances they cause in the electricity system. As a default, they will be balance-responsible parties or have to delegate their balance responsibility (Article 15.1).

RECs, on the other hand, emerge from the RED II (Article 22). This directive updates the framework for the promotion of energy from renewable sources. Member States have to provide an **enabling framework** for the different REC activities (supplier, aggregator etc.) to promote and facilitate their development. For example, Member States should take into account specificities of RECs when designing support schemes to allow them to compete for support on an equal footing with other market participants. They should also support RECs with advice and capacity building.

[6] Baker, P. (2020, June 8). *Challenges facing distribution system operators in a decarbonised power system*. Regulatory Assistance Project. https://www.raponline.org/knowledge-center/challenges-facing-distribution-system-operators-in-decarbonised-power-system/

Business models of communities with grid benefits

The question now is, what exactly are those grid benefits? Can they be sufficient to build a business case for energy communities?

After all, "Energy communities may pursue non-profit goals, but they still need to achieve a successful business model for their shareholders and lenders to get back their initial investment."[7]

PROSEU is an EU-funded research project that wants to help mainstream the renewable energy prosumer, largely equivalent to the renewable self-consumer as described in the European directives. They investigated possible business models for energy communities and prosumers.[8] So did Tractebel and Navigant in an Advanced System Studies for Energy Transition report on energy communities[9] and Delta Energy & Environment in an October 2020 webinar.[10]

Currently some form of virtual collective self-consumption of electricity generated by local renewable sources is an important component of many energy community business models. Also, cooperative energy supply to community members, or valorisation of renewable electricity sold to a supplier, are important.

Some technology pilot projects investigate disconnecting from the public grid and forming microgrids. This does not, however, receive broad interest among current energy communities and is certainly not a general energy system service — perhaps quite the contrary.

Collective self-consumption, cooperative energy supply or microgrids can be interesting for many reasons to energy communities and their members. They are not, however, necessarily offering specific grid or system benefits.

Strength in numbers: Aggregation

This is different when looking at aggregations of demand and distributed energy resources. The CE4ALL, and particularly the Electricity Markets Directive, clearly seek to drive demand side participation in the electricity markets and envisage this will be done through dedicated electricity tariffs and/or by third party aggregators. In the CE4ALL, both Renewable Energy Communities and Citizens Energy Communities

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[7] Tounquet, F., De Vos, L., Abada, I., Kielichowska, I. & Klessmann, C. (2019, May). *Energy Communities in the European Union*. Advanced System Studies for Energy Transition. https://asset-ec.eu/wp-content/uploads/2019/07/ASSET-Energy-Comminities-Revised-final-report.pdf

[8] Hall, S., Brown, D., Davis, M., Ehrtmann, M., & Holstenkamp, L. (2020, January). *Business models for prosumers in Europe*. Prosumers for the Energy Union. https://www.researchgate.net/publication/338595423_Business_Models_for_Prosumers_in_Europe

[9] Tounquet et al., 2019.

[10] Harrison, J., Desmyter, R., & Di Deodato, L. (2020, October 20). *Will energy communities replace conventional energy suppliers?* [Webinar]. Delta Energy & Environment. https://www.delta-ee.com/images/webinars/local_energy_systems/Webinar_Will_energy_communities_replace_conventional_energy_suppliers.pdf

have the right to participate in these flexibility markets in a non-discriminatory manner.

One could argue that energy communities are in fact a special kind of aggregator. They differ from commercial aggregators in their membership and goals, and possibly also technological scope (see Table 1). Compared to commercial aggregators, their bottom-up, mission-driven, local organisation might be better at mobilising small consumers to participate in aggregated demand response. Their knowledge of the local situation may also make them better able to resolve local grid issues.

If energy communities can indeed tap into a new potential for demand response, they will be catalysts for more flexibility in the energy system. In a recent paper, Wittmayer et al. make the case for considering the "informality" in energy communities a resource: "A lower degree of formalisation translates into lower administrative burden for community groups, for enterprises and businesses and makes engagement with energy activities more likely and desirable."[11] The challenge then becomes striking the right balance between informality and the very real formal requirements that come with doing business in energy markets.

Member States have to support energy communities through advice or dedicated provisions in renewable energy support schemes. Having accessible IT tools available will also make success more achievable. The importance of advice and support should not be understated. Energy cooperatives in Europe often refer to Scotland as a best practice in how to support energy communities. They combined a clear energy community growth goal with dedicated grants, low-cost financing and one-stop-shop advice and support.[12]

Aggregation, in and of itself, does not ensure a viable prosumer business model. It does, however, offer a way of solving some of the real problems of other actors in the energy system.[13] This is why it represents one of the few revenue streams to prosumers and prosumer communities that is not a direct or indirect subsidy. The challenge will be the complexity of operating aggregator business models and the size of the market they access. This might be difficult to reconcile with community decision making structures in a successful governance model.

Perhaps there is complementarity to be found between energy communities and aggregators. Energy communities can offer easier access to a possible pool of customers for a third-party aggregator, who could then bring in energy market acumen

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[11] Wittmayer. J.M., Avelino, F., Pel, B., & Campos, I. (2020, December) Contributing to sustainable and just energy systems? The mainstreaming of renewable energy prosumerism within and across institutional logics. *Energy Policy*. https://www.sciencedirect.com/science/article/pii/S0301421520307643

[12] IRENA Coalition for Action. (2020). *Stimulating investment in community energy: Broadening the ownership of renewables*. International Renewable Energy Agency. https://coalition.irena.org/-/media/Files/IRENA/Coalition-for-Action/IRENA_Coalition_Stimulating_Investment_in_Community_Energy_2020.pdf?utm_source=All+IRENA+contacts&utm_campaign=2a804cccdc-EMAIL_CAMPAIGN_2020_12_08_12_44&utm_medium=email&utm_term=0_29b5

[13] Hall et al., 2020.

and capital. There are very few independent residential aggregators active in the market today, so there might be an opportunity here. Voltalis in France is working hard to build up its business. Piclo in the UK actively pursues local flexibility. Another one was tiko in Switzerland, but they changed their business model to only working with suppliers.

Aggregator business models are about providing flexibility from decentralised energy resources to various possible requestors in the power system. The existence of a contract requirement with the supplier and the aggregator is a critical aspect, as well as the obligation for the aggregator to appoint the related balancing responsible party.[14]

Distributed aggregator models will likely work best with a large number of flexible assets that are controlled together to produce a significant network effect and derive meaningful revenue from the wholesale and balancing markets. Aside from the points about governance, this introduces an inherent need for scale, which may contradict the local focus of energy communities. One way out of this may be through local, distribution-level flexibility markets, as advocated for in the Advanced System Studies for Energy Transition report[15] on enabling demand side flexibility.

Of the multitude of possible revenue streams that can support business models, the following can add grid benefits by offering energy system services (as shown in Figure 1):

- **Arbitrage**: This is the storing and releasing electricity based on wholesale market prices. This is a strategy to change the costs of energy services, and as such, remains internal to the energy community. Although perhaps not a true system service, it does impact the system balance.
- **Flexibility**: Demand resources can participate in the wholesale market before gate closure and offer utilities a way to avoid imbalance charges from the system operator.
- **Balancing**: After gate closure, the system operator can use flexible resources to balance the difference between the actual demand and what utilities have scheduled.
- **Ancillary services**: These help fine tune the system to compensate for small fluctuations. Ancillary services, such as frequency regulation, are needed within seconds. They can be delivered by many small prosumers together and are paid for by the system operator.
- **Capacity markets**: For fear of possible future resource inadequacies, some system operators or administrations auction contracts for firm capacity a few years out. Demand response and distributed renewables have to be allowed to bid for

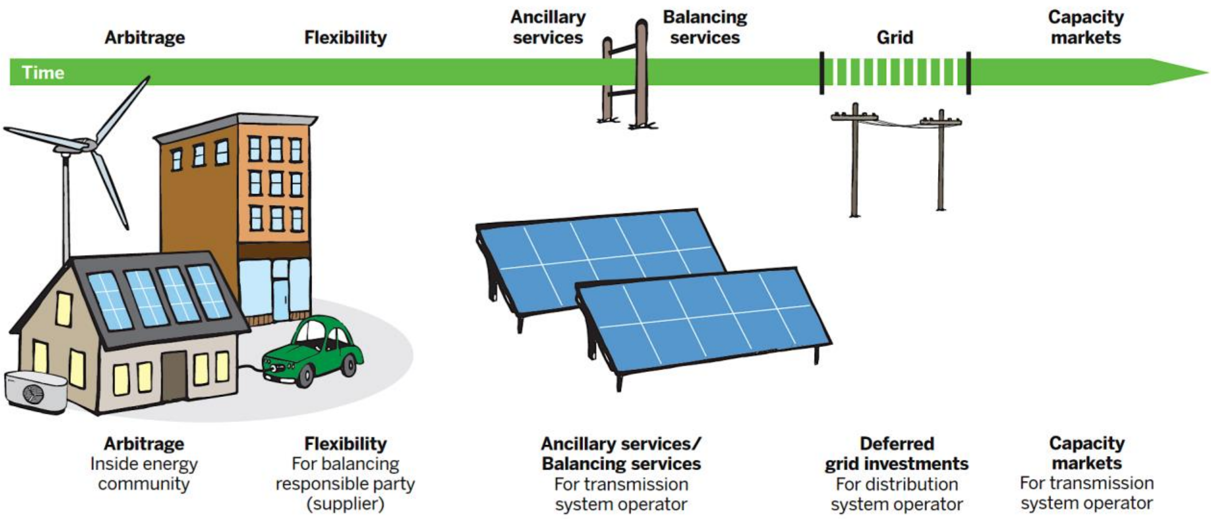
[14] Tounquet et al., 2019.

[15] Advanced System Studies for Energy Transition. (2020, November). *Study on regulatory priorities for enabling demand side flexibility*.

capacity contracts. Unfortunately, practice capacity markets tend to favour traditional baseload power plants. What's more, capacity mechanisms are meant to be a last-resort, temporary measure to deal with residual adequacy concerns,[16] and therefore cannot be the basis for a sustainable business model, just an additional, transitional source of income.

- **Defer grid investments**: Energy efficiency, local flexible load and decentralized generation can help alleviate distribution grid constraints. An argument can be made that those resources should be paid a fair share of the avoided investment cost. Examples of these kinds of deferred investments and a regulatory framework for managing them are arising in multiple states in the United States. In most European Union Member States, the regulatory framework is still lacking to reward deferred grid investments or to oblige system operators to look into "non-wire alternatives." This should change with the implementation of the IMD II.

Figure 1. Possible energy system services by energy communities



Energy trading or peer-to-peer energy exchange is often an area of interest to energy communities and their members. We don't consider this a grid service, rather an alternative to the traditional energy supply model.

Utility experience with collective demand response

To date, pilot projects using revenue from system services to drive the energy communities' business case are in too early a stage to deliver comprehensive results.

The best examples in the United States of mobilising large numbers of small consumers to aggregate demand response come from utility programs. Many utilities

[16] European Parliament and of the Council of the European Union, 2019 a.

have "direct load control" programs where customers can volunteer to allow the utility to remotely turn off their air conditioner during peak demand events, earning a once-per-year bill credit. These direct load control programs have been around for decades and have had modest success in enrolling customers.

One of the most interesting models is the peak-time rebate by Baltimore Gas and Electric (BGE).[17] The rebate is a part of their standard offer residential electricity supply tariff. For each such customer, BGE has assembled a baseline value (from smart meter data) for how much electricity the customer typically uses during peak demand conditions. On a small number of days each year, the utility sends an Energy Savings Day alert to customers (via phone, text or email) the day before a forecasted peak demand day. Each customer gets a $125/MWh credit on their next bill for reducing their actual energy consumption (as measured by their smart meter) during the Energy Savings Day event below their baseline value. BGE saves money on this because they sell the aggregated demand response into the wholesale electricity market during peaks when prices are above $125/MWh.

The BGE rebate has similarities to the Tempo tariff that EDF offers its French residential customers.[18]

Simplicity and ease of use for the participating customer and collecting large enough volumes of small dispatchable loads seem to be key to these utility programs. These are important takeaways for energy communities looking to enter the energy services markets.

Fair network tariffs

How the CE4ALL regulates network tariffs for these various new consumer types is a significant point of attention.

The default rule is that all consumers "are subject to cost-reflective, transparent and non-discriminatory network charges that account separately for the electricity fed into the grid and the electricity consumed from the grid" and active customers with storage facilities "are not subject to any double charging, and are not subject to disproportionate licensing requirements or fees." To this end, however, these consumers must also ensure metering and balancing responsibility (IMD II, Article 15.5).

Where electricity is shared over the public network, it must be subject to cost-reflective, fair and transparent network charges. Network costs are distributed evenly and fairly without discriminating against vulnerable customers and those who are not

[17] Baltimore Gas and Electric (n.d.). *Smart energy rewards*. https://www.bge.com/SmartEnergy/ProgramsServices/Pages/SmartEnergyRewards.aspx

[18] Kolokathis, C., Hogan, M., & Jahn, A. (2018, January 18). *Cleaner, smarter, cheaper: Network tariff design for a smart future*, p. 11. Regulatory Assistance Project. https://www.raponline.org/knowledge-center/cleaner-smarter-cheaper-network-tariff-design-for-a-smart-future

able to participate in peer-to-peer energy sharing or self-generation. Any reduced network charges for local sharing must reflect a benefit for the grid. This is important for energy communities.

The design of network tariffs will determine the extent to which energy communities and individual prosumers can be mobilised to contribute to more efficient system operation.[19] Member States are therefore encouraged to develop comprehensive policies and regulations on network charges. These should include provisions for energy communities as well as other types of active customers and distributed energy resources. There are key requirements in the IMD (Article 18) as well as in the RED II "requiring RECs and CECs to be subject to transparent, non-discriminatory and cost-reflective network charges and for those charges to encourage operational efficiency and support **flexibility in the network**."[20]

Both the IMD and the RED II require cost-benefit analyses of distributed energy resources in determining system charges. The concept of cost-benefit analysis is a common economic tool. Its application in network tariff methodologies is new, however. To our knowledge there are none currently implemented by European regulators. So far, the general European application of cost benefit analysis remains limited to infrastructure investments for transmission or storage.[21]

In the United States, regulators from different states are looking closely at how to identify and assess different distributed energy resources and their potential costs and benefits.[22] The goal is to translate this into rate design or incentive program design. In an October 2019 paper, the Regulatory Assistance Project examined the potential uses, valuation studies and methodologies for advanced distributed energy resources. The authors suggest new valuation and benefit-cost approaches that may benefit regulators and market participants, such as energy communities.[23]

Grid benefits and adjusted tariffs

Many energy communities maximise their collective self-consumption in response to network tariff design. Distribution system operators assume grid benefits from collective self-consumption and try incentivising this through dedicated, lower grid charges. France has pioneered in this field and Europe has increasingly followed its

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[19] Kolokathis et al., 2018.

[20] For an extensive discussion see Chapter 5.4 in RESCoop Client Earth. (2020, June). *Energy communities under the Clean Energy Package, Transposition Guidance*. https://www.rescoop.eu/news-and-events/press/energy-communities-under-the-clean-energy-package

[21] ENTSO-E. (2020, January 28). *3rd ENTSO-E guideline for cost benefit analysis of grid development projects*. Draft version. https://eepublicdownloads.entsoe.eu/clean-documents/tyndp-documents/Cost%20Benefit%20Analysis/200128_3rd_CBA_Guideline_Draft.pdf

[22] National Association of Regulatory Utility Commissioners. (2016, November). *NARUC manual on distributed energy resources rate design and compensation*. https://pubs.naruc.org/pub/19FDF48B-AA57-5160-DBA1-BE2E9C2F7EA0

[23] Littell, D., Shipley, J., Xuan, W., Kadoch, C., Brautigam, J., Linvill, C., & Shenot, J. (2019, October 10). *The economics of distributed energy resources*. Regulatory Assistance Project. https://www.raponline.org/knowledge-center/economics-distributed-energy-resources/

example.[24] We did not find quantitative analyses underpinning adjusted grid charges.

In 2019, the French energy regulator, CRE, introduced a reduced tariff for end users involved in collective self-consumption. Consumers and producers connected to the same medium-to-low voltage transformer can exchange locally produced electricity. They receive the more beneficial tariff without the need to go through the framework of a supplier offer.[25] The tariff differentiates between on- versus off-peak hours and self-consumption versus regular consumption.[26]

At the end of 2019 a total of 16 projects of collective self-consumption were reported in France.[27] Only one project (ACOPREV) has actually fully implemented the concept. Stakeholders have criticized the framework for not sufficiently supporting the emergence of sustainable business models.[28]

A similar framework to the French described above has been adopted in the Belgian Walloon region. The dedicated tariff for collective local self-consumption has not yet been established.[29] Portugal and Austria are thinking of introducing locally differentiated grid tariffs.[30]

The BRIDGE project warns against reducing energy communities to collective self-consumption and energy sharing.[31] Both RED II and EMD envision many more activities for them that can unlock possible revenue streams. What is more, collective self-consumption and energy sharing are not necessarily limited to energy communities either.

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[24] Verde, S.F., Rossetto, N., Ferrari, A., & Fonteneau, T. (2020, September 28). *The future of renewable energy communities in the EU, an investigation at the time of the Clean Energy Package.* Florence School of Regulation. https://fsr.eui.eu/publications/?handle=1814/68383

[25] Commission de Régulation de l'Énergie. (2018, June 7). *Délibération de la commission de régulation de l'énergie du 7 juin 2018 portant décision sur la tarification de l'autoconsommation, et modification de la délibération de la CRE du 17 novembre 2016 portant décision sur les tarifs d'utilisation des réseaux publics d'électricité dans les domaines de tension HTA et BT*. Déliberation No. 2018-115. https://www.cre.fr/Documents/Deliberations/Decision/Tarification-Autoconsommation-et-modification-deliberation-TURPE-HTA

[26] Commission de Régulation de l'Énergie. (2018, June 12). *Autoconsommation.* https://www.cre.fr/Transition-energetique-et-innovation-technologique/Autoconsommation

[27] Actu-Environnement. (2019, December). *Pour un developpement reel de l'autoconsommation collective*. https://www.actu-environnement.com/media/pdf/news-34580-document-autoconsommation-collectif-energies-renouvelables-pour-tous.pdf

[28] Sebi, C., & Vernay, A.L. (2020, December). Community renewable energy in France: The state of development and the way forward. *Energy Policy,* 147. https://www.sciencedirect.com/science/article/pii/S0301421520305905

[29] Commission wallonne pour l'Energie.(2019). *Communautés d'énergie renouvelable: Qu'est-ce qu'une communauté d'énergie renouvelable?* https://www.cwape.be/?dir=4.9.6

[30] Frieden, D., Tuerk., A., Roberts, J., & d'Herbemont, S. (2019, June). *Collective self-consumption and energy communities: Overview of emerging regulatory approaches in Europe*. COMPILE Consortium. https://www.compile-project.eu/wp-content/uploads/COMPILE_Collective_self-consumption_EU_review_june_2019_FINAL-1.pdf

[31] Hannoset, A., Peeters, L., & Tuerk, A. (2019, December). *Energy communities in the EU task force energy communities*. BRIDGE. https://www.h2020-bridge.eu/wp-content/uploads/2020/01/D3.12.d_BRIDGE_Energy-Communities-in-the-EU-2.pdf

Local grid services

A more interesting example of smart tariff setting to support load flexibility, customer cost savings and a lower need for grid investments is the FLEET project in Utrecht, the Netherlands.[32] The distribution system operator Stedin introduced smart time of use tariffs to give price signals to a centrally managed fleet of shared Renault Zoe electric vehicles capable of vehicle-to-grid electricity exchange.

Member States have to ensure energy communities have access to all suitable markets on a non-discriminatory basis (RED II, Article 22.2; IMD II, Article 16.3).[33] For reference, Article 2.8 of the IMD defines electricity markets as "markets for electricity, including over-the-counter markets and electricity exchanges, markets for the trading of energy, capacity, balancing and ancillary services in all timeframes, including forward, day-ahead and intraday markets." This right would also apply to local flexibility markets. These markets will need to be developed in the coming years under provisions that encourage Distribution system operators to procure flexibility through new market-based procedures (IMD 11, Article 32).[34] For local actors like energy communities this is an opportunity to look out for.

Regional focus and sufficient scale

Capturing the full value of combinations of distributed resources combinations will require action on many issues, at many levels, by many different decision-makers. In 2019 the Regulatory Assistance Project outlined comprehensive recommendations to make progress towards the aspirational goal of full value for distributed resources.[35] We identified specific actions to address the challenges.

From the perspective of the energy community, maximizing the money can entail tapping into as many options as are available or relevant for the specific community. Some of those may lie outside this paper's narrow scope of energy system benefits.

Inside this scope, however, it seems that taking inspiration from developing energy aggregator's business models — such as those of Next Kraftwerke, Centrica, Energy Pool and others — can provide interesting opportunities for energy community activities.

A **regional focus** on areas with current or expected grid congestion can put energy communities in a position to help alleviate this congestion through demand response and decentralised generation. This in turn can defer the need for the system operator

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[32] TKI Urban Energy. (n.d.) *Projectdoelen FLEET.* https://ssc-fleet.nl/project/projectdoelen-fleet/

[33] European Parliament and of the Council of the European Union, 2018; and European Parliament and of the Council of the European Union, 2019a.

[34] European Parliament and of the Council of the European Union, 2019 a.

[35] Shenot, J., Linvill, C., Dupuy, M., & Brutkoski, D. (2019, August 29). *Capturing more value from combinations of PV and other distributed energy resources*. Regulatory Assistance Project. https://www.raponline.org/knowledge-center/capturing-more-value-from-combinations-of-pv-and-other-distributed-energy-resources/

to invest in grid infrastructure upgrades. At a basic level this can resolve grid connection bottlenecks for renewable energy projects. An example is the smart combination of wind turbines and flexible refrigeration in the Belgian port of Antwerp that allowed more wind to be connected than otherwise would have been possible.[36]

Also in Belgium, a different example is the one of Buurzame Stroom in Gent.[37] One of their interesting trials is collectively slightly decreasing solar PV production in a street to lower the tension in the feeder of the street. As a result, all solar PV inverters remain operational and no one loses solar production, as would otherwise happen to homes that are farthest removed from the feeder.

An important condition to unlock these potential contributions is transparency by the system operator about where there's a need for flexibility to resolve congestion.

Sufficient **scale** and a **diverse portfolio** of load profiles can be another important design element for an energy community. This will enable it to offer system support through flexibility, balancing or ancillary services. Or they may act as complementary resources for today's aggregators active in the industrial and tertiary building markets. The diversity of load profiles will play as well on the demand side as on the generation side. So, one could imagine a combination of residential consumers, small business and public institutions, such as schools, with both solar and community scale wind projects, plus centrally managed thermal or electric storage. A community of "just" residential solar will have a much harder time unlocking revenue from system services.

A case in point is the example of Perth, Australia, where the local community-owned utility Synergy offers collective batteries for use by small PV owners.[38] The batteries help balance supply and demand and maintain voltage. The PV owners "rent" storage in the batteries and can draw on them in the evening. In the small town of Heeten, the Netherlands, a local pilot project called GridFlex uses decentralised storage to balance the local grid connected to one transformation station, which includes a PV project.[39]

We discussed earlier the experience of utility programs for demand response. So far most commercial aggregators have focused on gathering larger customers, such as office buildings or medium sized businesses. Some have shown that a successful aggregation of small loads is possible. ThermoVault, a project combining 3MW of electric boilers and accumulators, bids into the primary reserve market of the Belgian transmission system operator Elia. Voltalis, in France, follows a similar approach.

[36] Wind aan de Stroom. (2016, August). *Slim aansturen van elektriciteit: Diepvries als buffer voor windenergie.* https://www.windaandestroom.be/nieuws/129-slim-aansturen-van-elektriciteit-diepvries-als-buffer-voor-windenergie

[37] Energent. (2020). *Buurzame stroom eindrapport.* https://energent.be/projecten/innovatieprojecten/buurzame-stroom/

[38] Western Power. (n.d.). *Community batteries.* https://www.westernpower.com.au/faqs/community-batteries/community-batteries

[39] GridFlex. (n.d.). *Het initiatief gridflex.* https://gridflex.nl/over-gridflex/

We will attentively follow the further lessons learnt from the Interreg cVPP project.[40] A virtual power plant (VPP) refers to a cluster of dispersed generator units, controllable loads and storage systems aggregated to operate as a unique power plant. The Interreg project adds the community aspect (the "c") to the VPP. Started in 2017, the project will test cVPP concepts in three different markets of Belgium, the Netherlands and Ireland.

The winding path ahead

So, here's what we know. We're in the early days, with many energy communities still in pilot stage. European regulation just opened the door to create new forms of energy communities, including citizens, small businesses and local authorities. We have identified a sequence of potential energy market products or grid services that could support energy communities: flexibility and demand response, balancing and ancillary services. When distribution grid operators develop markets for local grid services those may be very important for energy communities.

Finally, there may be opportunities in capacity markets, though that will likely be less evident. By participating in those markets or delivering those services, energy communities will support the energy system and the electricity grid. It will not, however, be a long term, tenable proposition to predominantly aim at avoiding socialised grid costs more than justified by actual grid management savings. Collective self-consumption projects sometimes seem to overlook this.

There is no time to waste. The governing European bodies of legislation need to be transposed by January 2021 for the electricity markets and July 2021 for renewable energy.

In many ways the energy system services by energy communities overlap with commercial aggregators. But the unique local community character of energy communities may make them better suited to tackle local issues. They may also be better able to attract individual small energy consumers, local authorities, and businesses that may otherwise not be interested to join an aggregator. We recommend that energy communities and aggregators further explore possible synergies. Service providers, like aggregators, should develop appropriate offers and approaches, and energy communities should get skilled enough to seize the opportunities.

It is not possible yet to make general statements about the magnitude of system benefits from energy communities or whether they will in and of themselves be sufficient to build a business case for the energy community. After all, the experiences with aggregators successfully offering decentralised demand response services to system operators is still relatively new in Europe.

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[40] Interreg North-West Europe cVPP. (n.d.). *cVPP - community-based virtual power plant: A novel model of radical decarbonisation based on empowerment of low-carbon community driven energy initiatives*. https://www.nweurope.eu/projects/project-search/cvpp-community-based-virtual-power-plant

Key success factors for the community makeup will include a diverse portfolio of both flexible demand profiles and distributed generation, and the right geographical scope for communities that want to help alleviate local grid constraints. From the network operator we will expect transparent and complete access to information and the creation of markets for grid supporting services. The regulator should design the right tariff methodology, in particular delivering time-of-use price signals. Distribution system operators and regulators may also provide capacity building or assistance to energy communities. As of 2021, electricity suppliers have to offer dynamic pricing contracts, which will also help flexibility offered by distributed resources.

The path ahead for energy communities delivering energy system services as we see it:

- Energy community design.
    - Explore the full portfolio of short- and longer-term energy market products, including the qualifying conditions to participate in those.
    - Build on the strength of a local and diverse (in terms of load profile) participant base, encompassing families, businesses and local authorities.
    - Reach sufficient scale for a meaningful impact on the local grid or system level.
- Seek synergies between energy communities and commercial aggregators.
- Supportive framework.
    - Design smart time-of-use grid charges to support flexibility.
    - Offer advice and capacity building to energy communities.
    - Provide information about grid bottlenecks and create markets for distribution grid supporting services.

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