Nordic Energy Research

Energy Communities

Content

This publication is also available online in a web-accessible version at: https://pub.norden.org/nordicenergyresearch2023-03/

Preface

The establishment of energy communities aligns well with the Nordic Council of Ministers' vision 2030 of a green and inclusive Nordic region, aiming at involving citizen in the Nordic Region in the green transition.

The EU electricity market directive ((EU) 2019/944) includes new rules that enable active consumer participation, individually or through citizen Energy Communities, in all markets, either by generating, consuming, sharing or selling electricity, or by providing flexibility services through demand-response and storage.

The EU directive aims at improving the uptake of Energy Communities and at making it easier for citizens to integrate efficiently into the electricity system, as active participants. While energy communities have existed for a long time in several member states in the form of historical cooperatives, they are a novelty in others. Expected benefits of this new old idea are improved energy security and reduced CO2 emissions.

This study focuses on identifying barriers that hinder the establishment of Energy communities and enablers that can stimulate greater uptake of energy communities. In addition, the study provides a status on how the rules for Energy Communities in the Electricity Market Directive are implemented into the national legislation in the Nordic countries (Sweden, Denmark, Norway, and Finland) and three other European countries (the Netherlands, Austria, and Germany).

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Acknowledgements

This publication was funded by the Nordic Council of Ministers. Technopolis was commissioned to perform this study by Nordic Energy Research (NER) on behalf of the Electricity Market Group (EMG) under the Nordic Council of Ministers. Maj Dang Trong at Nordic Energy Research was the coordinator of the project.

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Proofreading

The report was proofread by Pia Sander, Sprog & Web, Denmark.

Abbreviations used in this Report

CEP	Clean energy for all Europeans package
CEC	Citizen Energy Community
CLEP	Clean Energy Community
DEA	Danish Energy Agency
DUR	Danish Utility Regulator
DSO	District System Operator
EEA	European Economic Area
IEMD	Internal Electricity Market Directive (2019/944)
LEC	Local Energy Community
PV	Photovoltaic
REC	Renewable Energy Community
REDII	Revised renewable energy directive (2018/2001)
RES	Renewable Energy Sources

↑ Photos: Unsplash and iStock

1. Executive Summary

The Nordic countries are all looking for ways to enable a green transition, and a part of this is the electricity grids. The Clean Energy for all Europeans Package (CEP) released by the European Commission in 2019 put citizens at the middle of the energy transition. Through Article 16 of the Electricity Market Directive (2019/944; "Electricity Directive") the new concept Citizen Energy Communities (CEC) was established and through the recast of the Renewable Energy Directive (REDII) the concept of Renewable Energy Community (REC) was established.

In 2022, Nordic Energy Research, on behalf of the Electricity Market Group, commissioned Technopolis Group to conduct a study that looks into how Energy Communities are currently implemented into the Nordic countries and into how other models are implemented in Europe, as well as into questions linked to market access, grid ownership and operation, and tariffication.

The overall objective of the study is to support the Nordic authorities in their implementation of the requirements of Article 16, to support the exchange of views on lessons learned and to profit from the common experiences in the Nordic and European countries. The study addresses the following aspects:

- The implementation of Citizen Energy Communities in the Nordics and in Europe
- Identification of different models for energy communities
- Identification of whether certain conditions in an energy system might imply that energy communities will be less likely to contribute to additional benefits.

1.1. Methodology

The study is based on:

- An overarching desk research and literature review on Energy Communities in Europe
- Seven country studies (Denmark, Sweden, Finland, Norway, Germany, Austria and the Netherlands), consisting of country specific desk research of relevant literature, studies and national policy documents as well as interviews. In total interviews with 40 interviewees were conducted within the scope of this study.
- A comparative mapping of the different aspects of the Energy Communities and the implementation of the directives in the respective country.

1.2. Conclusions

In the countries included in the study, few have fully transposed the definitions of REC and CEC into their national legislation. Even fewer seem to use the definition in the general discourse. Most often, they are simply referred to as Energy Communities (or a rather similar translation into the respective language) in which many different models are included. There are several attributes in which the communities differ, most prominently are: organisational form, technology, energy sharing models and activities conducted. The combination of difference in transposition of the definitions and large disparity in models for energy communities renders a cross-model comparison rather sprawly and to an extent inconclusive. Instead, it underlines the importance of simple and clear definitions in both legal documents and general discourse. This will help clarify which possibilities and responsibilities apply to the respective model and simplify the decision making when initiating a community.

Similarly, there is a large diversity of concepts and terminology used for community initiatives in energy across Europe. Both in the academic literature, general discourse and consultations, a wide range of terms are used, such as Energy community, Community Energy, Citizen Energy Community, Renewable Energy Community, Clean Energy Community and more. This exacerbates conceptual confusion and makes horizontally comparing both policy recommendations and research findings cumbersome and less stringent. A reduction on the number of concepts as well as a clear definition of what is encompassed in and required for each concept would facilitate more expedient policy analysis, recommendations and translation of lessons learnt.

Another important observation is that although interest in Energy Communities among the public is increasing, the public awareness of the concept is low, omitting both possible community initiatives and potentially important inputs to the public debate regarding Energy Communities.

Thus far, the studied countries have not found a conclusive way to circumvent the conflict between economic viability for the communities and fairness in shared costs for the collective grid. Without a simple, efficient as well as cost- and input-reflecting solution for electricity sharing, many potential initiatives are unviable and are either decreased in scope or never started. The choice of electricity sharing model for each country should be individually assessed, based on factors such as population density, foreseeable expansion needs of collective electricity grid, and current energy mix.

1.3. Recommendations

Given our general observations, the context of the Nordic countries and the currently evolving knowledge surrounding Energy Communities, we present three recommendations to help enable Energy Communities without promoting an unfair division of costs.

1.3.1. Introduce Clear and Coherent Definitions of Energy Communities

Clear definitions in both legal documents and general discourse lessen uncertainties and hesitation in the initial phase of establishing an energy community.

1.3.2. Ensure Accessibility to Establish Energy Communities

Two of the main barriers to the deployment of Energy Communities identified is related to **awareness and knowledge**. Firstly, few citizens are aware of the possibility of establishing or joining an energy community, thus acting as a first hindrance to possible deployment of an unknown number of communities. Secondly, the knowledge needed to establish an energy community, both technical and judicial, acts as a barrier for many citizens that do not have the prior knowledge or the time to fully acquire the necessary know-how. To mitigate these barriers, we propose two main strategies:

- **Ensure clear and simplified legislation.**

Counteract all risks of ambiguity. Partly, to provide an explicit and easily comprehensible framework for potential founders and members. Partly, to discourage geographically differentiated interpretations by e.g., local authorities or DSOs.

- **Promote support organisations.**

Support organisations and/or networks can benefit the dissemination of information that raise awareness in the general population. It can also provide a platform for knowledge sharing through handbooks or pamphlets. Furthermore, they can act as intermediaries between inquisitors and competency.

These support organisations can either be privately run or organised as a state entity. For example as a "one-stop-shop" solution.

1.3.3. Enable Electricity Sharing

The possibility to share electricity within the community in an efficient and cost-effective/-representative way seems to be of key importance to increase the establishment of Energy Communities. The national context is very relevant when looking at the potential benefits of a more restrictive or allowing legislation regarding electricity sharing. Thus, a model that would fit all are neither viable nor recommended. Given the current state of the respective legislation, the following steps are recommended:

- Enable electricity sharing through the collective grid, with clear and defined renumeration-schemes for the respective contribution to the collective grid, ensuring consistent calculations across regions.
- Include room for experimentation or "sandboxing" in the legislation on electricity sharing.

1.4. Caveat

A caveat from the study team is that the topic of Energy Communities is very topical and both research and regulation is evolving rapidly. The studied countries have and are still developing their regulations and surrounding frameworks (such as support structures). Currently the European commission is working on a reform of the EU electricity market design which may have a substantial impact on the coherence and relevance of the conclusions and recommendations of this study. Hence, we would raise a finger of caution regarding the relevance of the conclusions over time.

↑ Photos: i Stock and Pixabay

2. Introduction

2.1. Purpose of Study

The Nordic countries are all looking for ways to enable a green transition, and a part of this is the electricity grids. The Clean Energy for all Europeans Package (CEP) released by the European Commission in 2019 put citizens in the middle of the energy transition. Through Article 16 of the Electricity Market Directive (2019/944; "Electricity Directive") the new concept Citizen Energy Communities (CEC) was established and through the recast of the Renewable Energy Directive (REDII) the concept of Renewable Energy Community (REC) was established. The core objectives of the introduction of CEC and REC were to further the development of distributed energy technologies and to strengthen consumer participation in the energy markets, whilst prioritising the local production of electricity from renewable energy sources (RES). CECs allow for active consumer participation, either by generating, consuming, sharing or selling electricity, by providing flexibility services through demand-response and storage as well as – if member states have chosen this option – by operating the required electricity grid under the applicable requirements of the Electricity Directive for distribution system operators (DSOs).

In relation to what was outlined above, this study sets out to analyse how Energy Communities are currently implemented in Norway, Sweden, Finland and Denmark, and furthermore looks into similar models in three other European countries. In relation to Energy Communities, Nordic Energy Research (NER) also wants to investigate questions linked to market access, grid ownership and operation, and tariffication. The overall objective of the study is to support the Nordic authorities in their implementation of the requirements of Article 16, to support the exchange of views on lessons learned and to profit from the common experiences in the Nordic and European countries. The study addresses the following aspects:

- The implementation of Citizen Energy Communities in the Nordics and in Europe
- Identification of different models for energy communities
- Identification as to whether certain conditions in an energy system might imply that energy communities will be less likely to contribute to additional benefits.

2.2. Methodology

To collect, compare and analyse the lessons learnt regarding transposition of the CEP, the study builds on the following empirical foundation:

- First, a comprehensive **desk research and literature review** on energy communities in Europe was conducted. For instance, recent studies, such as Sweco and Oslo Economics (2019), NEWCOMERS project (2019-2022), were analysed.
- Second, in-depth **country studies** of seven countries, among them Nordic as well as other comparative European countries[1] were carried out. The country studies are based on desk research of relevant literature, studies, national policy documents and secondary data as well as approx. 5-7 interviews per country with local and context-specific experts on energy communities. In total, interviews with 40 interviewees were conducted. Figure 1 below summarizes the **focus of the country studies graphically**.
- A comparative **mapping** of the different aspects of the energy communities identified in the country studies enabled us to shed light on the different models for energy communities and highlight drivers, benefits and barriers for the implementation of energy communities across the countries. Besides drawing on the results of the country studies, we also included the results of additional desk research and interviews in the mapping.

Based on the empirical evidence gathered, the data was triangulated and analysed in an internal workshop. We assessed the applicability of the findings to the Nordic countries and issued both general and specific conclusions and recommendations respectively. These were presented to NER during an interpretation seminar before finalising the study.

The figure below summarizes the methodology graphically.

1. The country studies covered Norway, Sweden, Denmark, Finland, Germany, Austria and the Netherlands.

Figure 1. Focus of the country studies

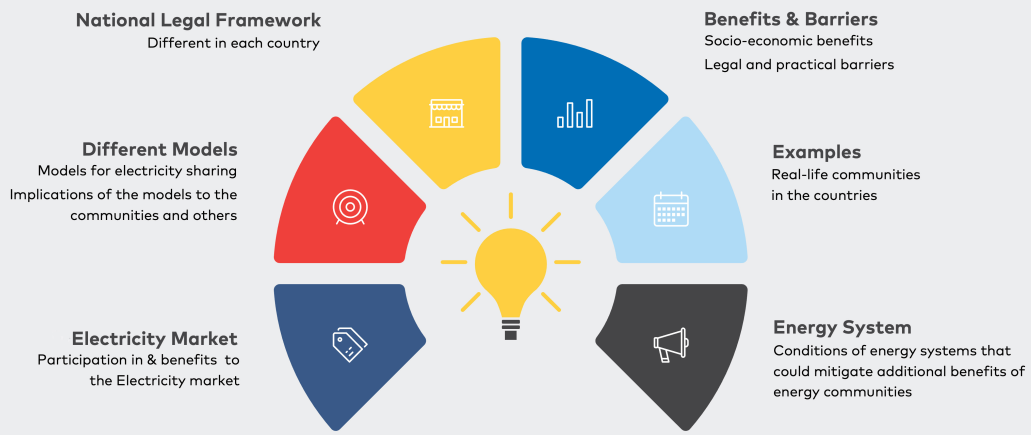

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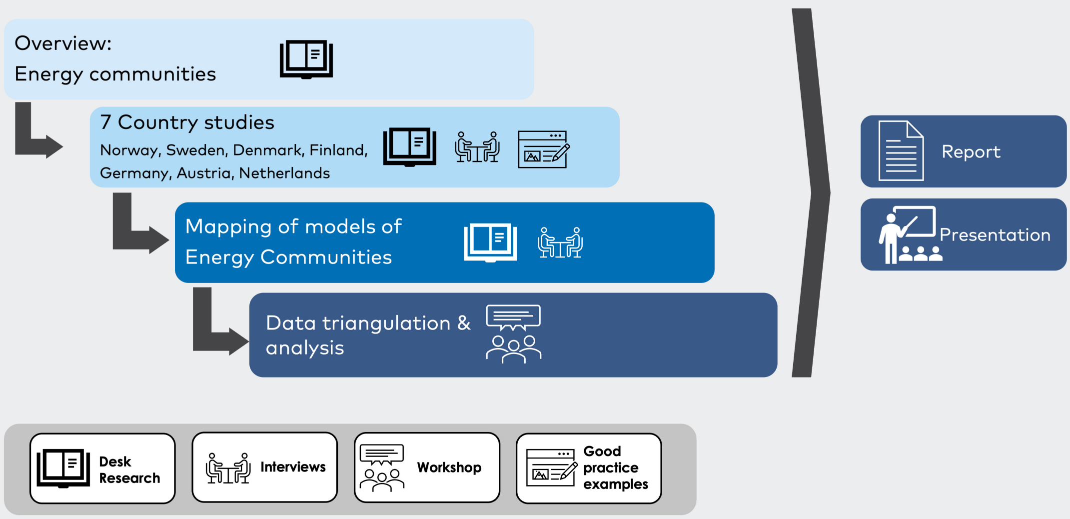
Figure 2. Methodological approach of the study



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2.3. Definition of Energy Communities

Since 2019, the CEP, aims at supporting the role of energy communities in the EU's energy transition. Currently, there are **two main definitions** of energy communities:

- Citizen Energy Community (CEC), which is "a legal entity that is based on voluntary and open participation, effectively controlled by shareholders or members who are natural persons, local authorities, including municipalities or small enterprises, and micro-enterprises". Activities of CEC include electricity generation, distribution and supply, consumption, aggregation, storage or energy efficiency services, generation of renewable electricity, etc. CEC aims at environmental, economic, or social benefits for its members and the region, not primarily at financial profit.
- Renewable Energy Community (REC), which is "a legal entity that, in accordance with the applicable national law, is based on open and voluntary participation, autonomous, effectively controlled by shareholders or members located in the proximity of the renewable energy projects that are owned and developed by that legal entity; the shareholders or members of which are natural persons, SMEs or local authorities, including municipalities". Activities of REC include energy generation, efficiency, supply, aggregation, mobility, energy sharing, self-consumption as well as heating and cooling – all based on renewable energy. Like CEC, REC aims at environmental, economic, or social benefits of its members rather than financial profit (European Commission, n.d).[2]

The study addresses Energy Communities in general and, when appropriate, either CEC or REC in particular.

2.4. Context

The Nordic countries included in this study are all connected through the Nordic Synchronous area and are members of the Nordic energy market Nord Pool. Although neighbouring countries with many similarities, the respective countries also have some overarching differences, both with respect to the energy system and policies, as well as other preconditions such as population density and natural resources. In this study, we have also conducted country studies of the Netherlands, Germany, and Austria. Although not part of the Nordic Synchronous area, they are members of Nord Pool.

2. European Commission (n.d). *Energy Communities Repository.* Available at: https://energy-communities-repository.ec.europa.eu/energy-communities_en

In the following section we shall provide a contextual overview of some relevant preconditions, preluding the analysis presented in the subsequent chapters.

2.4.1. Country Specific Preconditions

In Table 1 both the population density and urban population of the respective country are presented. Norway, Finland, and Sweden have a significantly lower population density than the other four. Denmark has (in this context) an average population density, being slightly more densely populated than Austria.

With respect to urban population the only country that stands out a bit is Austria at 59% compared to the other six countries with an urban population of 78–93%.

Hence, although being sparsely populated, a large share of the population in the Nordic countries live in urban areas.

Table 1. Demographic specifications of the studied countries

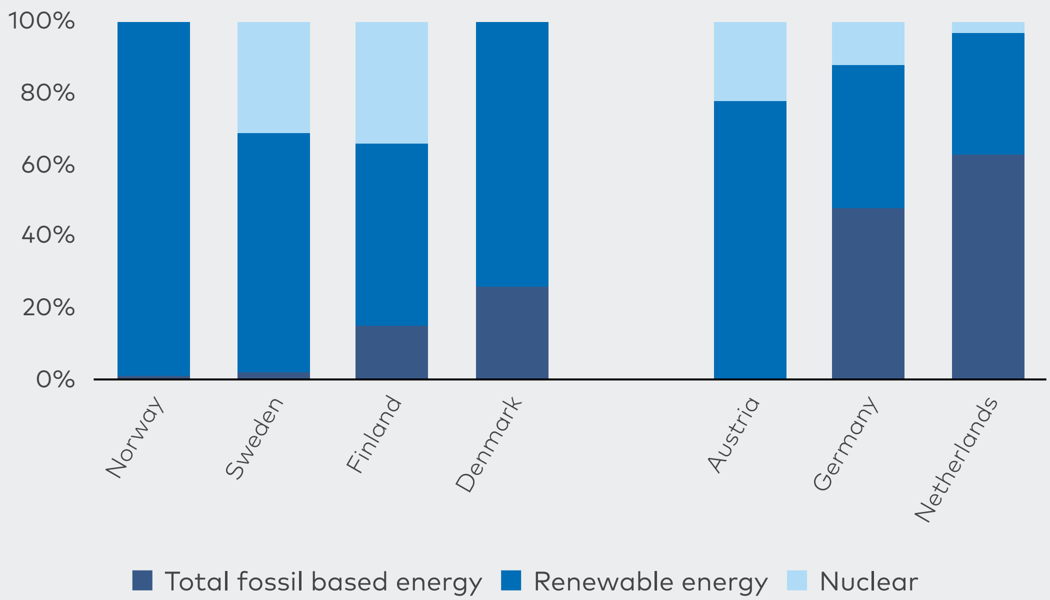
Header	Population density 2020 (people per km^2)	Urban population 2021 (% of total population)
Denmark	146	88%
Norway	15	83%
Finland	18	86%
Sweden	25	88%
Netherlands	518	93%
Germany	238	78%
Austria	108	59%

Sources: World Bank, https://data.worldbank.org

The energy mix in a country can affect both the motives to join an energy community and the possible effects on the energy transition to renewable energy sources (RES). Simply put, contributing to a transition to an energy production fully based on RES will be, to say the least, complicated in a country already fully transitioned. Likewise, motives related to sustainability and climate change are likely scarcer in such a context.

As evident in Figure 3, in the context of the seven countries, the Nordics have a low share of fossil fuels in their electricity production. Norway has almost 100% renewable energy in their electricity production, while Denmark has the second largest share of RES but also the largest share of fossil fuels of the Nordic countries. Nuclear energy comprises 31% and 34% of Sweden and Finland's electricity production respectively, while neither Denmark nor Norway have nuclear energy in their energy mix.

Figure 3 Share of electricity production by source (2021)



Source: Our World in Data – based on BP statistical Review of World Energy & Ember (accessed 2023-02-08)

↑ Photos: Ritzau/Scanpix and Pixabay

3. Brief Literature Overview

There has been a **large interest for Community Energy and citizen involvement historically across Europe and it has received even more traction with the implementation of CEP**. This has also led to more studies that are more directly applicable to the concepts of REC and CEC. The field is constantly growing and since IEMD and REDII were released in 2019 and 2018 respectively, extensive research on the actual results and effects are not yet available. Although our study covers more literature, this chapter will focus on the more prominent, recent, and relevant (to this study) projects and studies. This overview should be seen as providing context, rather than an all-encompassing literature overview.

3.1. Sweco and Oslo Economics (2019)

When evaluating the distributed electricity production in the Nordic countries, Sweco and Oslo Economics found that installed capacity of renewable electricity production for self-consumption had significantly increased between 2005 and 2017 (from 1 880 MW in 2005 to 2 570 MW in 2017). Much of the increased capacity was driven by the increase in photovoltaic installations. However, the most dominant electricity production in the Nordic countries in 2017 was still wind power, which accounted for about three quarters of the electricity production for potential self-consumption in Sweden and Denmark. Of the Nordic countries, Denmark had in 2017 the largest estimated electricity production for potential self-consumption of 3 636 GWh. Sweden had the second largest estimated production of 722 GWh, Norway and Finland had an estimated production of 145 GWh and 114 GWh respectively, and Iceland had the lowest estimated production of only 30 GWh.

When evaluating the regulatory framework, Sweco and Oslo Economics found that **most Nordic countries have a legislation that promotes the development of distributed electricity production.** For all countries except Iceland there are national support schemes and tax deductions specifically directed at small-scale distributed production, in addition to general support schemes for renewable electricity production. And while there are differences in definitions and specific designs, the general regulatory framework and support system for the promotion of distributed production share many similarities across countries. For example, all Nordic countries have a system where prosumers have the right to be connected to the public energy grid to which they can sell their excess electricity to a competitive price.

Sweco and Oslo Economics (2019) found very few barriers to the development of distributed electricity production and self-consumption in the Nordic countries. They argue that the regulatory system in the Nordics has been designed to ensure that there are no discriminatory or disproportionate procedures on the market. It should be noted that this study focuses on self-consumption in general and not specifically on the legislation for Energy Communities. It is highlighted that perceived obstacle exits, which could hinder the development of distributed electricity production. This includes for example the complexity of the regulatory framework and a perceived uncertainty regarding future policies. As such, Sweco and Oslo Economics suggest that there are large growth potentials in the Nordics and and estimate that the distributet electricity production potentially used for self-consumption could increase to 24 000 GWh in 2040, depending on the technological advancements. (Krönert et al, 2019).[3]

3.2. The Current State of Research on Energy Communities (2021)

In their overview of the current state of research on energy communities Gruber, Bachhiesl and Wogrin (2021) find that **a majority of energy communities in the literature generate their electricity using photovoltaic installations and that they often use storage systems to reduce their reliance on the public grid**. They also find that P2P trading is an essential part of energy communities and suggest that with P2P trading the energy flows can be further optimised which allows for more of the locally produced energy to be consumed within the energy community. Moreover, they find that micro-grids are not as common as they expected as they only occurred in 16% of the studied literature, thus making Gruber, Bachhiesl and Wogrin (2021) conclude that micro-grids are not a technological necessity for the creation and sustainability of an energy community. Lastly, Gruber, Bachhiesl and Wogrin (2021) find that third-party aggregators can be an important component in an energy community and suggest using them on a more widespread basis to make the development of energy communities easier.

3. Krönert, F., Henriksen, G. L., Boye, S., Edfeldt, E., Weisner, E., Nilsson, M. F. & Uusitalo, O. (2019). Distributed electricity production and self-consumption in the Nordics

3.3. The NEWCOMERS Project (2019–2022)

One of the largest contemporary European initiatives for research on energy communities is the NEWCOMERS project.

The **NEWCOMERS** *(New Clean Energy Communities in a Changing European Energy System*) project (2019–2022) was an **EU-funded project aimed at exploring and evaluating a variety of different new clean energy communities across Europe**. By analysing how different types of clean energy communities operate, in what regulatory, institutional, and social conditions they emerge and thrive, but also what kind of benefits they could offer their members and society at large, the programme hoped to provide practical recommendations to policy makers. These recommendations were intended to help policy makers successfully support new clean energy communities and subsequently contribute to the decarbonisation of the European energy system.

The NEWCOMERS project had six partner countries across Europe, in which ten different energy communities were examined and used as case studies (Germany, Italy, the Netherlands, Slovenia, Sweden, and United Kingdom). The different energy communities were studied using a multi-method approach which included online surveys among community member, qualitative interviews with community members and managers, and an in-dept business model analysis of the 10 different case studies. The study also included a field experiment of a virtual energy community in Slovenia, an analysis of the socio-technological system in the six partner countries and a large-scale survey among the general population in nine European countries (France, Germany, Italy, the Netherlands, Poland, Slovenia, Spain, Sweden, United Kingdom).

It is worth noting that the NEWCOMERS project uses a **broader definition of Energy Communities** than both CEC and REC.

3.3.1. NEWCOMERS Findings

In their studies, the NEWCOMERS project found that **for new clean energy communities (CEC in their reporting, CLEC here to avoid confusion) to survive and thrive they need to develop new and often highly innovative business models**. The NEWCOMERS project was able to identify relatively standardised and stable business models, but the report with key project findings (2022) highlights that the new business models are often highly influenced and linked to each country's national policy frameworks. The reports also highlight that the communities do not operate in a vacuum and that the development of new business models will affect the relationships within the European energy system. The NEWCOMERS project further emphasised in its key project findings report that only a small number of the studied energy communities were engaged with active management of electricity networks or trying to engage with emerging flexibility markets. In addition, they found that whilst CLECs differ in context and operational models, they all largely share the same overarching goal of contributing, in some capacity, to the success of the energy transition.

With respect to actors and networks, the NEWCOMERS project reported in their report on key project findings that **CLECs are increasingly forming partnerships with each other and local government to accelerate the local energy transition**. In addition, they found that CLEC members are increasingly sharing and acquiring knowledge regarding renewable energy and energy efficiency. The project did however also find that the studied countries differ considerably in supportive infrastructure and that many communities to a large degree are **reliant on third party actors for technical expertise and operational support**.

While the NEWCOMERS project is able to identify **numerous benefits with CLECs** the key project findings report (2022) highlights (i) **finances** (lowering energy costs); (ii) the opportunity to become **self-sufficient**; (iii) **environmental concerns** (being able to contribute to energy transitions and reduction of CO_2 emissions); and (iv) **social benefits** (communal living, social recognition, and social approval) as the most commonly mentioned motivators for individuals to join a CLEC. The economic benefits are especially mentioned as a motivating factor by non-members, wereas already active members place special emphasis on the social benefits of a CLEC membership. In the key project findings report it can also be seen that by joining a CLEC, members indicate that they have gained an increased feeling of empowerment. It is also suggested that members have become more environmentally conscious overall after joining a community. **On a society level there are additional benefits**. As an example, it is suggested in the key project findings report that CLECs have the ability to **mobilise people to invest and take action**, that they can promote learning and the spread of know-how both regionally and nationally, in addition to **increasing the proportion of renewable energy in the supply mix**. With locally produced energy there is also a reduced need for system balancing.

A consistent finding from the citizens surveys highlighted in the key project findings report is that **the vast majority of households consider CLECs as an important or very important element in the transitions to more sustainable energy systems**. It is also highlighted that non-CLEC members consider CLEC as most beneficial if they are run by citizens, has a large member influence and lead to decreased energy costs. Despite the large benefits there are however very few incentives identified by the NEWCOMERS project for CLECs to offer flexibility services, and if they do offer flexibility, it is often facilitated by a commercial actor.

The NEWCOMERS project was also able to identify favourable environments for the creation and viability of CLECs. It found that apart from positive publicity, **CLECs benefit from support from the local government to overcome administrative and legal hurdles**. CLECs would also benefit from new housing legislations to encourage new clean energy investments by renters and landlords, in addition to increased dissemination of information and promotion of a less consumption-oriented culture. An increased dissemination of information and knowledge about CLEC could contribute to the diffusion of energy communities, as not being aware of energy communities was the most common reason given for not having joined a CLEC.

The NEWCOMERS project also found that there are multiple ways of scaling up or diffusing CLECs, which includes members sharing knowledge, experience, and information with others outside the community on either online platforms, social media, or mouth-to-mouth in both formal or informal settings. Furthermore, the key project findings report suggests that a way of diffusing the benefits of CLECs could be through licensed partnerships, where a licenced supplier could replicate the partnership with a new community elsewhere. To enable successful scale-ups there is however a need for increased incentives provided by legislation, regulation, and policies. There is also a lack of knowledge and understanding among politicians and decision-makers of how to effectively support the development of CLECs. Here the key project findings report suggests that simple guidelines could help improve the scalability of CLECs. In regard to regulation and policies, the NEWCOMERS project suggested that there is a need for adaptation to national circumstances to promote the development of local energy communities (NEWCOMERS, 2022).[4]

3.3.2. NEWCOMERS Recommendations

Based on the findings, **the NEWCOMERS project recommends that three key principles should guide policy makers in their work**, namely, ***Recognise, Priorities*** **and** ***Simplify***. In the final policy recommendations report, it is specified that this would include recognising the benefits, which energy communities offer their members and local communities, prioritise the CLECs by offering policy support and by simplifying the existing legislation and regulations. Along these three key principles **five main categories of policy recommendations** were formulated.

The **first category; *Recognising the value and strengthening the role of energy communities***, argues that consistent, unambiguous, and lasting support to CLECs are required at all governmental levels to further the position of CLECs in the European energy system. The authors suggest that this support can be provided by creating clear and nationally adopted definitions of the term energy community to provide increased legal clarity. The authors also suggest preferential regulatory treatment in European legislation is a way to strengthen CLECs position.

4. NEWCOMERS. *Key Newcomers Project Findings: A short overview.* https://www.newcomersh2020.eu/upload/files/D7_1%20-%20short.pdf, 2022 (Accessed: 2023-02-02)

Moreover, they recommend that policy makers develop and expand the concept of 'collective-self consumption' further to allow multiple users to be considered a 'single entity settlement' (Andor et al, 2022).[5]

The **second category; *Informing about energy communities***, recommends that policy makers and CLEC members to launch awareness raising campaigns to increase the understanding and knowledge of the benefits and opportunities, which CLECs can offer. To increase the visibility of CLECs is especially important as lack of awareness was the most common reason for people not to have joined a CLEC.

In the **third category, *Creating incentives for energy communities***, they recommend setting national targets for the development of the CLEC sector to be met by 2050, with interim targets for 2030. They also recommend that policy makers create and incentivise the connection of small operators to the energy grid and facilitate P2P markets, by different tax incentives and dedicated financing schemes which would create a pull effect for the CLECs.

The **fourth category; *Creating a supportive regulatory environment***, suggests that it is important to not just level the playing field of the European energy market, but that there is a need for actively encouraging and promoting the creation of CLECs in the legal framework. This would include simplifying current procedures and regulations, in addition to allowing space for new alliances between professional and volunteer-based citizen-led CLECs to emerge.

In the **last category, *Creating supportive networks for energy communities***, the authors suggest that setting up advisory services, umbrella organisations, and other intermediaries across the EU would benefit the development of CLECs, as it would provide legal, financial, and technical advice for potential but also already operating CLECs (Andor et al, 2022).[6]

3.4. Empowering Citizens for Energy Communities, Interreg Europe (2022)

The findings made by the NEWCOMERS project are to a large degree supported by the *Empowering citizen for energy communities* report written by Interreg Europe (2022), which suggests that energy communities could be a key tool in Europe's energy transition and in the fight against climate change. For example, the report suggests that renewable energy communities could be a driving actor of the energy transition in the heat sector by energy communities jointly investing in renewable district heating networks which would allow older houses to switch from fossil fuels

5. Andor et al. (2022), NEWCOMERS Final policy recommendations. July 2022. Available at: https://www.newcomersh2020.eu/upload/files/Newcomers_policy-final.pdf
6. Andor et al. (2022), NEWCOMERS Final policy recommendations. July 2022. Available at: https://www.newcomersh2020.eu/upload/files/Newcomers_policy-final.pdf

to renewable heating. The report also suggest that **energy communities and prosumers could account for 45% of EU electricity consumption by 2050**. However, for this to be achievable Interreg Europe suggests that energy communities need increased support from regional authorities to provide the right framework, expertise, advice and enable access to financing, as well as making sure that regulatory issues can be easily understood and navigated (Interreg Europe, 2022).[7]

3.5. European Energy Communities – Interreg North Sea Region (2021)

Similarly, in the *European Energy Systems* position paper written in 2021 by Interreg North Sea Region**,** where the opportunities and obstacles to the IEMD and REDII are analysed, it is suggested that **EU countries should include guidelines in their legal frameworks of how energy communities are to be supported for local authorities** to be able to set up community energy plans. It is also recommended that the European Commission makes an inventory and provides **clear guidelines for how countries can support energy communities in overcoming the obstacles which arise when energy communities function as market players**. It is for example recommended that the Electricity Directive 2019 needs an amendment or appendix to more clearly dictate the obligations of DSOs to ensure that CEC can access the public grid without being exposed to restrictive tariffs or permits, as the current directive leaves room for interpretation. In addition, the paper suggests that there is a need of a European Civic Energy Forum to provide capacity building measures and to function as a knowledge resource pool to help aid the clean energy transition (Interreg North Sea Region, 2021).[8]

3.6. Polycentric Energy Governance: Under what Conditions do Energy Communities Scale? (2022)

In their paper "Polycentric energy governance: under what conditions do energy communities scale" Petrovics, Huitema and Jordan (2022) are able to identify **23 different conditions which they suggest are important for the scaling and development of energy communities**. Petrovics, Huitema and Jordan subsequently divide these 23 different conditions into three dimensions, namely: (i) **external condition**; (ii) **interactions between initiatives**; and (iii) **functioning of initiatives**, to be able to address what happens within, between and in the context of individual initiatives. They suggest that an increased understanding of how the different dimensions and conditions interact could help policy makers improve their support

7. Interreg Europe. (2022) *Empowering Citizens for Energy Communities – A Policy brief form the Policy Learning Platform on Low-Carbon economy*. Available at: https://www.interregeurope.eu/sites/default/files/good_practices/PolicyBrief_RECommunities_final.pdf
8. Interreg North Sea Region(2021). European Energy Communities: With recommendations derived from the Interreg North Sea Region project 'Delivering Community Benefits of Civic Energy (COBEN)

of energy communities in their development. They also suggest that energy communities now have entered a new phase, which is characterised by digitalisation and the emergence of market-oriented business models. According to the authors, this has resulted in a move away from a community logic to emphasis on market logics, consequently hollowing out of the energy community citizenship and made members of energy communities as mere producers or consumers of energy (Petrovics, Huitema & Jordan, 2022).[9]

9. Petrovics, D., Huitema, D. and Jordan, A. (2022) 'Polycentric energy governance: Under what conditions do energy communities scale?' *Environmental Policy and Governance*, 32(5), pp. 438–449. doi:10.1002/eet.1989.

↑ Photos: Pixabay and iStock

4. Implementation of Renewable Energy Communities and Citizen Energy Communities in the Nordics and Europe

As previously mentioned, the transposition of the REC and CEC definitions into the respective national legislation varies widely among the studied countries. Denmark and Austria have transposed both of the definitions into the national legislations while Finland has chosen to use a singular definition "local energy community" which encompass both RECs and CECs. The remaining countries are at various stages in the transposition process. Consequently, the transposition of the enabling and incentivising frameworks for the respective models has also progressed at different rates.

4.1. Country Specific Implementations in Brief

In the Nordic countries, **Finland and Denmark have implemented the REDII and IEMD in their legislative framework, while Sweden and Norway have not yet implemented the relevant concepts in their legislation**. In **Denmark**, in 2021, RECs were included in the law on promotion of renewables, while the definitions of both RECs and CECs were defined in an executive order which added to the law on electricity supply. In **Finland,** the definition Local Energy Communities (LEC) was integrated in the legislation in 2021, although there is currently no legal differentiation between REC and CEC.

At the time of this study, **Sweden** has not transposed Energy Communities into the national legislation. The Swedish Energy Regulator has drafted a proposal on how to transpose the directives into the national legislation but no formal proposal on legislation regarding transposing Energy Communities has been made so far. **Norway**, lastly, has not implemented CEC or REC as concepts in neither the national legislation nor in practice. Since Norway is not an EU Member State they do not have to transpose the EU legislation directly. As part of the European Economic Area (EEA), the directives will be implemented in Norway if the EEA and EFTA agree that the directive is relevant to the EEA agreement.

In European countries outside the Nordics the transposition is also **of various stages,** depending on the country. Of the non-Nordic countries included in this study, **Austria** is most far ahead in terms of transposition. Energy communities were established within the legal framework in 2019, with the passing of the Renewable Energy Act, a direct translation of the European directive into Austrian law. Additionally, the "Complete Legislation for Electricity Markets and Organization Law", has established a clear definition of and framework for Citizen Energy Communities. In **the Netherlands,** the two concepts of CEC and REC are to be joined into one concept in the Energy Law, called energy community. In **Germany**, there is also no single definition of citizen energy communities or renewable energy communities. Recently, REScoop.eu launched a transposition tracker to visualise the transposition of the concepts CEC and REC in each EU member state according to an assessment of a set of indicators. The tracker is continuously updated to assure a relevant depiction of the respective transposition (REScoop, 2023).[10]

4.2. Synthesis of the National Legal Frameworks

Although the transposition of the Clean Energy for all Europeans package into the respective national legislations are at varying stages of progress, all the studied countries have existing legislation that regulate the initiation, activities, and organisation of Energy Communities.

In the Nordic countries, there are one or two main laws that make up the national legal framework, and **which are implemented by one or two relevant (energy) agencies**. In **Denmark**, the main laws regulating Energy Communities are the Law on Promotion of Renewables and the **Law on Electricity Supply**. The main public bodies regulating and supervising the Danish energy market are the Danish energy agency (DEA), responsible for tasks linked to energy production, supply, and consumption, and the Danish Utility Regulator (DUR), responsible for securing consumer interests in the utility sectors. Both agencies answer to the Ministry of Climate, Energy and Utilities. In **Sweden,** the main legislative framework is the Electricity Act, which regulates the energy market and the implementation of energy communities. The Swedish Energy Agency (Energimyndigheten) is the government agency responsible for promoting energy-efficient measures and investments in renewable energy technologies. Furthermore, the Swedish Energy Market Inspectorate supervises the Swedish energy market actor's compliance with

10. Rec and CEC definitions (2023) REScoop. Available at: http://rescoop.eu/transposition-tracker.

laws and regulations at the national and EU level. In **Finland**, the Electricity Market Act is the main legislation regulating Energy Communities, which formalises the rights of actors in the electricity market. The Energy Authority implements, supervises and reinforces policies set by the legislation. Finally, in **Norway,** the main national legislative frameworks are in the Energy Act, Energy Regulations, and the Grid regulation and the Energy Market Regulation.

In the case study of countries outside the Nordic countries, the same situation can be seen. In **Austria**, there are two main legislative frameworks: (1) the Renewable Energy Act, the direct translation of EU regulation regarding energy communities into national law, and (2) the Complete Legislation for Electricity Markets and Organization Law. The Austrian Ministry of Climate Action and Energy is the ministry responsible for implementing and translating the EU directives into national legislation, while E-Control is the Austrian government's regulatory authority for electricity and natural gas markets. In **Germany**, the most important national regulations are the Renewable Energy Sources Act, and the Energy Industry Act, as well as laws on particular legal company models, such as the law on cooperatives, which play important roles with respect to energy communities. The federal government plays a role in the oversight of these laws, as well as the federal grid agency ("Bundesnetzagentur") on an implementation level. Finally, in **the Netherlands,** the laws that were of importance until now were the Electricity Act and the Gas Act, which as of this year or the next will be combined in the Energy Act, which will encompass the regulation for all energy carriers. The main regulatory authorities for the energy system, and renewable energy communities, are the Ministry of Economic Affairs and Climate (Ministerie van Economische Zaken en Klimaat, EZK), which is responsible for the policy side, and the Netherlands Enterprise Agency (Rijksdienst voor Ondernemend Nederland, RVO), responsible for the implementation of the policies.

4.3. Energy Communities in Practice

In the following, we shall provide an overview of the definitions of Energy Communities in the seven countries of analysis and compare the different models for Energy Communities of the countries.

In almost all countries of analysis, except Austria, there is **little or no differentiation made between REC and CEC in the general discourse;** often they are referred to as energy communities. Thus, much of the literature and the interviewees do not discern between the two definitions. In the following, we will use the term Energy Communities as an umbrella term for the different forms and models in the different countries. While, using the specific terms REC and CEC when a differentiation is being made.

The country studies shed light on the different roles of energy communities in the analysed countries showing that scale of Energy Communities varies. In **Norway,** the interest and need for Energy Communities is rather low due to a historically robust energy system and low energy prices. Hence, although there are some active Energy Communities and new projects aim at establishing more, the implementation remains at an early stage and is rather small scale. Similarly, Energy Communities in **Sweden** are at an early stage, and the definition of Energy communities has not yet been included in the national legislation. However, active Energy Communities exist and both political as well as public interest in locally produced energy is growing. The same situation applies to **Finland**, where around 100 Energy Communities are established, yet the system remains in its infancy. **Denmark** has a long history of citizen ownership and is one of the EU countries with the highest share of citizen ownership of energy assets. Although Danish legislation discerns between CECs and RECs, in general conversation people refer to Energy Communities (Energifælleskaber).

Energy Communities have a longer history in **Germany** being established since 1995. There was a strong increase in numbers between 2006 and 2013. Yet, the foundation of new Energy Communities, especially of those focusing on solar power (which constitute the largest part of ECs in Germany), has been decreasing since then. In total, there are around 1,700 Energy Communities in Germany. The **Netherlands** has around 700 Energy Communities and the numbers are currently increasing. The high interest is also reflected explicitly in the national Energy Law. **Austria** is the only country that distinguishes between CEC and REC in the general discourse. REC may produce energy from renewable sources and consume, store, or sell self-generated energy, CEC is a legal entity that generates, consumes, stores, or sells electrical energy. Overall, there are around 100 RECs and between 3 and 10 CECs. In general, interest in Energy Communities is increasing and since March 2022 there is a first funding call for energy communities.

4.4. Comparative Analysis of Models for Energy Communities

Due to the high variety of models across the countries, no systematic definition formodels of Energy Communities can be established. Yet, various factors, such as focus on Renewable Energy Communities (REDII) versus Citizen Energy Communities (EMD), technology, legal form and regulations, location, property ownership, and stakeholders, seem to be important when analysing the formats of Energy Communities in the countries. In the following, the role of these factors in the respective countries will be summarised:

In **Norway**, most projects aiming at implementing energy communities are driven by property owners and real estate companies trying to increase local power production and self-sufficiency of energy for buildings. Further, Distribution System Operators (DSO) are engaging in research projects to strengthen their knowledge of the potential of energy communities. There are also some pilot projects to develop energy communities for production and sharing renewable energy on remote island off the coast of Norway.

In **Sweden**, the main factors defining the model of implementation are the organisational structure and the model for electricity sharing. Four different models of organisation can be identified: First, wind power cooperatives are organised as incorporated associations. Second, eco-villages with individuals focusing on sustainability and self-sufficiency are established. Third, there are solar power cooperatives within tenant-owned apartment buildings ("Bostadsrätts-föreningar"). Fourth, rural communities run small scale heating systems.

In **Finland**, the Electricity Market Act allows for three types of communities. The single-property communities use the produced energy for the community members. Based on "compensatory calculation" the production is monitored and shared among the members. In case the production exceeds the needs of the residents, the excess is sold to an energy provider. . Cross-property energy communities produce and consume energy on different, but immediately adjacent properties. This way, an energy community can be established when, for instance, the site of consumption is not suitable for production. The energy community is connected to the grid via single connection points instead of a ring connection. Further, there is a possibility to create de-centralised energy communities across the country. This can for example comprise energy production at summer cabins and consumption of the energy at the members' homes. In this model, members pay grid service charges and taxes as usual and currently both sites must have same supplier.

In **Denmark**, the main difference in energy communities lie in the organisational structure of the different types of communities, type of energy produced (eg. heat or electricity) and model for energy sharing. Energy communities exist as eco-villages, small-scale heating systems in rural communities, and cooperatives focusing on local wind and solar panels on residential buildings.

In **Germany,** factors such as the technological focus and the legal framework define the different models for energy communities. Traditionally, the largest sector of energy communities are cooperatives focusing on solar power to produce energy. Increasingly, there is a shift to wind energy parks organised as companies with limited liability (GmbH & Co KG). The limited partners "Kommanditisten" are citizens. Moreover, there are alternative legal frameworks such as "Gesellschaft bürgerlichen Rechts" that are more attractive for smaller projects (<€100,000). There are also examples of energy communities, where several municipalities found a public agency to organise energy supply and operate electricity grids (Joint municipal company). This way, all citizens can take part in the community independently of personal investments in the setup. There is also an opt-out option for citizens living in municipalities with municipal energy communities, ensuring that participation is voluntary.

In the **Netherlands**, models of implementation depend on the national legal framework. The main forms of organisation are cooperatives, foundations, Associations of Owners (Vereniging van Eigenaren), and companies. A requirement for receiving subsidies for energy communities is that the community is organised as a cooperative or a foundation.

In **Austria**, there are three types of energy communities: (1) in Joint/Communal Communities several people can produce and use electricity together on the same property, using joint infrastructure, (2) Local Energy Communities (REC) are usually implemented by municipalities and SMEs and are connected via a common transformer substation and (3) in Nationwide Energy Communities (CEC) members receive energy from the same DSO and are not geographically bound. Most Energy Communities are mainly organised as cooperatives (often having their own infrastructure), or as associations with the latter often not having any infrastructure of their own but combining the members' facilities. In terms of technology, focus lies on energy production with solar panels. In the future, wind power and biomass will probably play a more important role.

4.5. General and Country/Model Specific Barriers

4.5.1. Knowledge Barriers for Both Community Members and Policy Makers

A barrier that is mentioned by most countries, is the **lack of awareness and knowledge among local, regional, and national policy makers and the general public**. The lack of awareness among local and regional policymakers prevents municipalities from assigning space for energy communities or allowing communities when they take initiative. In Germany, for example, it can be difficult to convince mayors of the possibility to start an energy community in their municipality. The lack of awareness among national policy makers prevents energy communities to be properly integrated in the national governance framework.

The lack of awareness among the general public creates barriers as this can make it difficult to convince the local citizens to accept an energy community (as the German country case study shows), or to gather a sufficient number of people to start an energy community (as the Norwegian country case study shows).

Furthermore, setting up energy communities requires specific knowledge. In most countries, a barrier is that **community members lack the technical and legal knowledge required** inthe starting phase of the community. This barrier is present in most countries, including Sweden, the Netherlands, Germany, and Norway. The knowledge deficit creates barriers for the energy communities as it can be difficult and time-consuming for their members to acquire the knowledge. Sometimes this barrier is reinforced through DSOs or network operators that do not provide information to communities, which they would need to start their energy community.

4.5.2. Financial Barriers Related to Large Upfront Investments

Neither RECs nor CECs may have financial profit as a primary purpose. However, savings are often a significant motivator for members to start or join an EC. Starting up an energy community requires large upfront investments. This creates financial barriers for aspiring community members, especially for less affluent citizens. Even when it is clear that the business case for the energy community can be profitable in the long run, the upfront investment can still create a barrier. Especially when subsidies or other types of funding or loans are not easily available, this barrier can prevent energy communities from being initiated.

4.5.3. Legal Barriers Related to Energy Sharing

The Clean Energy for all Europeans package gives energy communities the right to share energy within the community. The package differentiates between energy supply and energy sharing. However, as energy sharing currently is not clearly defined, the practical framework for energy sharing is to a large degree decided by the respective member state.

Energy sharing in the context of energy communities can be performed in numerous ways. It is worth noting that energy sharing is not confined to the activity of direct and physical sharing of energy among community members but can also be defined as administratively sharing of the energy, such as sharing electricity through the collective grid, offsetting energy components, sharing of remunerations and/or tariff adjustments. If a member state allows an energy community to construct a communal grid the energy community would, in accordance with the EU directive, also need to take on the role and responsibilities of a DSO.

In this report we have looked at the various ways in which the respective country has interpreted energy sharing and provided options for energy communities. Hence, the definitions observed are broad and are rather defined by the various objects of the study than by a predefined definition by the study team. It is worth noting that, at the time of authoring the report, the EU commission has proposed a reform of the EU electricity market design, in which rules on sharing renewable energy are being revamped.

Austria is the country that has the most established governance framework among the investigated countries, which allows energy sharing. Even here, though, the administration of energy sharing is rather complicated. In **Denmark**, regulations on energy sharing permit electricity sharing within a single building such as a housing cooperative, but electricity sharing outside of a building is only possible through the collective grid and is subject to the general tariffs and taxes. In **Finland** and in **the**

Netherlands, energy sharing is currently only possible when the communities make use of administrative solutions to enable energy sharing on paper. The energy is shared via the grid and is subject to the general tariffs and taxes. In **Finland**, one administrative solution is to make use of *virtual net metering*: the DSO is responsible for this, measuring electricity usage of the community's members and organising internal credit calculation. The other solution is to apply back metering, where the housing company only has one DSO meter (and subsequently only one supply contract) and divide the energy bill among the shareholders either by non-DSO submeters or with fixed proportions, for example based on area of the respective apartment. In **Sweden**, energy sharing is only possible when a microgrid has been deployed in a building by a company or a DSO. In **Norway**, it is only possible to share energy produced within a residential building if the community members form a power production company and act as shareholders of this company. In **Germany**, there is currently no legal framework for energy sharing or landlord-to-tenant electricity, which limits the development of energy communities.

Some ECs wish to build a (micro-)grid for the community with the purpose of electricity sharing among members. The extent to which this is possible varies per country. In line with the IEMD DSOs have a monopoly on deploying regional and local distribution grids. In **Finland,** only DSOs are by law allowed to build separate electricity grid lines crossing property limits, an exemption in the law allows energy communities to build separate lines of max 2 MW, connecting a small-scale electricity production to its designated point of use and if multiple properties are owned by the same owner, a network between these properties can be constructed. In **Sweden**, there is also an exemption in the law, however it only applies to small internal networks within an easily defined area. A few pilot projects have been permitted to develop a common energy system for residential areas. In **Norway**, also only DSOs are permitted to develop distribution grids, limiting the possibilities to form larger communities that can produce and share energy. In **Germany,** other actors than DSOs can also apply for concessions of local electricity grid. As a result, several energy communities manage their own electricity grid. In **Austria,** the ownership of a community's infrastructure depends on the specific model of energy community. Communities established as associations do not own infrastructure but tend to lease infrastructure. On the other hand, communities run by large cooperatives often own their infrastructure**.**

In the Nordic countries, energy sharing via an internal grid has an extra dimension to take into account: the principle of fairness. The Nordic countries are sparsely populated and inhabitation is more distributed within the countries, with some areas having a very low population density. This means that energy prices are usually distributed among all those connected to the collective grid, independently of how long the lines required to connect them to the grid are. This is to prevent the cost of maintenance of the grid in sparsely populated areas to be way higher than in the cities. If energy communities would create their own micro-grid, this could mean that network operators would lose (a part of) the income from the energy community members in terms of contributions to the collective grid.

4.5.4. Practical and Technological Barriers Vary per Country

In some of the countries, there are **technological barriers related to a lack of digital infrastructure**. In Germany, the lack of digital infrastructure is one of the main barriers for renewable energy communities. Also in Norway and Austria there are challenges related to the digitalisation of the grid. Another challenge is that in some countries (e.g. Germany and Austria), the nationwide **rollout of smart meters is slow**. This limits the opportunities for accurate monitoring or measurement of community- or household-level energy supply or use.

4.6. General and Country/Model Specific Mitigators for Barriers

4.6.1. Legal Barriers Mitigated by Administrative Solutions or Newly Developed Laws

In most of the case study countries, new laws have been, or are being introduced in the next few years that incorporate room for energy communities in the legal framework. In Austria, a new law has been introduced in 2019. In Denmark new regulation has most recently been introduced in 2023. In the Netherlands, new laws will be introduced in the next few years. In Finland, a working group has been set up to identify whether additional regulation changes are needed to further promote energy communities.

For energy sharing, a solution that can mitigate barriers is to introduce locally differentiated tariffs. In Denmark, a study has been made to analyse possibilities for local collective tariffing for energy communities, enabling tariffs tailored to the respective energy community's contribution to the collective grid. The study resulted in a new regulation, which has entered into force in 2023.

4.6.2. Representative Body to Lobby for Energy Communities

The barriers related to lack of a governance framework for energy communities can be mitigated by representative bodies of energy communities thatlobby for the inclusion of energy communities in the governance framework. A good example at EU level is REScoop[11], the European federation of almost 2000 European energy cooperatives. This federation lobbies at EU level for inclusion of energy communities in the governance frameworks, as well as supports the national energy community representative bodies.

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11. Rescoop (n.d) REScoop. Available at: https://www.rescoop.eu/.

4.6.3. Knowledge Barriers Mitigated by Education from Representative Bodies

The barriers related to lack of knowledge among local, regional, and national policymakers can be alleviated with the help of representative bodies of energy communities. A representative body can act as an organisation that facilitates the knowledge transfer between energy communities and policy makers. On the one hand, a representative body can educate policy makers about the benefits of energy communities, and on the other hand it can educate (aspiring) energy community members. A good example is the Coordination Office for Energy Communities in Austria. It acts as an intermediary between the energy communities and Austria's federal states as well as the relevant ministry and other relevant actors, and supports energy communities as well as policy makers.

4.6.4. Financial Barriers Mitigated by Availability of Support and High Energy Prices

The current high energy prices cause the business models for the energy communities to be more profitable. Especially in countries that are still largely dependent on fossil fuels for their energy supply, the energy prices have been very high in recent years. Support from governments in the form of funding or subsidies also supports the mitigation of financial barriers. In Austria, for example, the Coordination Office for Energy Communities sets up funding programmes for the establishment of energy communities. In the Netherlands for example, a subsidy scheme has been introduced to ensure that the energy price for energy communities stays within a certain range. If the energy price was to drop, this does not endanger the business model of the energy community. A subsidy scheme like this can convince banks to invest in energy communities, as their business case is more stable, providing a source of financial capital for upfront investment.

4.7. General and Country/Model Specific Enablers

4.7.1. Governance Framework can also Enable Energy Communities

While previous sections often mention that governance frameworks creates barriers for energy communities, there are also laws that can enable energy communities. In Austria, for example, recent laws established clear definitions of and framework for energy communities, enhancing their adoption. Another example is the Netherlands, where space was created in a previous law specifically to allow experimentation with innovative ideas like energy communities.

4.7.2. Possibilities for Energy Communities to Reduce the Energy Load of Local Grids

In Austria and the Netherlands, energy communities are seen as possible solutions for energy load reduction, grid stabilisation, thus lowering the necessity for (local) grid expansion. In the Netherlands, where grid congestion already poses a problem, the DSOs are eager to collaborating with energy communities to get their support for local congestion alleviation.

4.8. Drivers for Founders and Members of Energy Communities

4.8.1. The Prospect of Control over Energy Supply and Related Financial Savings

A main driver for aspiring energy community members is the prospect of control over their own energy supply, and the related possibilities for financial savings. Especially when energy prices are high, **the prospect of (relatively) stable and low energy prices** can be a big driver for citizens to take the step to start an energy community. Hence, high or volatile energy prices can act as an increased incentive to start or join an EC.

Also, in some countries **the prospect of security of supply in rural areas** is a driver. Especially in some of the Nordic countries, energy communities can be found on (remote) islands. These energy communities are sometimes entirely off-grid. An energy community can be the only way to have a security of energy supply, especially when existing connections to the collective grid have limited capacity or when they experience frequent power failures, as is the case on a Norwegian island described in the Norwegian country case.

4.8.2. The Possibility to Contribute to the Acceleration of the Energy Transition

Another driver for implementers is the chance to contribute to the energy transition, or its acceleration. Especially when a country still has a relatively low share of renewable energy, or is not planning on increasing the share of renewable energy, citizens can be compelled to support the transition themselves. Hence, starting a renewable energy community can be a local solution to the national energy transition challenge.

4.8.3. The Promise of Democratisation of and Benefits for the Community

For some implementers, the **democratisation of the neighbourhood is an important driver** to engage in the establishment of an energy community in their neighbourhood. An energy community, especially when established as a cooperative, often functions as a democratic body in which each citizen can contribute. Especially in Germany and the Netherlands, the cooperative is seen as a way to provide benefits for the community. For example, the profits that an energy community can make from selling their excess electricity to the collective grid can be used to invest in the neighbourhood. Also, an energy community can make sure to also involve marginalised or vulnerable citizens and support them, financially and socially.

4.9. Conditions in Energy Systems that Render Contributions Less Likely

4.9.1. High Share of Renewable Energy in the Energy Mix

When a country already has a high share of renewable energy in its energy mix, citizens are less likely to engage in the establishment of energy communities. In such countries, the environmental and financial benefits are less convincing for citizens. It is not necessary to push the energy transition bottom-up in these countries. Also, with a high share of renewable energy, the energy prices are likely to be lower than in countries that are more dependent on fossil fuels such as natural gas, which push the energy prices higher when they make up a large share of the energy mix.j

↑ Photos: Pixabay

5. Associated Benefits

In our country studies and in the literature reviewed a multitude of benefits have been associated with Energy Communities. Both financial, environmental, cultural, and social. In this chapter we present an overview of the most commonly reoccurring benefits, categorised according to whom the benefits primarily apply. Most of the addressed benefits are applicable to both RECs and CECs while occasional benefits primarily apply to CECs, and in those cases it is stated in the text.

5.1. Community Members

In accordance with the main drivers to join an energy community, the two predominant benefits presented by our interviewees are **monetary savings** and a sense of pride and/or satisfaction associated with **contributing to the energy transition** and **increased sustainability**. These benefits are mentioned in each country that has been studied and the aspect of monetary savings seem to be even more prevailing now, clearly associated with the energy crisis and the increased prices and risk of energy poverty.

Other benefits that are mentioned in many countries, but not all, are those of increased knowledge and awareness of renewable energy sources.

In remote and rural areas, the possibility to produce and share energy adds stability to the local energy supply. In Norway, one example is that remote islands are often subject to harsh weather conditions and subsequent power failures. The possibility for these areas to have local energy production, coupled with a microgrid which can be “islanded” (functional regardless of the collective grid) would facilitate electricity supply when the function of the collective grid is compromised.

5.2. Society

As previously mentioned, among the most evident benefits stemming from Energy Communities are the contributions to the transition to RES.

Energy Communities accelerate the **democratisation of the electricity market** and **increase citizen autonomy** in relation to other actors on the energy and electricity markets. The possibility to manage one's own electricity supply, storage and sharing places the power into the citizens hands and gives them an increased leverage on the market.

Furthermore, the **resilience of a decentralised** and **independent energy system** has been presented. Less reliance on a centralised grid could help to mitigate the effects of outside disruptions such as cyber-attacks, sabotage on gas pipelines or weather-related disturbances.

5.3. Electricity Market

Regarding the electricity market and general energy system, the potential benefits can be divided into supply-related and demand-related contributions.

A majority of the discourse surrounding Energy Communities focuses on the contributions related to supply of electricity or energy in general. However, it is possible that Energy Communities could also provide **demand-related contributions**, both regarding **decreased demand** and **demand flexibility**. To our knowledge, few studies have been conducted on the subject, but it has recently received some traction. In a study from 2022, the authors conclude that Energy Communities are capable of developing demand-side solutions that are distinguished from government- and/or business-led approaches. Their analysis suggested that demand reduction via energy communities is challenging but possible. There is a limited range of possibilities, and it requires dedicated work to identify and exploit these possibilities. Regarding flexibility their analysis suggested that more configurational work is needed than for demand reduction, but it is also possible to contribute with flexibility solutions. The authors emphasised that future research is required (Barnes et al. 2022).[12]

With respect to **supply of energy and/or electricity**, there are several ways that Energy communities could benefit the electricity market. Most commonly discussed are the contributions to an **accelerated transition into RES, increased capacity and resilience, and support in congestion alleviation.**

12. Barnes, J., Hansen, P., Kamin, T., Golob, U., Musolino, M., & Nicita, A. (2022). Energy communities as demand-side innovators? Assessing the potential of European cases to reduce demand and foster flexibility. *Energy Research & Social Science*, 93(102848). https://doi.org/10.1016/j.erss.2022.102848.

The role of Energy Communities in the transition to a fully renewable electricity production is often highlighted, both as a motive and subsequent benefit. The contributions to the transition are based on three main aspects: **increased production of electricity from RES** in Energy Communities, **increased public acceptance** of renewable energy systems in the public space, and a **decrease in electricity demand**. As previously mentioned, the last aspect is not yet substantiated and seems to depend heavily on factors such as share of self-produced electricity of consumption and initial motives for self-consumption.

The focus on local electricity production and consumption can help alleviate grid congestion through a decreased need for transport through the collective grid. In the Nordic countries this will often be dependent on what type of technology is used. Given that congestions in the Nordic grids often occur during the winter and the Nordic preconditions greatly reduce the effectiveness of PV-solutions during the winter, a high share of PV in communities may omit some of the overall positive effects on grid congestion.

↑ Photos: Pixabay and iStock

6. Conclusions and Recommendations

6.1. General Conclusions

There seems to be a steep increase in the interest in Energy Communities, related to the current energy crisis. Partly due to the increased energy prices and partly due to apparent vulnerability of the centralised energy system, many citizens see Energy Communities as a means to contribute to a **sustainable transition** as well as **monetary savings, social benefits** and **autonomy.**

In the countries that we have studied, **few have fully transposed the definitions** of REC and CEC into their national legislation. Even fewer seem to use the definition in the national discourse. Most often, they are simply referred to as Energy Communities (or a rather similar translation into the respective language) in which many different models are included. There are several attributes in which the communities differ, most prominently: organisational form, technology, energy sharing models and activities conducted. The combination of difference in transposition of the definitions and large disparity in models for energy communities renders a cross-model comparison rather sprawly and to an extent inconclusive. Instead, it underlines the importance of simple and clear definitions in both legal documents and general discourse. This will help clarify what possibilities and responsibilities apply to the respective model and simplify the decision of what model to choose when initiating a community.

Similarly, there is a large diversity of concepts and terminology used for community initiatives in energy across Europe. Both in the academic literature, general discourse and consultations, a wide range of terms are used, such as Energy community, Community Energy, Citizen Energy Community, Renewable Energy Community, Clean Energy Community and more. This exacerbates **conceptual confusion** and makes horizontal comparison of both policy recommendations and research findings cumbersome and less stringent. A reduction on the number of concepts as well as clear definition of what is encompassed in and required for each concept would facilitate more expedient policy analysis, recommendations and translation of lessons learnt.

Another important observation is that although interest in Energy Communities among the public is increasing, the **public awareness of the concept** is low, omitting both possible community initiatives and potentially important inputs to the public debate regarding Energy Communities.

Thus far, the studied countries have not found a conclusive way to circumvent the conflict between economic viability for the communities and fairness in shared costs for the collective grid. Without a simple, efficient as well as cost- and input-reflecting solution for electricity sharing, many potential initiatives are unviable and are either decreased in scope or never started. The choice of an electricity sharing model for each country should be individually assessed, based on factors such as population density, foreseeable expansion needs of collective electricity grid, and current energy mix.

6.2. Applicability in a Nordic Context

Even though there are many preconditions and circumstances that are relevant across the Nordic context, there are also country-specific conditions that need to be considered. Hence, the following section will be divided into a subsection with country specific observations and a subsection with observations that are horizontally applicable in the Nordic context.

The relatively low population density of Norway, Sweden, and Finland, demands a comparatively vast collective grid including transport of electricity over long distances to ensure security of supply to the citizens. Local production and consumption can help decrease the transport losses from centralised energy production as well as the need for grid expansion in remote areas, where a local energy community could act as a closed distribution system operator or DSO. Energy Communities can also improve the security of supply and resilience in remote areas, as exemplified in the projects on islands in Norway.

On the other hand, the cost of maintenance of long-distance transport lines may be unevenly distributed. However, this could be mitigated through both the electricity injected to the local distribution grid and the subsequent decreased need for transport of electricity.

A large share of the electricity production in the Nordic countries stems from RES, and there is a low inclusion of fossil fuels. This is especially true for Norway, while both Sweden and Finland also rely on nuclear power and Denmark had an inclusion of 26% fossil fuels in 2021. This seems to also relate to the progression of energy community deployment in the respective countries, seeing as one of the main drivers for starting/joining an EC is to support the transition of the energy system. Denmark has by far the highest number of energy communities while Finland and

Sweden are on the rise. The development of energy communities in Norway is still in its cradle and one clear reason is that Norway is not an EU member state. However, another possible factor is the already high inclusion of RES.

6.3. Recommendations

Given our general observations, the context of the Nordic countries and the currently evolving knowledge surrounding Energy Communities, we present three recommendations to help enable Energy Communities without promoting an unfair division of costs.

6.3.1. Introduce Clear and Coherent Definitions of Energy Communities

Clear definitions in both legal documents and general discourse lessen uncertainties and hesitation in the initial phase of establishing an energy community.

6.3.2. Ensure Accessibility to Establish Energy Communities

Two of the main barriers to the deployment of Energy Communities identified are related to awareness and knowledge. Firstly, few citizens are aware of the possibility to establish or join an energy community, acting as a first hindrance to possible deployment of an unknown number of communities. Secondly, the knowledge needed to establish an energy community, both technical and judicial, acts as a barrier for many citizens that do not have the prior knowledge or the time to fully acquire the necessary know-how. To mitigate these barriers, we propose two main strategies:

- **Ensure clear and simplified legislation.**

Counteract all risks of ambiguity. Partly, to provide an explicit and easily comprehensible framework for potential founders and members. Partly, to discourage geographically differentiated interpretations by e.g., local authorities or DSOs.

- **Promote support organisations.**

Support organisations and/or networks can benefit the dissemination of information that raise awareness in the general population. They can also provide a platform for knowledge sharing through handbooks or pamphlets. Furthermore, they can act as intermediaries between inquisitors and competency.

These support organisations can either be privately run or organised as a state entity. For example as a "one-stop-shop" solution.

6.3.3. Enable Electricity Sharing

The possibility to share electricity within the community in an efficient and cost-effective/-representative way seems to be of key importance in order to increase the establishment of Energy Communities. The national context is very relevant when looking at the potential benefits of a more restrictive or allowing legislation regarding electricity sharing. Thus, a model that would fit all are neither viable nor recommended. Given the current state of the respective legislation, the following steps are recommended:

- Enable electricity sharing through the collective grid, with clear and defined renumeration-schemes for the respective contribution to the collective grid, ensuring consistent calculations across regions.
- Include room for experimentation or "sandboxing" in the legislation on electricity sharing.
    - One way of proceeding to do this is to ensure room in the legislation for experimental projects, through specified exemptions.
    - Policymakers could, possibly at a later stage, specify the conditions for the experimentation projects as well as what exemptions are applied. This ensures that potential experimental or sandbox projects will fit within the scope that the policymakers want to explore.
    - Allow for projects led by both prospective communities, DSOs, and other relevant stakeholders in the transition to apply for making use of this experimentation opportunity. This way, citizen and stakeholder-led experimentation ideas can be explored within the boundaries set by policymakers.
    - Assess whether further incentives should be included, such as project funding from grants.

COUNTRY STUDIES

Norway

Background Information

The implementation of energy communities (EC) is in its infancy in Norway. Citizen Energy Communities (CEC) and Renewable Energy Communities (REC) have not yet been implemented as concepts in national law or in practice according to the definitions specified in the EU Electricity Market Directive (EMD) (2019/944)[13] and Renewable Energy Directive (REDII) (2018/2001)[14]. Due to relatively low energy prices historically and a robust energy system based on hydropower, the public and political interest in exploring new energy solutions such as energy communities have not been particularly strong. Additionally, as Norway is not an EU member state, the implementation of CECs or RECs is pending. There are, however, active energy communities in Norway today, mostly organised as pilot projects, and the general interest in energy communities or other alternative solutions to produce renewable energy locally has intensified over the past few years, mostly due to climate change and increased energy prices.

There is no existing database on initiatives. However, a previously conducted study [15] identified 30 active energy community initiatives, of which only five had been implemented and the rest were at early stages. The majority of energy community initiatives were initiated by property developers and real estate companies, developing energy-efficient residential buildings that produce and store renewable energy. Another common form of energy community initiative was conducted by DSOs, aiming at developing different models of microgrids in identified areas to limit the load on the main grid, and thereby decrease future investment costs related to maintenance (Thema Consulting group, 2018).

The implementation of energy communities in Norway is regulated by national legislation. As Norway is not a member of the EU, the implementation of CEC and REC does not automatically apply to the national legislation (MchElhinney et al, 2022).[16] The central actors within the Norwegian energy system, and consequently the most important actors for the implementation of energy communities, are The Norwegian Water Resources and Energy Directorate (NVE), The Norwegian Energy Regulatory Authority (NVE-RME), The Norwegian TSO Statnett, the Norwegian

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13. EU directive 2019/944. *EU directive on common rules for the internal market for electricity.* Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019L0944&from=EN.
14. EU directive 2018/2001. *Renewable Energy Directive (RED II).* Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L2001&from=EN.
15. THEMA Consulting Group (2018). *Descriptive study of Local Energy Communities.* Available at: https://thema.no/wp-content/uploads/THEMA-Reort-2018-20-Local-Energy-Communities-Report-Final.pdf.
16. McElhinney, M.T. *et al.* (2022) *Energy Communities in France & Norway.* *https://bora.uib.no/bora-xmlui/bitstream/handle/11250/3026547/ARQUS%20-%20Energy%20Communitites57%20%281%29.pdf?sequence=1&isAllowed=y*.

DSOs, municipalities, communities of citizens, and private companies.

The Norwegian power grid is structured as a monopoly and regulated by the state. NVE is a directorate under the Ministry of Petroleum and Energy, responsible for managing Norway's water and energy resources. NVE regulates the energy system and grants licences for the transmission and production of renewable energy. NVE is responsible for maintaining national power supplies and is also an important factor in energy-related research and development (R&D), being part of a substantial number of projects, including energy community initiatives (NVE, n.d). [17] NVE-RME is the national regulator for the Norwegian electricity and gas markets. Its main responsibility is to supervise the Norwegian electricity and gas markets and to enforce the provisions of the national legislation. NVE-RME is part of multiple innovative energy-related projects, of which several are aiming at implementing energy communities (e.g., Smart Senja and Lohøgda Borettslag). Statnett is the state-owned TSO in Norway, responsible for the national transmission grid. Statnett's main objective is to facilitate the national power supply according to Norway's climate objectives. Furthermore, Statnett invests in innovation and technology projects and currently has a portfolio of around 60 projects, including energy community initiatives.

There are around 130 DSOs in Norway, responsible for operating the regional and distribution grids. The DSOs control the distribution market as monopolies, owning concession licenses which give them exclusive rights to operate distribution grids within designated areas (NVE, 2018).[18] As noted above, DSOs in Norway have shown interest in developing models for energy communities and several are currently part of projects today, mainly to limit the load on their grids and decrease future investment needs (see example 1). Lastly, several energy community initiatives in Norway are driven by cooperatives of citizens together with municipalities, private investment companies and other types of actors. These actors are primarily driven by economic and environmental incentives or a wish to establish a more stable energy supply in rural communities.

The energy system in Norway is unique, having the highest share of electricity produced from renewable sources in Europe and the lowest emissions from the power sector. Almost all of Norwegian electricity production is based on hydropower, while wind power and thermal power constitute a minor part. Norway is currently investing extensively in the production of renewable energy, with wind power dominating the investments, potentially improving the prospects to implement energy communities in the future (Energy facts Norway, 2021).[19]

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17. NVE. *About NVE* (n.d). https://www.nve.no/about-nve/.
18. NVE. (2018) *The Norwegian power system - Grid connection and licensing.* https://www.statkraft.com/globalassets/9-statkraft-datacentres/documents/faktaark-energi-nve.pdf
19. Energy Facts Norway (2021). *Electricity production.* https://energifaktanorge.no/en/norsk-energiforsyning/kraftproduksjon/

Models for Energy Communities & National Legal Framework

Present Models for Energy Communities

As previously noted, energy communities conforming to the definitions of CECs and RECs in accordance with the EU directives have not yet been implemented in Norway. Interviewees state that actors in Norway do not relate to these definitions of energy communities. There are, however, currently multiple active energy community initiatives in Norway with various scopes. The main factor differentiating these initiatives is their organisational structure and model for energy production. Our combined data indicate that the present models forenergy communities in Norway mainly consist of DSOs investing in local flexible markets, energy production and storage, development of microgrids on remote coastal islands to stabilise energy supply, and various actors investing in renewable energy in residential housing associations (borettslag) (McElhinney et al, 2022).[20]

As indicated by interviewees, various models for energy community initiatives in Norway are driven by DSOs to reduce future investment costs on distribution grids. These projects are mainly initiated to add flexibility to the system and to lessen the strain on the main grid during peak demand by installing locally flexible loads systems and investing in local production (typically solar power) and storage of energy. The initiatives are almost exclusively driven by economic incentives from the DSOs but could lead to other effects, such as decreased future costs for consumers, and additional renewable energy and flexibility within the system.

Another currently present model for energy community initiatives in Norway is property developers, real estate companies, residential housing associations (boretsslag), and other actors, investing in the production of renewable energy on residential buildings for internal consumption. The most common example of these projects is property developers investing in solar panels on the roofs of housing associations to produce energy for the building. There are, however, legislative constraints related to these projects, as pointed out by interviewees. According to the Energy Act, only one person can be a solar power customer, effectively limiting the possibility for multiple consumers to share the energy produced within a residential building. To overcome this constraint, consumers could form a power production company and act as shareholders.

This would, however, effectively make it an investment and not a non-profit community, producing renewable energy. In interviews, representatives of NVE-RME emphasise that they have been assigned by the government to develop new legislation to improve the conditions for housing associations to produce and share

20. McElhinney, M.T. *et al.* (2022) *Energy Communities in France & Norway.* https://bora.uib.no/bora-xmlui/bitstream/handle/11250/3026547/ARQUS%20-%20Energy%20Communitites57%20%281%29.pdf?sequence=1&isAllowed=y.

renewable energy, thereby improving the capacity for "prosumers" (pluskunder) (NVE (2022).[21]

Finally, another example of present energy community initiatives in Norway is the development of microgrids in remote areas that can produce, store and share energy. One example of these types of projects, described by multiple interviewees, is the development of microgrids on islands off Norway's Atlantic coast (see examples 1 and 3) (McElhinney el al, 2022).[22] Due to harsh weather conditions and outdated grids, many remote islands experience an unstable power supply with frequent power failures. This is a substantial problem for the residents and not least for the nationally important fishing industry, often present on these islands. Due to these problems, several projects are developing complementary internal energy systems and implementing various solutions for renewable energy production, energy storage, and smart distribution, to strengthen stability and flexibility. Multiple actors are involved in these projects, including DSOs, citizens, local companies, tech companies, municipalities, and universities. Interviewees further state that NVE and NVE-RME are closely monitoring these projects and their results.

National Legal Framework

The framework encompassing the energy system, and thus the implementation of energy communities, is regulated by national legislation. The main national legislative frameworks are the Energy Act *(Energiloven)*, Energy Regulations (*Energilovforskriften*), Grid regulation and the Energy Market Regulation *(Nettregulering og Energimarkedet-forskriften – NEM)*. As Norway is not a member of the EU, EU directives do not automatically apply national legislation. However, through the EEA agreement, the directives can be implemented in Norway if the EEA and EFTA agree that the directive is relevant to the EEA agreement (Government of Norway, n.d).[23]

The Energy Act (1990:50) was implemented in 1990 to ensure that all produced energy in Norway is used in a societally rational manner. The framework regulates the production, transformation, sale, distribution and use of energy in Norway. As stated previously, the Energy Act provides the legal basis for regulating the DSOs that are responsible for developing and maintaining the distribution grid. The act further imposes that the production, conversion, transmission and distribution of electricity cannot be operated without an area license. By owning area licenses,

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21. NVE (2022). *Hearing – Proposal for the introduction of a model for sharing surplus production.* https://www.nve.no/reguleringsmyndigheten/regulering/regelverk-og-hoeringer/horinger/hoeringer-reguleringsmyndigheten-for-energi-rme/hoering-forslag-om-innfoering-av-modell-for-deling-av-overskuddsproduksjon/ (Norwegian).
22. McElhinney, M.T. *et al.* (2022) *Energy Communities in France & Norway. https://bora.uib.no/bora-xmlui/bitstream/handle/11250/3026547/ARQUS%20-%20Energy%20Communitites57%20%281%29.pdf?sequence=1&isAllowed=y*.
23. The Government of Norway (n.d). Norway-EU energy cooperation. https://www.regjeringen.no/en/topics/energy/eu-and-energy/norway-eu-cooperation-on-energy/id714280/

DSOs do not need to apply for licenses for each separate installation within their designated areas. Other actors, such as energy communities, need to apply for a license to produce, store, share and sell electricity. NVE's praxis, however, is not to permit licenses for other actors to develop distribution grids than to those who own area licenses (i.e., DSOs), which significantly limits the possibilities to form larger energy communities that can produce and share energy (NVE n.d).[24] [25]

Another important legislative framework is *Energilovsforskriften (*Energy regulations). The framework was implemented in 1990 under the Energy Act (1990:50) and regulates the production, conversion, transmission, turnover, distribution, and use of energy in Norway. The framework shall ensure that all operations within the Norwegian energy system should be rational from a societal perspective and further should consider private and public interests. Energy regulations constitute a more comprehensive and detailed framework of the conditions to be granted licenses to develop and maintain regional and local distribution grids.[26]

Forskrift om nettregulering og energimarkedet (NEM) was implemented in 2019 to regulate the Norwegian energy market. NEM is intended to facilitate an efficient energy market, where the operations within the market are conducted in a socially rational manner and to ensure effective market surveillance. NEM furthermore constitute a detailed framework of the Norwegian energy market's legislative conditions. NVE-REM is responsible for monitoring the energy market to ensure that NEM is enforced (FOR-2019-10-24-1413). [27]

Lastly, there are several legislative frameworks in Norway ensuring that energy production is conducted in an environmentally sustainable manner. In 2011, The Electricity Certificate Act (No. 39 2011) was implemented to promote the production of energy from renewable sources by establishing an electricity certificate market in Norway. The act constitutes a market-based scheme, shared with Sweden, where producers of renewable electricity receive one certificate per MWh of electricity produced for a period of up to 15 years.[28] The National Climate Plan[29] and Climate Change Act[30] are furthermore the most significant sustainability-related frameworks regulating the energy system. The Climate Plan

24. Act 1990:50. *The Energy Act.* https://lovdata.no/dokument/NL/lov/1990-06-29-50,
25. NVE (n.d). *Energy society and microgrids. Available at: https://www.nve.no/reguleringsmyndigheten/kunde/nett/tilknytning-av-forbruk-og-produksjon/energisamfunn-og-mikronett/*
26. Act 1990:50. *The Energy Act*, *Energy regulations.*https://lovdata.no/dokument/SF/forskrift/1990-12-07-959
27. *Regulations on development of grids and the energy market.* https://lovdata.no/dokument/SF/forskrift/2019-10-24-1413
28. *Act on electricity certificates.* https://climate-laws.org/rails/active_storage/blobs/eyJfcmFpbHMiOnsibWVzc2FnZSI6IkJBaHBBcUFLIiwiZXhwIjpudWxsLCJwdXIiOiJibG9iX2lkIn19--8511db02d55e96d4c199bfaa8698a044ba0ae50f/1520%20Norwegian.pdf (Norwegian)
29. The Government of Norway (2021). *Norway's Climate Action Plan for 2021–2030*. Available at: https://www.regjeringen.no/contentassets/a78ecf5ad2344fa5ae4a394412ef8975/en-gb/pdfs/stm202020210013000engpdfs.pdf
30. McElhinney, M.T. *et al.* (2022) *Energy Communities in France & Norway. https://bora.uib.no/bora-xmlui/bitstream/handle/11250/3026547/ARQUS%20-%20Energy%20Communitites57%20%281%29.pdf?sequence=1&isAllowed=y*

defines Norway's prioritised measures to reduce emissions while the overall objective of the Climate Change act is to reduce GHC emissions by 2050. All actors need to consider these overarching environmental frameworks when operating within the Norwegian energy system (Government of Norway, 2021), (McElhinney et al, 2022).

Drivers and Benefits

Our combined data indicate that there are several drivers and potential benefits of implementing energy communities, on multiple levels. The interviewees emphasise financial and environmental incentives as driving factors for citizens to engage in energy communities, while public actors in Norway engage in energy community initiatives as measures within the green transition. Additionally, securing a stable energy supply is stated as an important driver for citizens and organisations situated in rural communities. Lower costs, additional flexibility and stability, reduced load on grids, and increased knowledge and consumer power are a few of the highlighted potential benefits of implementing energy communities on a greater scale in Norway.

There is a consensus among interviewees that financial incentives are an important driver for citizens and organisations in Norway to engage in energy community initiatives or other innovative measures to produce renewable energy. Due to recently increasing energy prices, citizens and organisations in Norway are exploring new and alternative solutions to produce energy. One of these solutions is to invest in locally produced energy within an energy community. Interviewees state that many citizens in Norway are starting to show an increased interest in energy communities with the expectation to decrease future costs. Further, housing developers have started to invest in solar panels on residential buildings due to the consumer demand for being able to lower their energy costs and live in sustainable apartments. Financial incentives are also an important driver for DSOs investing in microgrids or other models for energy communities. By investing in new solutions to produce renewable energy locally and smart steering capacity, the companies are expected to reduce the load on grids, thereby limiting future investment costs.

Also noted as an equally important driver is environmental-related motives. Citizens and organisations in Norway see investments in energy communities or other innovative solutions as a measure to facilitate the green transition, thereby contributing to reach Norway's climate goals. As noted, governmental actors are financing and monitoring research projects aimed at implementing various innovative solutions to produce, store, and share renewable energy, such as energy communities. The objective is to gain knowledge and to determine if the solutions are scalable and societally rational, as part of Norway's future climate measures.

Despite Norway having a generally robust and flexible energy system, rural communities regularly experience power shortages which affect citizens' daily life and the conditions for the industry in these communities. Hence, interviewees present the need to secure a more stable energy supply as an important driver for these relevant communities to engage in energy communities (McElhinney et al, 2022).[31]

As noted above, there are multiple potential benefits of implementing energy communities on a greater scale in Norway. Firstly, interviewees state that investing in energy communities potentially could lead to financial gains, both for society and for individual citizens. By producing, sharing and selling renewable energy, communities of citizens could decrease their future costs and become prosumers. Moreover, by introducing microgrids or other models of complementary local energy systems, the state and the DSOs would also potentially decrease their investment costs related to the maintenance of grids. By developing complementary microgrids with the ability to store and share energy effectively, the main grid could be relieved from some of the load, especially during demand peaks, and consequentially expand its life span. However, interviewees representing authorities in our study note that it is not established whether investments in developing energy communities are economically rational from a societal perspective and that this is currently being investigated in several research projects.

Additionally, several interviewees note that investing in energy communities that can produce and store energy would further strengthen the flexibility of the Norwegian energy system by adding complementary energy sources. By installing applications for smart distribution of energy within microgrids, energy communities could lessen the strain on the main grid, consequently further stabilise the supply of electricity, which is particularly relevant for remote communities in Norway.

Interviewees also discuss several social benefits, on multiple levels, of introducing energy communities. Firstly, by engaging in energy communities, members will likely increase their knowledge regarding energy consumption and their awareness of them as actors within the energy system, potentially leading to more effective energy consumption. Secondly, by increasing knowledge and awareness, citizens would presumably strengthen their sense of agency as consumers and demand new types of services from DSOs and energy suppliers, that could facilitate their operations as energy communities. Lastly, in a longer perspective, the implementation of energy communities on a greater scale could also potentially lead to a shift towards increased consumer influence and democratisation of the Norwegian energy market. Through the organisation of consumers within energy communities, a new type of actor would be introduced that potentially would

31. McElhinney, M.T. *et al.* (2022) *Energy Communities in France & Norway.* https://bora.uib.no/bora-xmlui/bitstream/handle/11250/3026547/ARQUS%20-%20Energy%20Communitites57%20%281%29.pdf?sequence=1&isAllowed=y

affect the energy market and force actors to develop new services that facilitate energy communities' operations.

Legal and Practical Barriers

There are several legislative and practical barriers constraining the implementation of energy communities in Norway. The Energy Act and its secondary regulations limit the current possibilities for communities to produce, share and store energy within and among residential buildings. Additionally, a well-functioning energy system and relatively low energy prices in the past have led to a generally low level of public knowledge of alternative solutions to produce energy, consequently impairing the conditions to implement energy communities. The investment costs to install applications required to facilitate energy communities furthermore constitute a constraint for its implementation, both for individual citizens and various organisations.

The interviewees emphasise that the current national legislation constitutes a main barrier to implementing energy communities on a greater scale. As stated earlier, the Electricity Act stipulates that operating grid assets requires a specific area license, owned by the DSOs, and NVE does not generally grant licenses toother actors than the DSOs. In the Interviews, the difficulties navigating within the legislative framework as an alternative actor in the Norwegian energy market are highlighted. One example of these constraints, described by an interviewee, is for residential housing associations (borettslag) that are installing solar panels to produce electricity for the consumption of the whole building. The current legislation prohibits more than one person to be a solar energy customer, consequently hindering cooperatives to produce and share energy together. Another example, described by an interviewee, is the regulations on batterie that are needed to store energy. The legislation is currently restricting the size of batteries that are permitted to be used, thereby limiting the capacity to store and share energy within larger energy communities.

Interviewees, however, note that the current national framework is being adjusted to create better conditions to implement energy communities and other forms of local energy production. In 2022, RME proposed that producers of renewable power should be able to share their energy with other consumers in the same property. Customers who together invest in renewable power production within a common property will thus be able to utilise production to reduce their own consumption in the grid, which typically applies to customers in multi-family homes or apartment buildings (NVE, n.d).[32] Being only one of the relevant examples, it indicates that

32. NVE (n.d). *Energy society and microgrids. Available at:* *https://www.nve.no/reguleringsmyndigheten/kunde/nett/tilknytning-av-forbruk-og-produksjon/energisamfunn-og-mikronett/*

the Norwegian government is presenting an interest in energy communities and are trying to adjust the legislative frameworks to facilitate their implementation.

Another hindering factor is the relatively low public knowledge related to the energy system and awareness of available solutions. Due to a well-functioning energy system and low energy prices in the past, the incentives for citizens have not been strong to strengthen their knowledge and engage in public debate regarding energy consumption, production, and the framework surrounding the energy market. Without the knowledge and awareness of alternative solutions, the conditions have not been present for individual citizens and organisations to engage and invest in alternative solutions to produce and share energy, such as energy communities. However, due to the current energy crisis and subsequent increasing energy prices, one interviewee stated that the public interest in energy communities probably will increase in the near future.

Lastly, the interviewees underline the investment costs, for individuals and organisations, related to forming an energy community as a limiting factor. Although many applications to produce and share energy are getting cheaper, it is still a considerable investment for individual members of a community. Interviewees point out that it is not established wheter it is financially beneficial for citizens to join an energy community under the current conditions. Furthermore, the current legislative framework limits the financial incentives for individuals to form energy communities. Additionally, to facilitate energy communities on a greater scale, private and public investments in digitalisation are needed. One interviewee emphasises that these investments are investigated to determine whether they are societally rational or whether further investments on the main grid would be a more effective measure.

Examples of Real-life Communities

In the following, **examples of energy community initiatives in Norway** are presented:

- Example 1, **Smart Senja,** is an innovative project aiming at developing a local energy system on the remote island of Senja to supply the growing fishing industry's increasing demand for electricity.
- Example 2, **Lohøgda,** is an example of a housing cooperative, acting as an energy community by investing in local renewable energy production and sharing.
- Example 3, **Utsira Island,** is a community acting as a testbed for smart renewable energy generation, distribution, management and control in weak grids.

EXAMPLE 1: SMART SENJA

The project Smart Senja was initiated in 2019 with the overarching objective of supplying the Norwegian island Senja's growing fishing industry's increasing demand for electricity. The project gathers actors from multiple sectors of society, and in close cooperation with the island's residents, to develop innovative solutions as measures to supply the island's demand for consistent power. One of the solutions being developed is the installation of smart power management systems in businesses and households to facilitate an even distribution of electrical load between day and night. Further, large lithium batteries have been installed in two locations to balance out fluctuations in consumption. At present, these batteries are the largest existing in Norway. The project will explore whether locally produced renewable energy and smart distribution systems will contribute to solving the problems related to the energy supply, often experienced on coastal islands in Norway situated on the end of the electrical grid. Smart Senja is owned by the energy distributor Arva AS and is financially supported by the governmental agency ENOVA. The project is set to run until 2025 (Smart Senja 2020).[33]

EXAMPLE 2: LOHØGDA BORETTSLAG

Lohøgda borettslag is one of the largest housing associations in Norway, containing 777 apartments. The housing association is placed in the district of Tveita in Oslo and has developed a form of an energy community by investing in the production and storage of renewable energy to be shared and used by all apartments within the community. The initiative started as a pilot project in 2016 and afterwards progressed on a full scale. The first measure was implemented in 2017 when the cooperative decided to install common water heater systems in the basement of their buildings, which previously were individual heaters, placed in the bathrooms of all apartments. The measure led to a reduction of the resident's energy costs by 50%. In 2019, solar panels were installed and tested on a roof which lead to further significant financial gains for the association and the residents. In 2021, the residents decided to continue and install more solar panels. The association is now considering implementing energy storage through hydrogen, which would further increase the storage capacity. Lohøgda Borettslag is now waiting for national regulations to change so they will be permitted to install solar panels on all their residential buildings. The association is also exploring the possibility to be exempted

33. Smart Senja (2020) The project. Available at: https://smartsenja.no/en/prosjektet/

from the obligation to share their produced electricity with the grid, thereby directly transferring their produced electricity to residents by joint measurement. The community is currently not entirely energy self-sufficient, but it has significantly reduced the resident's costs and the strain on the grid, as a result of the investments (Aarsbog n.d).[34]

EXAMPLE 3: UTSIRA ISLAND

Utsira is an island located 20 km from the city of Haugesund in Norway. The community has around 200 inhabitants and is connected to the mainland by ferry. The island is connected to the main grid by an ageing underwater cable with limited capacity. Due to the limited capacity and frequent power failures, the municipality of Utsira has invested in local production and storage of renewable energy together with the development of a microgrid, to deliver a stable supply of electricity. Currently the island has two wind turbines that can cover the entire island's energy needs when fully operating. Batteries are also utilised, together with a smart management and control system, to complement the wind turbines when the weather conditions are not favourable. In the future, the goal is to integrate further renewable sources to add flexibility to the grid. The community is currently a test bed within several projects aiming at developing new solutions that can contribute to a stable and predictable energy supply that can meet the power needs of islands and other remote communities in the future. One of the projects is led by the DSO Haugaland Kraft together with partners from multiple sectors to develop solutions for smart energy management, microgrids and a flexibility market at Utsira. The project started in 2020 and is financially supported by the governmental agency Enova until 2024 (Haugaland Kraft n.d).[35]

34. Aarsbog, P. (n.d) *Between houses - stories from OBOS*. Available at: https://www.obos.no/mellom-husene/hjemme/lohogda-borettslag-satser-pa-miljoet (Accessed: 23 May 2023).
35. Haugaland Kraft (n.d). *An island self-sufficient on renewable energy.* Available at: https://hkraft.no/fou/

Denmark

Background Information

Denmark has a long history of citizen ownership and is one of the EU countries with the highest share of citizen ownership of energy assets. A study from 2019 estimated that 52% of the existing installed wind capacity in Denmark in December 2016 was owned through some kind of citizen ownership model. At the time wind energy produced 37% of the final electricity demand in Denmark and although the authors of the study emphasised the uncertainties in the analysis, they conclude that citizen ownership has contributed greatly to the implementation of Danish wind turbines in 1977–2016 (Gorroño, Sperling & Djørup, 2019).[36]

In a study commissioned by the Nordic Council of Ministers and published in 2019, Denmark was estimated to be the Nordic country with the highest distributed electricity production for potential self-consumption in 2017. It was estimated that Denmark produced over 3.6 TWh, approximately 79% of what was produced in all of the Nordic countries. Most of this electricity stemmed from wind power (Krönert et al, 2019).[37] In 2020, 31.7% of Denmark's energy consumption consisted of renewable energy and wind power's share of domestic electricity supply was 47% (Energistyrelsen 2022).[38]

All in all, this paints a picture of a rich history of both citizen engagement in energy production and in energy production through wind power.

In a recently published overview of European Energy Communities, it is estimated that there are 633 Energy Communities in Denmark, with a majority (467) subsiding in Jutland (European Commission n.d), (Wierling et al, 2023).[39] [40] Compared to the other Nordic countries included in the overview (Norway, Sweden and Finland), Denmark has more Energy communities than the other three countries combined. It should be noted that the overview applies a broader definition of Energy Communities than the definition for both CECs and RECs. However, it gives an indication of the deployment of citizen led energy initiatives, in relation to the neighbour countries. One explanation to the comparatively large deployment of energy communities could be the aforementioned history of both citizen ownership and wind power in Denmark. Another explanation could be the Danish dependence

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36. Haugaland Kraft (n.d). *An island self-sufficient on renewable energy.* Available at: https://hkraft.no/fou/
37. Krönert, F., Henriksen, G. L., Boye, S., Edfeldt, E., Weisner, E., Nilsson, M. F. & Uusitalo, O. (2019). *Distributed electricity production and self-consumption in the Nordics.* Available at: https://www.nordicenergy.org/wordpress/wp-content/uploads/2019/06/Distributed-energy-production-and-self-consumption-20190607-1.pdf
38. Energistyrelsen (2022). Energistatistik. 2021
39. European Commission (n.d). *Map. https://energy-communities-repository.ec.europa.eu/energy-communities/energy-communities-map-0_en*
40. Wierling, A. et al. (2023) 'A Europe-wide inventory of citizen-led energy action with data from 29 countries and over 10000 initiatives', *Scientific Data*, 10(1). doi:10.1038/s41597-022-01902-5.

on fossil fuels in the electricity production, which was 26% in 2021(Rosado & Ritchie, 2021).[41]

The main public bodies regulating and supervising the Danish energy market are the Danish energy agency (DEA) and the Danish Utility Regulator (DUR), both answering to the Ministry of Climate, Energy and Utilities. DEA has the main responsibility for tasks linked to energy production, supply, and consumption. DEA is also responsible for the Danish efforts to reduce carbon emissions as well as supporting the economic optimisation of utilities that, in addition to energy, includes heat, waste, and water. DUR is responsible for securing consumer interests in the utility sectors (electricity, district heating and natural gas) by striving for a higher level of efficiency, the lowest possible costs in the short and long term, a stable and secure supply, and a cost-effective development in technology and climate-friendly initiatives.

Models for Energy Communities & National Legal Framework

The main laws regulating Energy Communities are the law on promotion of renewables (*lov om fremme af vedvarende energi*) and the law on electricity supply (*elforsyningsloven*). RECs were included into the law on promotion of renewables in 2021 and in the same year the definitions of both RECs and CECs were set in an executive order which added to the law on electricity supply. Although the legislation discerns between CECs and RECs, the distinction is seldom used in the general discourse. Real-life communities are mostly referred to as *Energifælleskaber* (Energy Communities), rather than being differentiated as *Borgerenergifællesskaber* (Citizen Energy Communities) and *VE-fællesskaber* (Renewable Energy Communities).

The two main models for electricity sharing in Denmark are behind the meter and through the collective grid. Electricity sharing behind the meter is restricted by regulation, making it a solution only applicable within a single building. For example, in the case of a housing cooperative (*andelsboligforening*) in a building with rooftop PV. Sharing through the collective grid is the only option for other types of communities. Currently electricity sharing through the collective grid is subject to the general tariffs and taxes. However, new tariff legislation has recently been passed, which enables DSOs methods for tariffing energy communities according to their contributions to the collective grid.

An energy community can be organised as an association, partnership, cooperative, or capital company. Often the communities are initiated through already established groups of people, such as municipalities, housing cooperatives (*andelsboligforeninger*) or eco-villages (*økosamfund*). Both the preconditions and

41. Rosado, H.R. and P. (2021) *Energy: Key charts, Our World in Data*. Available at: https://ourworldindata.org/energy-key-charts (Accessed: 23 May 2023).

motives often differ between these groups, resulting in different choices of model for the community.

One common type of community in Denmark is so called Eco-villages (*økosamfund*), which are usually organised as a communal institution with collective ownership. They often have an overarching motive to obtain self-sufficiency and contribute to sustainable living, also beyond energy consumption and production. The focus is often on heating, of which sharing is not as heavily regulated as sharing of electricity.

Another form of current Energy Communities is housing cooperatives that have installed either PV or hybrid solutions of both PV and heat pumps. Under current regulations community members within one building are able to share the produced electricity internally without using the collective grid.

There are also examples of villages as well as newly established neighbourhoods organised as Energy Communities. These neighbourhoods are often placed so that they can use adjacent areas to produce heat or set up wind turbines. For these, larger types of communities sharing through the collective grid is the most relevant model for electricity sharing.

In August 2022, an executive order on subsidies for local energy communities and local anchoring of the climate transition was passed. The executive order provides for the DEA to issue grants for projects related to developing renewable energy projects by local communities. The purpose of the grants is partly to support information projects that can disseminate information, which can contribute to the development of renewable energy solutions, and partly to support larger projects that can develop common solutions for the establishment, organisation, operation and financing of energy communities locally, and which can increase knowledge of the energy communities (BEK 1162, 2022).[42]

Legal and Practical Barriers

Legal Barriers

One of the presented obstacles for additional deployment of energy communities that reoccurs across literature and many interviews is insufficient opportunities for efficient and cost-effective electricity sharing. Currently, CECs and RECs are not allowed to operate their own distribution networks. While, at the moment, electricity sharing through the collective grid is subject to the general tariffs and taxes. However, enabling tariff models are being proposed and a renumeration or incentivising system for energy sharing is currently being developed and assessed.

42. BEK nr 1162 af 09/08/2022: Bekendtgørelse om tilskud til lokale energifællesskaber og lokal forankring af klimaomstilling: https://ens.dk/sites/ens.dk/files/Stoette_vedvarende_energi/bekendtgoerelse_om_tilskud_til_lokale_energifaellesskaber_og_lokal_forankring_af_klimaomstilling.pdf

As is stipulated in the current EU directive, the creation of an internal grid or microgrid by an energy community would also mean that the energy community would need to adhere to both the role and responsibility of a DSO, including the obligation to ensure third party access. The reluctance to grant CECs and RECs the role of DSO seems to stem from a general concern regarding parallel grids and the risk of either erosion of the collective grid or an undue economic burden for citizens who are not members of an energy community.

One solution to mitigating the economic effects of sharing community electricity through the collective grid was presented in an analysis by DEA published in December 2021. The solution would consist of a local collective tariffing for energy communities, enabling tariffs tailored by the respective community's contributions to the collective grid (Energistyrelsen 2021).[43]Consequently, this was presented in a legislative proposal that was recently passed (Hoeringsportalen 2022).[44]

Practical Barriers

The knowledge, both technical and juridical, necessary to establish an energy community is presented as a deterrent. This is most likely exacerbated by the fact that, at the time of the data collection for this study, the surrounding enabling framework was not fully established and implemented, leading to some uncertainty on what are, and will be, the preconditions for an energy community. Vis a vis the more exact return of investment calculations and the like for specific business cases.

The need for juridical and technical competence act as a threshold for people who are not knowledgeable in this specific area or are particular enthusiasts willing to spend a large amount of time and effort into understanding the context. The general knowledge, or rather lack thereof, of one's own energy consumption and energy sources is also presented as an incentive lost due to unawareness. There is access to counselling and every Danish consumer has access to real-time data regarding consumption. However, there may be a discrepancy between the knowledge available, the use of the information sources and the awareness of its existence. Relating to the need for knowledge is understanding and navigating the bureaucratic process surrounding the energy market as well as having an understanding of the processes for permits and complaints as well as the possible response times from various agencies.

Another issue presented is that the main contact point for an energy community is the respective network operator since it provides the connection and decides on the type of tariff to pay, whether it is a production or consumption tariff. This can at

43. Energistyrelsen (2021), *Analyse af geografisk differentierede forbrugstariffer og direkte linjer*, https://ens.dk/sites/ens.dk/files/El/analyse_af_geografisk_differentierede_forbrugstariffer_og_direkte_linjer.pdf
44. Hoeringsportalen (2022) *Fornyet Høring af lovforslag om ændringer af lov om elforsyning*. Available at: https://hoeringsportalen.dk/Hearing/Details/66808

    (Accessed: 23 May 2023).

times be a bit controversial since they have a monopolistic role and the propensity to aid and inform can vary between different DSOs and their general attitude towards energy communities.

The technological aspects for the implementation of energy communities seem to be in place and are not mentioned as a barrier in any interview on the contrary it is occasionally emphasised that it does not pose an issue.

Examples of Real-life Communities

In the following, **examples of energy community initiatives in Denmark** are presented:

- Example 1, **Karise Permatopia**, is an eco-village that has developed a common geothermal heating system based on locally produced energy from renewable sources.
- Example 2, **Avedøre,** is Denmark's first citizen energy community. The community has initiated several projects to develop the production and storage of renewable energy.
- Example 3, **Københavns solcellelaug,** was Denmark's first solar cell association where citizens can buy shares in urban solar cell plants.

EXAMPLE 1: KARISE PERMATOPIA

Karise Permatopia is an eco-village located in the town of Karise in the southeast of Denmark. The community consists of 90 terraced houses and is focusing on sustainability in all aspects of its operations, including being self-sufficient on energy. Permatopia has a specially appointed energy supply group, responsible for making the communities energy supply 100% renewable. The community's ambition is to be a circular energy system of its own to the greatest extent, so that the usage of energy from waste can be optimised. All houses, and large parts of the communal yard, which is operated by the community, are heated with a common geothermal heating system. Permatopia also owns and operates a wind turbine that produces electricity for the geothermal heat system, the communal yard, and charging stations for electric cars in the community. Excess heat from the system further contributes to heating water for residents and the communal yard (Permatopia, n.d).[45]

EXAMPLE 2: AVEDØRE

Avedøre A.M.B.A is Denmarks first citizen energy community, based in the district of Avedøre, in Hvidovre municipality, south of Copenhagen (EBO Consult, n.d).[46] The community was founded in 2020 by actors from various parts of the local society, such as Hvidovre Municipality, Hvidovre Gymnasium, the local heating company Avedøre Fjernvarme A.M.B.A., and the consultancy EBO Consult A/S, that has specialised in implementing energy communities.

Avedøre A.M.B.A is part of a development plan called "Avedøre Green City", where local stakeholders are collaborating to develop sustainability-related measures in the district, as part of the UN's 17 global goals. One of the measures that have been implemented is the instalment of 60 solar panels, which are used to heat water for residents within the area. In 2021, the community also installed two charging stations for electrical vehicles that is powered by solar panels, mounted on station's roofs.

The project was funded by Hvidovre Municipality in 2020 and developed together with European Green Cities and Solar Lighting Enterprise ApS. The project is part

45. Karise Permatopia (n.d). *Experience Permatopia.* Available at: https://permatopia.dk/.
46. EBO Consult (n.d). *Denmark's first energy community.* Available at: https://eboconsult.dk/en/2020/06/08/denmarks-first-energy-community/.

of the EU-project POCITYF, that is supporting projects aiming at making Europe's cities smart and sustainable. The community is now considering to install more solar powered charging stations in Avedøre (POCITYF, 2021).[47]

EXAMPLE 3: KØBENHAVNS SOLCELLELAUG

Established in 2005, Københavns solcellelaug is Denmark's first solar cell association, where private citizens could buy shares. Due to a high demand, all of the association's shares were sold within months. The association owns two urban solar cell plants in Copenhagen that produce renewable electricity for the shareholders. The overarching purpose of the association is stated to be to spread knowledge of solar power and its use in Denmark, and to produce energy for its members (Solcellelauget, n.d).[48]

47. POCITYF (2021). *Charging points under power generating roofs in Avedøre Green City ready for use.* Available at: https://pocityf.eu/news/charging-points-under-power-generating-roofs-in-avedore-green-city-ready-for-use/?cn-reloaded=1
48. Solcellelauget (n.d). *About the organisation. Available at:* http://www.solcellelauget.dk/om_lauget.htm

Drivers and Benefits

The incentives for establishing or joining an energy community are often presented as **ideological** and/or **financial**. In the interviews, there is often an emphasis on sustainability and an intent to increase the production and consumption of renewable energy alongside the economic benefits for the members. It varies which of the motives that gets the strongest emphasis. One interviewee expresses it like this:

"The driving force is foremost, as we see It, to contribute to a sustainable transition. There are financial incentives, of course, but that's not the most important thing."

Another interviewee mentions both motives but in the opposite order of priority:

"The benefits are mainly economic, it will be cheaper by implementing this. You also get a greener energy supply. We can establish local energy sources."

Drivers

The **high energy prices** in recent years increase the financial incentive. Both through energy savings and decreasing the length of the repayment period for investments in energy solutions.

Furthermore, the interviews indicate that a personal perception that the **transition of the energy system is moving too slow**, can act as a driver to take matters in one's own hands and contribute to the acceleration of the transition.

Recently a **financial pool** has been implemented, which may contribute to decrease the financial risk of starting an energy community (BEK 1162, 2022).[49]

49. BEK nr 1162 af 09/08/2022: Bekendtgørelse om tilskud til lokale energifællesskaber og lokal forankring af klimaomstilling: https://ens.dk/sites/ens.dk/files/Stoette_vedvarende_energi/bekendtgoerelse_om_tilskud_til_lokale_energifaellesskaber_og_lokal_forankring_af_klimaomstilling.pdf

Benefits

For members

- The aforementioned incentives are also closely related to the benefits to the members in the energy communities. The **monetary savings** alongside a fulfilment and pride from contributing to the **sustainability transition**.

Environmental benefits

- Helps to **accelerate the energy transition** through:
    - A higher rate of **decentralised installations of RES.**
    - **Less transport losses** due to local production and consumption.
    - **Decreased energy consumption** due to higher awareness of the consequences of energy consumption among the community members.
- Citizen ownership and inclusion are presented as correlated to an **increase in general climate awareness and responsibility**. This goes beyond energy solutions and includes other mitigating factors on climate change.
- **Increased acceptance of renewable energy**. As previously mentioned, there has been an increase in public resistance towards wind turbines and PV-installations. This seems to be lessened through local initiatives.

For the collective grid

- **Grid congestion alleviation**: because the energy communities use the locally supplied energy locally as well, the energy communities can play an important role in balancing the local electricity net, if implemented in an appropriate manner. This can help alleviate bottlenecks through decreased transportation needs.
- **Increased resilience in the system.** A more distributed system with regional and local backups could increase the resilience of the energy systems. Among other things, this would decrease the effects of a potential attack on the collective energy supply system, providing alternative sources for energy production.

Sweden

Background Information

The Implementation of energy communities is in its inception in Sweden. Although variants of energy communities have been present for an extensive time, there are no current examples of energy communities adhering to the definitions of citizen energy communities (CEC) or renewable energy communities (REC) as specified in EUs Electricity Market Directive (IEMD) (2019/944)[50] and Renewable Energy Directive (REDII) (2018/2001).[51] A considerable amount of juridical and practical issues are yet to be addressed before energy communities can be implemented on a greater scale.

There is no existing database of active energy communities in Sweden today and no umbrella organisation currently exists. A study performed in 2017, utilising the Swedish Energy Agency's database "Cesar", covering registered organisations in the Swedish electricity certificate system, identified 140 active energy community initiatives and around 20 that had been discontinued.[52] The mapping indicated that the most common forms of initiatives in Sweden were wind power cooperatives, eco-villages, and communities based on small-scale heating systems or solar power. The energy communities are generally organised as incorporated associations, non-profit organisations (samfällighet), and tenant-owned apartments associations (bostadsrättsföreningar).[53] Almost all active energy communities in Sweden today are locally delimited communities that produce renewable energy for their members (Magnusson & Palm, 2019).

The implementation of energy communities in Sweden is regulated by the national government and EU bodies (Swedish Energy Agency, 2022).[54] The Swedish Energy Agency is the government agency responsible for promoting energy-efficient measures and investments in renewable energy technologies. Furthermore, the Swedish Energy Market Inspectorate (Energimarknadsinspektionen) supervises the Swedish energy market actor's compliance with laws and regulations at national and EU level. Other important actors are the state-owned enterprise Svenska Kraftnät, responsible for monitoring and developing the national transmission grid, and Distribution System Operators (DSOs), responsible for the distribution grids in specified areas around the country. The market for the distribution of electricity in

50. EU directive 2019/944. *EU directive on common rules for the internal market for electricity.* https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019L0944&from=EN.
51. EU directive 2018/2001. *Renewable Energy Directive (RED II).* https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L2001&from=EN.
52. Magnusson, D. and Palm, J. (2019) 'Come together—the development of Swedish Energy Communities', *Sustainability*, 11(4), p. 1056. doi:10.3390/su11041056.
53. Magnusson, D. and Palm, J. (2019) 'Come together—the development of Swedish Energy Communities', *Sustainability*, 11(4), p. 1056. doi:10.3390/su11041056.
54. The Swedish Energy Agency (2022). *Policy and Legislation.* Available at: https://www.energimyndigheten.se/en/about-us/policy-and-legislation/

Sweden is formed as monopolies with approximately 170 companies having area licenses, known as network concession (Swedish Energy Market Inspectorate 2022).[55] In addition, municipalities generally play an important role as owners of DSOs and housing companies and as actors within development projects aiming at implementing energy communities or other energy-related solutions.[56]

The Swedish energy market has been deregulated since 1996 and is part of the EU's common electricity market. The market for sale of electricity is competitive, and customers have around 120 suppliers to choose from. The three main companies in the Swedish electricity market have more than 800,000 customers while the smallest have less than 1000 customers. The companies are privately owned, cooperative economic associations or owned by municipalities (Swedish Energy Market Inspectorate 2021).[57]

Models for Energy Communities & National Legal Framework

As noted, energy communities have not yet been implemented in Sweden according to the definitions of CEC and REC. There are, however, existing models for energy communities sharing the same characteristics as CECs. The most common models for energy communities in Sweden today are wind power cooperatives, solar power communities, eco-villages, and small-scale heating cooperatives (Magnusson & Palm, 2019).[58]

Wind power cooperatives have become increasingly popular in Sweden during the last 20 years. The cooperatives are predominately structured as incorporated associations where members buy shares in a wind turbine to produce energy, thereby bearing the investment cost together. Studies on wind power cooperatives in Sweden have identified around 80 active cooperatives. Most wind power cooperatives have 200–300 members, while the largest cooperatives have up to 4000 members (Horn, 2019).[59]

Another common model of energy communities in Sweden is eco-villages. Eco-villages are generally rural communities focusing on social, ecological, and economicsustainability and self-sufficiency. Eco-villages in Sweden differ significantly in theirsolutions to produce and share energy. While most eco-villages focus on energyefficiency and decreased consumption in various ways, a few have developedinnovative ways of producing energy for heating and electricity. The eco-villages are exclusively based on cooperation and social inclusion and vary in size

55. The Swedish Energy Market Inspectorate (2022). *Electricity.* https://ei.se/ei-in-english/electricity
56. See examples one and three.
57. The Swedish Energy Market Inspectorate (2021). *About the electricity market.*https://ei.se/ei-in-english/electricity/the-electricity-market
58. Magnusson, D. and Palm, J. (2019) 'Come together—the development of Swedish Energy Communities', *Sustainability*, 11(4), p. 1056. doi:10.3390/su11041056
59. Horn, V. (2019) Wind power shares and wind shares, el.se. Available at: https://el.se/vindkraftsandelar (Accessed: 23 May 2023).

from a few up to around 50 households per village (Magnusson, 2018).[60]
A further increasingly popular model of energy communities in Sweden is solar power cooperatives. Interview data and previous studies indicate that one of the most common forms of solar cooperatives in Sweden is tenant-owned apartments associations (bostadsrättsföreningar), which are investing in solar panels on their apartment buildings for their internal consumption (KTH n.d).[61] The recently declining cost of solar PV panels together with rapidly increasing electricity prices are stated as two central factors for the growing interest in this solution. Another present form of solar cooperatives in Sweden is cooperatives organised as incorporated organisations, consisting of members buying shares in a solar power plant to produce renewable energy.

Finally, a fourth present model of energy communities in Sweden is small-scale heating systems, often located in rural villages and communities. These communities generally operate common small-scale heating systems for residents in villages, to produce and distribute hot water. These initiatives by communities are often based on the resident's financial incentives, but they also strengthen the community's local connection.

The legislative framework, encompassing the energy system in Sweden, is regulated by EU directives and national laws. The main EU directives regulating energy communities are the Electricity Market Directive (EMD) and Renewable Energy Directive (RED) (Swedish Energy Agency 2022).[62] The EU directives define the criteria for CECs and RECs to be recognised as legal entities in EU member states. The Swedish Energy Market Inspectorate is responsible for the implementation of these directives in Sweden. As previously stated, the concepts of CECs or RECs have not yet been implemented in the Swedish legislature. Our combined data indicates, however, that the concept of energy communities will be implemented in some form in the near future.

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60. Magnusson, D. (2018) 'Going back to the roots: The fourth generation of Swedish eco-villages', ScottishGeographical Journal, 134(3–4), pp. 122–140. doi:10.1080/14702541.2018.1465199.
61. KTH (n.d). *Solar photovoltaic systems in Swedish cooperative housing.* Available at: https://www.energy.kth.se/applied-thermodynamics/key-research-areas/integrated-energy-sy/solar-photovoltaic-systems-in-swedish-cooperative-housing-1.1094451
62. The Swedish Energy Agency (2022). *Policy and Legislation.* Available at: https://www.energimyndigheten.se/en/about-us/policy-and-legislation/

The most significant national legislative framework, regulating the energy market and implementation of energy communities, is the Electricity Act (1997:857). The Electricity act was implemented in 1997 to regulate the generation, conversion, transmission, trading, distribution, and use of energy in Sweden. Within the framework, electrical installations are classified according to their degree of hazard in power installations and low-voltage systems and their environmental impact. The Energy Market Inspectorate is responsible for supervising that all actors in the energy market are complying with the regulations within the act.[63]

Another legislation framework that is affecting the preconditions to implement energy communities in Sweden is the regulation on exemption from net concession (IKN-förordningen) (2007:215).[64] As stipulated by the Electricity Act, DSOs operate the regional and local distribution grids as monopolies in designated areas around the country. To do so, they are required to have an area license, known as network concession. The regulation on exemption from the requirement for concession, however, allows certain networks to be developed without concession. To be granted exemption from the concession, the network must be internal within an easily defined area and may not be too large (e.g., an internal network in a residential building or a factory). The regulation does not permit exemption from concession for the development of networks sharing electricity between buildings, which affects the conditions to implement energy communities in Sweden of several buildings that can produce and share electricity in a common network. A few pilot projects, however, have been permitted to develop a common energy system for residential areas to investigate the potential effects and challenges related to the development of energy communities.[65]

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63. Act 1997:857. *The Electricity Act.* https://www.riksdagen.se/sv/dokument-lagar/dokument/svensk-forfattningssamling/ellag-1997857_sfs-1997-857
64. Regulation 2007:215. *Regulation on exemption from net concession.* https://www.riksdagen.se/sv/dokument-lagar/dokument/svensk-forfattningssamling/forordning-2007215-om-undantag-fran-kravet-pa_sfs-2007-215
65. See example 1.

The most central sustainability-related legislative framework, which is also i regulating the energy system, is The Swedish Environmental Code (Miljöbalken). The environmental code was implemented in 2000 and constitutes a legislative framework to promote sustainable development at all levels and sectors of Swedish society. The framework stipulates that all actors in the energy market actively should strive to limit their energy consumption and primarily use renewable energy sources (Ds 2000:61).[66] Furthermore, the development and maintenance of power grids need to consider and limit their effect on the environment and nature. The supervision of the Environmental code is guided by Sweden's overarching environmental goals and energy policy goals. Sweden's energy policy goals are that the country's energy system should be exclusively based on renewable sources by 2040 and that energy production should be 50% more effective by 2030 (Swedish Government n.d).[67]

Legal and Practical Barriers

There are several legal and practical barriers impeding the implementation of energy communities in Sweden. Data from interviews and previous studies emphasise the regulation on the requirement of network concession as a major legal barrier. Further stated hindering factors are the DSO's monopolistic position on the distribution market, various actors' economic and technical constraints, a generally low level of public knowledge, and a political and judicial ambiguity related to the definition of energy communities.

Several interviewees emphasise the regulation on network concession and exemption from concession as a barrier, hindering further models for energy communities to be implemented in Sweden. Because it is generally prohibited to develop networks that connect several buildings in residential areas, many of the potential positive financial and environmental effects of energy communities are limited. However, due to the implementation of the EU Clean Energy Package, EMD and REDII, and a recently stronger public interest in finding new energy-efficient solutions, interviewees expect that the national legislation will soon be adapted, to enable energy communities to produce, share and store energy. Furthermore, as noted previously, there are currently pilot projects that have been permitted to share and store energy within a community, indicating an increasing interest in these solutions among Swedish authorities.[68]

Interviewees also describe the DSOs as potential keepers of the services needed to implement energy communities at a larger scale. Although some DSOs currently are

66. Ds 2000:61. *The Swedish Environmental Code.* https://www.government.se/legal-documents/2000/08/ds-200061/
67. The Swedish Government (n.d). Energy Policy Objectives. https://www.regeringen.se/regeringens-politik/energi/mal-och-visioner-for-energi/
68. Example 1 and 2.

invested in projects to implement energy communities, interviewees representing projects express a general lack of interest from the DSOs to engage in projects aiming at developing energy communities. One potential reason for this,as expressed by interviewees, is that DSOs might consider the emergence of energy communities as future competitors that potentially could threaten their position in the distribution market in a longer perspective.

Moreover, several interviewees have pointed out current economic and technological constraints as hindering factors. Developing, installing, and maintaining solutions needed to produce, store, and share energy is a major investment for individual members in smaller communities, thus composing an important barrier for citizens. A few interviewees also express uncertainty about whether the net cost of producing energy within an energy community would be reduced after the investment compared to the regular energy price. Further, Sweden has come from a long period of relatively low electricity prices and has a stable national grid, hence making the economic and other forms of incentives relatively weak to invest in alternative solutions, such as energy communities. However, with electricity prices currently increasing and the investment costs for various modules to produce renewable energy decreasing, a few interviewees consider that there will be a shift toward more locally produced and shared energy in the future, creating better conditions for the implementation of energy communities.

The generally low public knowledge regarding energy consumption and unawareness of solutions to lower costs is furthermore described as a barrier by interviewees. Due to historically low energy prices, the relatively robust energy system, and the stable energy supply in Sweden, interviewees underline that the public has not generally engaged in acquiring energy-related knowledge. Due to rapidly increasing energy prices, however, the public debate on the national energy supply has intensified, leading to increased public interest and knowledge. Civilians are currently becoming increasingly aware of their energy consumption and showing a greater interest in alternative solutions to decrease their electricity costs, which potentially will lead to better conditions for implementing energy communities in the future.

Lastly, several interviewees describe a general political and juridical ambiguity concerning the definition of energy communities nationally and in EU legislation which impedes public debate and juridical implementation. Multiple interviewees state that a higher degree of clarity regarding the definition of energy communities is needed to generate public interest and to create better conditions for the implementation of energy communities on a greater scale. Thus, several interviewees are sceptical of implementing the two definitions of energy communities from the EU directives.

Drivers and Benefits

Our combined data indicate that there are several drivers and benefits to implementing energy communities in Sweden on a greater scale. The main drivers, emphasised by interviewees, are mainly based on economical and sustainable incentives while multiple benefits for society, the energy market, and citizens are stated, such as financial gains, more renewable energy available, an increased sense of agency for the consumer, and increased knowledge.

The majority of interviewees agree that citizens and organisations engaging in energy community initiatives in Sweden, to varying degrees, are driven by economic incitements. As energy prices have risen rapidly in Sweden and Europe, citizens and organisations are exploring new solutions to lower their energy costs, consequently showing interest in alternative energy investments, such as energy communities. Actors in Sweden have mainly shown interest in engaging in energy communities producing renewable energy for electricity and heating, as a complement to power from the national grid.

Second, there is a consensus among interviewees, and previous studies show, that the desire to live sustainably and exclusively consume renewable energy is an important driver of why citizens and organisations engage in energy community initiatives in Sweden. Several interviewees that are engaged in energy communities emphasise sustainability as the far most important driver and the importance to produce and consume renewable energy as part of a sustainable lifestyle, thereby potentially affecting others toward a green transition.

The combined empirical data depicts several benefits of energy communities, both for the Swedish Energy system as a whole and for the individual communities and their members. One of the main potential benefits for actors engaging in energy communities is financial gains. Through participation in energy communities, members expect to reduce their costs for heating and electricity. Interviewees emphasise that the financial gains have been particularly relevant during the last year due to the energy crisis and consequently rapidly increasing energy prices. One interviewee notes that the financial gain of energy communities for consumers could be particularly evident for larger communities organised as incorporated associates, where larger groups of members together can bear the investment costs. On a systemic level, several interviewees note that larger communities also could have major effects on politics and the future energy market by organising themselves. One potential effect, discussed by one interviewee, is that larger communities that organise themselves potentially could force DSOs to develop by demanding new services to facilitate the operations of energy communities.

Another important potential benefit of energy communities, described by interviewees, is an increased sense of ownership and agency among consumers engaged in energy communities regarding their energy consumption. Joining energy communities may potentially increase members' energy-related knowledge and their awareness of themselves as actors within the Swedish energy system. An increased level of public knowledge and awareness within the system may in turn lead to more effective energy consumption from a systemic perspective and additionally lead to decreased costs and environmental impact for the consumers.

Furthermore, several interviewees state that the development of energy communities with the possibility to produce and store energy will lead to a more locally stable energy supply in remote communities in Sweden. The implementation of energy communities that can produce and store energy locally could be particularly relevant in the future, and a solution, for remote communities in northern Sweden, often experiencing power shortages. Additionally, interviewees point out that implementing energy communities on a greater scale will lead to a higher degree of renewable energy in the Swedish energy system and would also lead to more flexibility within the system by adding local energy sources that could complement the main grid.

Examples of Real-life Communities

In the following **examples of energy community initiatives in Sweden** are presented:

- Example 1, **Tamarinden**, is an innovative project aiming at developing an energy community within a new residential area that will be able to produce, store and share energy.
- Example 2, **ElectriCITY – Hammarby Sjöstad 2.0**, is a citizen-driven innovation platform that is developing an energy community in the district of Hammarby Sjöstad in Stockholm.
- Example 3, **SIMRIS**, was a project conducted in southern Sweden to demonstrate that a village can be 100% self-sufficient in energy from renewable sources.

EXAMPLE 1: TAMARINDEN IN ÖREBRO

The project Tamarinden aims at developing a new energy-efficient residential area in the Swedish city of Örebro. The construction of ten residential buildings, that will contain 800 apartments in the area, started in autumn 2022. The municipality of Örebro leads the project together with the construction companies and building operators ÖBO, Friendly Building, Magnolia, Serneke, and Tornet to create conditions for the community to be able to reduce, produce, store, and share energy in a local energy system. The overarching goal is to contribute to more locally produced renewable energy, cut power peaks, relieve the national grid, increase flexibility, and save substantial amounts of energy. Tamarinden is a pilot project within the research project "Systemic change through locally shared energy", which is financed by The Swedish Energy Agency and RISE. The initiative is a four-year project with the purpose to investigate energy communities from a broad interdisciplinary perspective and its ability to renew the Swedish energy system, to be able to meet the energy needs of the future while protecting the climate and the environment. The goal is to make the pilots scalable as national role models for the energy transition in other municipalities and housing companies that today are looking for new solutions to contribute to achieving climate goals (Municipality of Örebro, 2023).[69]

EXAMPLE 2: ELECTRICITY – HAMMARBY SJÖSTAD 2.0

ElectriCITY is a citizen-driven innovation platform that was formed in 2014 and operates from the district of Hammarby Sjöstad in Stockholm. All of ElectriCITY's operations are run under the project name Hammarby Sjöstad 2.0. The platform has more than50 public and private partners and its overarching aim is to transform the Paris climate agreement into smart and local energy and environmental measures. The goal is to make the district climate neutral by 2030. One of ElectriCITY's current projects is to establish an energy community in Hammarby Sjöstad. In the project, which started in 2022, actors will together develop a local energy community to produce solar electricity and have a microgrid with load-balancing functions and batteries that can support the local supply of electricity. ElectriCITY will also support housing associations in the district with energy-saving measures to reduce their energy needs. The goal is to create a sustainable cycle of energy, where the district's residents become so-called

69. The municipality of Örebro (2023). *About Tamarinden.* https://extra.orebro.se/byggorebro/tamarinden.4.4ffbbf5616ac98ac8f49fb.html

"prosumers" of electricity by consuming self-produced energy to some extent (Hammarby Sjöstad 2.0, n.d).[70]

EXAMPLE 3: SIMRIS

In 2017¬–2019, the demonstration project SIMRIS developed a 100% self-sufficient energy system run on renewable energy, in the rural village of Simris, in southern Sweden. The project was conducted by the DSO E.ON together with several other project partners. The project's overarching goals were to prove that an entire village, of about 150 households, could run on 100 per cent renewable energy, to find measures to increase the utilisation of renewable energy sources and to develop business models for energy communities. In the system, a pre-existing wind turbine and solar power plant were connected to a smart control system, two large batteries, and a biofuel-run backup power generator. The smart control system together with the batteries were able to isolate the village from the main electricity grid every fifth week. The system also monitored whether the local power generation was aligned with consumer energy needs. The Surplus of renewable energy was stored in the large flow battery, which was used when the system was disconnected from the national grid. Further, heat pumps, PVs, and batteries owned by Simris residents were used to add flexibility to the system. The surplus energy produced beyond the consumer's needs was sold to E.ON. SIMRIS was one of six demonstrators in Europe in the Interflex project that was co-founded by the European Union's Horizon 2020 research and innovation program (E.ON, 2022) (InterFlex, n.d).[71] [72]

70. Hammarby Sjöstad 2.0 (n.d). *About the project.* https://hammarbysjostad20.se/, https://www.ri.se/sv/systemforandring-med-lokalt-delad-energi/systemforandring-med-lokalt-delad-energi-piloter

71. E.ON (2022). *We're renewing Simris.* https://www.eon.se/en_US/om-e-on/local-energy-systems/we-are-renewing-simris
72. InterFlex (n.d) *THE SWEDISH DEMONSTRATOR – SIMRIS. Available at: https://interflex-h2020.com/interflex/project-demonstrators/sweden-simris/?cn-reloaded=1*

Finland

Background Information

As legal entities and practical realities, energy communities are in their infancy in Finland. A considerable number of issues and questions are yet to be answered. This said, elements intrinsically involved in communities have been made legally and technologically possible long before the concept of energy communities became recognised.

Today, the Ministry of Economic Affairs and Employment (Työ- ja Elinkeinoministeriö, TEM) formally recognises three types of energy communities in Finland. The first two types, single property energy communities and cross-property energy communities, are currently implementable in practice. The third type, dispersed energy communities, is presently subject to scrutiny, and work to deliver a feasible and implementable legislative framework for them is currently underway (Elenia & VTT, n.d).[73]

The actual number of active energy communities in Finland is not monitored, although according to Datahub there are more than 80 communities that use the compensation calculation provided by Datahub. Additionally, there are several housing companies that have one singular meter and can be considered ECs. Hence, the estimated number is that there are more than 100 ECs in Finland.

An interviewee highlights that Energy communities comprise a prevalent theme in local energy research. Specific focal areas concern local solutions, like the optimisation of the exploitation of solar energy as well as opportunities for charging. The research is also widely concerned with relevant legislation to identify the most sensible terms regarding the operation of the communities. A central point of concern in the process is the division of roles and responsibilities.

Single-property Energy Communities

Single property energy communities comprise the simplest and most implementable energy community at the moment. Aligned with the term, a key characteristic for these communities is that both the production and the point of consumption are located within the same property. Intended as a clean energy solution for people not living in detached houses, the most typical example of single property energy communities is a housing cooperative (Elenia & VTT, n.d).[74] This

73. Elenia & VTT: Energy Community Handbook (n.d), Available at: : https://www.elenia.fi/files/7de35936c413685a502e8cfe531bdc1e42653201/elenia-energiayhteisokasikirja.pdf
74. Elenia & VTT: Energy Community Handbook (n.d), Available at: : https://www.elenia.fi/files/7de35936c413685a502e8cfe531bdc1e42653201/elenia-energiayhteisokasikirja.pdf

said, the single property aspect applies to larger entities too. A few of the interviewed experts estimated that there is much potential for actors like university campuses and business sites to form communities within their properties.

Current energy communities use "compensation calculation" ('hyvityslaskenta') to monitor the electricity production and to share the produced electricity among the members of the community. In a cooperative, the consumption is comprised by electricity spent in the premises of its individual members, as well as in the general premises. The calculation prioritises the electricity spent in the general premises with any surplus distributed among the members. If, in turn, the residents are unable to fully spend the generated surplus, the community can choose whether the excess is attributed to the community or to the individual members. In this instance, the electricity is sold tax free.[75] (Single property energy communities are still connected to the main grid and pay for the electricity accessed through the grid, tariffs etc.) (Elenia & VTT, n.d).[76]

The electricity system in Finland recognises DSOs as the sole network operators in their locations and the construction of parallel networks is strictly limited. This is exempted within individual properties wherein energy communities have been enabled to build internal connections without permit requirements. This has provided single property communities with a degree of freedom to optimise their processes.

Cross-property Energy Communities

A cross-property energy community, like single property communities, is a local model in which the production and consumption are connected via a separate electricity line. As the name suggests, however, the difference between the two models is that the cross-property communities establish the mode of production in a property adjacent to the point of consumption.[77] The rationale for this is to allow the community to optimise the production, should a neighbouring property be better suited for it. A commonly presented example for this is a scenario where the energy community resides close to a field optimal for a solar panel (Elenia & VTT, n.d).

Some technical details (e.g., how close together the properties may be) are not strictly defined in the legislation, and are mostly left determined by practicalities. One critical legislative detail in the process, however, concerns the connection to the main grid. Cross-property energy communities may only have a single point of

75. Elenia & VTT: Energy Community Handbook (n.d), Available at: https://www.elenia.fi/files/7de35936c413685a502e8cfe531bdc1e42653201/elenia-energiayhteisokasikirja.pdf
76. Elenia & VTT: Energy Community Handbook (n.d), Available at: https://www.elenia.fi/files/7de35936c413685a502e8cfe531bdc1e42653201/elenia-energiayhteisokasikirja.pdf
77. Elenia & VTT: Energy Community Handbook (n.d), Available at: https://www.elenia.fi/files/7de35936c413685a502e8cfe531bdc1e42653201/elenia-energiayhteisokasikirja.pdf

connection to the main grid. Where both properties previously have their respective connections, one must be undone. If the community interconnected at least two connection points to the grid, the entity would become a licensable electricity network.

Dispersed Energy Communities

Dispersed energy communities are yet to be realised in practice. Much of the current policy work concentrates on how best to facilitate them. The defining elements for dispersed communities are that they do not need to be geographically connected. Their members, as well as the production may be located anywhere in Finland.[78] In theory, this mode of community may best optimise generation with the freedom to choose an ideal location anywhere in the country. The lack of limitation to a single location may potentially enable dispersed communities to be considerably larger in size and include thousands of members (Elenia & VTT, n.d).

The point where dispersed communities are distinct from single property and cross-property communities is the increased reliance on the main grid. While local communities must be connected to the grid, the electricity produced within the community is mobilised for consumption via a separate line. Dispersed communities make use of the main grid for this purpose. Therefore, dispersed communities will likely be subject to the same grid service charges and taxes as the general population but avoid the electricity tariff. (Elenia, n.d).[79] This said, the potential for dispersed communities to grow larger beyond local limits may ultimately enable larger investments, such as entire solar fields (Elenia & VTT, n.d).[80]

As mentioned above, dispersed energy communities are not reality of the time of this case. However, it is possible to create a dispersed energy community within the same supplier. At the time of writing, in December 2022, there is an active Working Group focused on the legislative framework for dispersed communities due to finalise their work in February 2023.

Models for Energy Communities & National Legal Framework

The major actor in the Finnish electricity ecosystem is the state-owned national transmission grid operator, Fingrid, operating as a natural customer-centred monopoly. Connected to the main grid (and supervised by Fingrid) are distribution networks operated by about 70 DSOs that form another monopoly (HELEN,

78. Elenia & VTT: Energy Community Handbook (n.d), Available at: https://www.elenia.fi/files/7de35936c413685a502e8cfe531bdc1e42653201/elenia-energiayhteisokasikirja.pdf
79. Elenia (n.d). *Energy Communities. Available at:* https://www.elenia.fi/tulevaisuuden-energia/sahkontuotanto-ja-kulutus/energiayhteisot
80. Elenia & VTT: Energy Community Handbook (n.d), Available at: : https://www.elenia.fi/files/7de35936c413685a502e8cfe531bdc1e42653201/elenia-energiayhteisokasikirja.pdf

n.d).[81] The DSOs act in accordance with the policies reinforced by the Energy Authority, the regulative body for energy markets, renewable energy and energy efficiency (Energy Authority, n.d).[82] The Energy Authority, in turn, implements, supervises and reinforces policies set by the legislation.

Fingrid has also established a Data Hub for the standardisation and centralisation of data exchange on the market. Some of the DSOs are also currently the source of compensation calculation required by energy communities. The Hub went live in February 2022 but is expected to be better realised in 2023, when Data Hub starts to offer the compensation calculation. More importantly, the Hub is expected to take over the compensatory calculation function by June 1, 2023 which will enable anyone to establish a community regardless of their local DSO.

As of 2009, the Energy Market Act has allowed the construction of separate lines. The Act considers the separate line an electric line that connects a unit of production to the owner's own premises, spin-outs or customers for direct energy supply. According to the Act, DSOs have a monopoly to construct networks in their areas with some exceptions. One of the exceptions concerns a separate line connecting a small-scale electricity production (max. 2 MW) to its designated point of use, or to the grid of a designated property or cluster of properties (Market Energy Act 9.8.2913/588).[83]

In September 2016, the Ministry of Economic Affairs and Employment established a working group to explore and propose concrete measures through which the smart electricity system could facilitate the ability of customers to actively participate in the electricity market. The Working group oversaw the agreements regardingl arger, overarching elements pertaining to energy communities (Government of Finland, 2018).[84] This work laid down important groundwork in preparation for the introduction of the directive on energy communities by the European Union in 2019. By 2021, energy communities were formally recognised as micro grids in an update to the Energy Market Act. With the formalisation of the communities came the requirement for a juridical individual (i.e., a collective, like a cooperative, acting as one voice with legal rights and responsibilities) (Tommiska, 2020).[85] Finally, by taking over the compensation calculation function, Data Hub, once it is scaled up in 2023, is expected to enable energy communities to anyone with the wish and means to establish one.

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81. HELEN (n.d). *Electricity distribution in Helsinki. Available at :* https://www.helen.fi/en/electricity/customer-benefits/helen-electricity-ltd
82. Energy Authority (n.d). *About* us. Available at : https://energiavirasto.fi/en/energy-authority
83. The Market Energy Act 9.8.2013/588 chapter 1, Article 3; chapter 3, Article 13 (in Finnish), URL: https://www.finlex.fi/fi/laki/ajantasa/2013/20130588
84. Government of Finland (2018). *A Flexible and Customer-driven Electricity System – Final report by the Smart Grid Working Group*, Available at: https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/161147/TEM_39_2018.pdf?sequence=1&isAllowed=y
85. Tommiska, T (2020). *Energy community of Kankaa.* Available at: https://www.theseus.fi/bitstream/handle/10024/341644/Opinn%C3%A4ytety%C3%B6_Valtteri_Tommiska.pdf?sequence=2&isAllowed=y

The Finnish energy grid is built on the principle of fairness. As a sparsely populated country, Finland has multiple regions with far less concentrated inhabitation than in the larger cities. If not for the decreed fairness, the costs of maintenance of the grid would end up placing the inhabitants in those sparsely populated areas at a considerable disadvantage. Thus far, this principle blocks the potential for deals for energy communities. The topic emerged in a number of interviews with a tentative consensus on protecting the fairness principle. A few interviewees, however, considered separate pricing possibilities in exchange for the benefit of increasing renewable energy and potentially providing added stability in the networks.

Legal and Practical Barriers

Inhibition on Applications

The main legislative limitation for the future applications concerns the regulations regarding connections to the network. Cross-property communities are strictly regulated in terms of connection-building beyond property lines to prevent more than a single point of connection. Cross-property communities must take careful steps to avoid resembling a parallel network. In addition, the Electricity Market Act does not recognise "island" energy communities (i.e., those entirely off the grid). The regulative framework, still partially underway, limits the experimental application element in this sense. Some interviewees brought up the concept of regulative sandboxes in the future as a means to consider future applications. However, they are not a current priority in the legislative work.

State of Networks

A more practical barrier concerns the state of the local networks. The dispersity of the inhabitation in Finland constitutes a factor in the renewal and maintenance of the networks. Grids in concentrated urban areas tend to be newer and laid underground, thus lengthening their lifecycle and rendering the need for maintenance more infrequent. By contrast, grids in more rural, less populated areas tend to run off utility poles, making the maintenance more challenging in practice and its need more frequent. This is expected to negatively impact the likelihood of establishment of energy communities in rural areas.

DSOs

Additionally, the way in which DSOs approach energy communities will impact the ease at which communities can be maintained. Until the Data Hub incorporates the compensatory calculation service at the beginning of 2023, energy communities depend on their local DSOs for this function. Beyond compensatory calculation, DSOs are anticipated to take on a key role in supporting the implementation and maintenance of energy communities. However, there was a concern voiced in the interviews that DSOs may consider energy communities as competitors, which may suppress interest in collaborating on their part.

General Uptake in Light of Increased Ownership and Responsibilities

The interviews paint a mixed picture of the public interest in energy communities. Some interviewees expect the uptake to surge once the compensatory calculation becomes available for all on Data Hub. Others have been more sceptical in the light of the responsibilities which the maintenance of an energy community brings. In this respect the challenges are twofold. First is the general burden derived from regular billing, administration and upkeep. Secondly, establishing and maintaining an energy community requires technical understanding and capability. Tasks like repairs have been handled by trained experts in the energy sector thus far. A few interviewed experts expected these requirements to impact the overall public interest. Nonetheless, other interviewees expected the gradual uptake and upskilling to occur organically in the longer run, once communities become more commonplace.

EXAMPLES OF REAL-LIFE COMMUNITIES

The most prominent energy community initiative in Finland is located s in Marjamäki industry area in the municipality of Lempäälä. **LEMENE energy community** is run by a subsidiary of the municipality-owned energy and property company Lempäälän Lämpö Oy. It is an innovative and self-sufficient industrial and business district where the inhabitants share generated solar and biogas energy. The community was proposed and selected for funding as a key project for future energy solutions by the Ministry of Economic Affairs an Employment in 2017 and became subsequently operational in 2019. One of the eleven key projects financed by the ministry, LEMENE, received a €4.74m funding. This came as a part of a major decision from the government to invest a total of €100m in renewable energy and technologies between 2016 and 2018.

Other funders and financial backers for the project include Lempäälä's Local Council and Tampere Region Council. In addition, the development of LEMENE has been supported by the University of Tampere and the Tampere University of applied sciences, along with the sector specific industry.

The community area is approximately 300 ha in size, of which 30 ha has been made available for businesses. At present, there are about 300 businesses operating in the area. With the concentration of public and private support, the community houses 7,300 solar panels (2 + 2 MW), a gas engine capacity of 8.1MW and fuel cell solutions. The modelled annual production of the solar panels alone is approximately 1,800 MWh.

In adherence to the legislation, LEMENE is connected to the main network, sourcing additional electricity and selling its surplus. If needed (or made legislatively possible), the community has the capacity to function as a reserve for the main grid or become an self-sustaining island capable of going off grid.

Drivers and Benefits

Drivers

While the **DSOs** may limit the capacity for energy communities, the communities may also create demand for added services like general maintenance or billing calculation. This function is one which can be carried out by either the energy community or the local DSO. One interviewee mentioned the possibility of DSOs becoming a vital aid for energy communities where the general level of knowledge and skills may not meet the requirements within the community. It needs mentioning that the established approach to energy communities by DSOs remains to be seen.

Benefits

It also remains to be seen how the dynamic between energy communities and DSOs will be in the future. The research regarding communities has explored the potential to cultivate energy communities as local traders at grass root level. Some of the current work is concerned with possible applications for electric vehicles and questions regarding charging options in the future. Should the collaboration between energy communities and DSOs become commonplace and workable, future applications and services may branch out considerably.

A resulting awareness may also support the electricity market in managing surges in consumption. As a part of the shift to renewable energy in Finland, a central question has emerged about the rigid nature of green energy, where the supply is limited by natural factors. With the seasons impacting both, wind and available solar capacity, Finnish conditions provide a challenging ground for a sustained source of energy for a large part of the year. Prior to this, the use of coal-fired plants has allowed a degree of flexibility in supply efficiency to meet the consumer demand all year round. Thus, the shift away from fossil fuels has brought about the need to shift the flexibility on the part of the supply to that of the consumers to ensure a secure supply. Multiple interviewees highlighted the benefit of bringing consumers into the green shift. Prior to the current energy crisis, the electricity ecosystem was of little interest to the general population. The monopoly status of Fingrid and the DSOs in Finland (as is for TSOs and DSOs across Europe), as well as the generally good quality of electricity has not required participation from the consumers. Joining an energy community may help incentivise people to think about their electricity consumption and to make more informed choices.

There was a general consensus among the interviewees that the communities result in financial benefits to their members. The electricity produced by the community costs only the establishment and maintenance for local energy communities. Moreover, the possibility to sell the excess electricity has the potential for communities to become local traders in renewable energy.

Austria

Background Information

Energy communities were established within a legal framework in Austria in 2019, with the passing of the "Renewable Energy Act" (No. 150/2021)[86] ("Erneuerbaren-Ausbau-Gesetz", short EAG), which is a direct translation of the European directive into Austrian law. Additionally, the "Complete Legislation for Electricity Markets and Organisation Law" (No. 110/2010)[87] ("Gesamte Rechtsvorschrift für Elektrizitätswirtschafts- und –organisationsgesetz", short ElWOG), has established a clear definition of and framework for Citizen Energy Communities.

There are different types of energy communities in Austria:

Joint/Communal Energy Communities were established in 2017 within the Small Green Electricity Amendment (2017)[88] ("kleinen Ökostrom-Novelle 2017"). Within a joint or communal energy community, several people can produce and use electricity together on the same property, using joint production infrastructure, such as PV-panels on an apartment building, to be shared among the complex's residents.

Local Energy Communities are powered by the same transformer. Municipalities and SMEs are usually part of local energy communities. In the European context, these are Renewable Energy Communities ("Erneuerbare Energiegemeinschaft"). They are connected via a common transformer substation and collection point. Limited liability companies ("GmbHs") may not participate in Renewable Energy Communities.

Nationwide Energy Communities are not geographically bound, but members must receive their energy from the same network operator. This model is popular among families that are dispersed within the country and want to share their electricity with each other. Additionally, people living within grid areas where no Renewable Energy Community has been established yet may opt to join or form a nationwide energy community. In the European context a nationwide energy community would be considered a Citizen Energy Community ("Bürgerenergiegemeinschaft").

86. Renewable Energy Expansion Act No. 150/2021. Available at: https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=20011619
87. Electricity Markets and Organisation Act No. 110/2010. Available at: https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=20007045
88. Small Green Electricity Amendment (2017). Available at : https://www.ris.bka.gv.at/Dokumente/RegV/REGV_COO_2026_100_2_1346954/COO_2026_100_2_1347360.pdf

According to an interviewee, Austria currently has an estimated 100 Renewable Energy Communities and, according to the Coordination Office for Energy Communities' energy community map (2022)[89], between three and ten Citizen Energy Communities (last updated April 29, 2022). These figures are estimates as Renewable Energy Communities and Citizen Energy Communities are obligated to register with their network operators, who must then pass on the information to E-Control (the government regulator for electricity and natural gas markets in Austria). Although these communities must disclose the information to E-Control, they are not obligated to register publicly with the Climate and Energy Fund, the main funding agency and initiator of the coordination office.

The substantial difference in numbers of Citizen Energy Communities and Renewable Energy Communities can be attributed to the hurdles associated with founding an energy community. For one, the founder needs sufficient legislative knowledge to establish a legal entity, as well as seed capital to provide the infrastructure. Citizen Energy Communities are also more complex to organise, as every member needs to have the same network operator, which may be difficult with the dispersion of citizens and Austria having more than 120 operators to choose from.

Most Renewable Energy Communities may also stem from a company's interest in seeking financial gain and additional revenue by producing and selling energy itself. Additionally, they already have the legal know-how on how to establish a legal entity. Through our interviews we havenot been made aware of any large companies that are involved in energy communities yet, but an interviewee has registered interest by some.

Source of Energy

Most communities in Austria are producing their energy from solar panels, partly due to the advantage of not having to construct new infrastructure. There is potential for the integration of wind power and biomass in the future as soon as bigger actors participate who have sufficient capital to invest in such technologies.

Current Developments

In March 2022, Austria saw its first funding call for energy communities. According to an interviewee, most energy communities are still in the first operating phase of administrative establishment. Many energy communities plan to take on an advisory function for their members at a later stage. Current topics that are under discussion among energy communities are the handling of energy management,

89. Austrian Coordination Office for Energy Communities (2022). Map and service provider list for energy communities. Available at: https://energiegemeinschaften.gv.at/landkarte-und-dienstleister-liste-fuer-energiegemeinschaften/

storage integration and aggregation services (energy communities storing electricity and providing services to the grid operator, such as reducing the load at peak hours).

Austria's Energy[90] ("Österreichs Energie") is currently working on developing a roadmap that would make it possible for people to be part of several energy communities, which is to be implemented in 2023. As of 2023 it will most likely also be possible for Citizen Energy Communities to be operated by several network operators.

Currently, excess-produced energy is sold back to the network operator. Provided communities were to integrate more energy storage, they could actively store and strategically sell energy to interested parties in the future. Currently, 12,500 kWh may be sold by an individual producer without having to pay tax.

In accordance with the EAG, a cost-benefit analysis of the implementation of energy communities in Austria must be published by the end of the first quarter of 2024, which will be based on comprehensible data. It must provide information as to whether an appropriate and balanced participation of Renewable Energy Communities as well as Citizen Energy Communities is ensured at the system costs. In particular, this includes the costs for balancing energy, for which the regulatory authority may have to submit proposals for a user-based distribution.

The interplay between and the number of actors involved in energy communities in Austria is rather complex. Here we provide a definition of primary and secondary actors identified.

Primary Actors

- **The Austrian Ministry of Climate Action and Energy**[91] ("Bundesministerium für Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie", short BMK) is the ministry responsible for implementing and translating EU-law into national legislation and passing regulations.
- **The Coordination Office for Energy Communities** ("Koordinationsstelle Energie-gemeinschaften") was established in May 2021. The office is a national actor providing information on a national level, acting as intermediary between energy community related stakeholders and **energy advisory authorities of federal states** with whom it works. It interacts with the Austrian Ministry of Climate Action and Energy, regulatory authorities, network operators, and anyone interested in learning more about energy communities. Additionally, the Coordination office sets up funding programmes for the establishment of energy communities and host events.

90. Oesterreichs energie (n.d). *Oesterreichs energie*. Available at: https://oesterreichsenergie.at/
91. Austrian Ministry of Climate Action and Energy (n.d). Available at: https://www.bmk.gv.at/

- Anyone wanting to found or participate in an energy community must communicate their interest to the **network operator** who is responsible for billing the energy intake and production. The operator is also responsible for providing a costumer interested in joining an energy community with a smart meter. Austria currently has around 120 network operators.
- **E-Control**[92] is the Austrian government's regulatory authority for electricity and natural gas markets in Austria. It has control rights and publication obligations. Network operators need to report the data of energy communities to E-Control, who then checks whether they are acting in accordance with national law.

Background Actors

- **Energy Data Exchange**[93] ("Energiewirtschaftlicher Datenaustausch", short EDA) started as a project in 2012 and became a corporation in 2020. Since 2022, EDA is a service provider commissioned by the network operators for the operation, hosting, and implementation of the energy data exchange. It is responsible for transmitting all energy-related data to the network operators. Every electricity producing unit of an energy community needs to be registered with EDA.
- **The Climate and Energy Fund**[94] (Klima- und Energiefonds, short KLIEN) was set up in July 2007 by the Climate and Energy Fund Act (No. 40/2007)[95]. It supports modern technologies for a sustainable energy supply, innovative research projects and climate-friendly transport projects. Both the Climate and Energy fund and the **Austrian Energy Agency**[96] ("Österreichische Energieagentur", short AEA) also promote energy communities by hosting public events for interested parties. It is the founder and initiator of the Coordination office.
- **The Processing Center for Green Electricity**[97] ("Abwicklungsstelle für Ökostrom", short OeMAG) was set up in 2006. It is a relevant actor in private energy production, as it purchases energy produced by private households.
- **Austria's Energy** ("Österreichs Energie") is an interest group for the energy industry and an important actor operating in the background, advising its members on the development of new processes.

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92. E-Control (n.d). Available at : https://www.e-control.at/
93. Energy Data Echange (n.d). Available at: https://www.eda.at/
94. Klima energie fonds (n.d), *Welcome to the website of the Climate and Energy fund.* Available at: https://www.klimafonds.gv.at/
95. Climate and Energy Fund Act No. 40/2007. Available at : https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=20005371
96. Austrian energy agency (n.d). *We provide answers for a climate-neutral future.* Available at: https://www.energyagency.at/
97. OeMAG (n.d). *news :* Available at: https://www.oem-ag.at/de/home/

Models for Energy Communities & National Legal Framework

There are two main legislative sources for the definitions and rights of Renewable Energy Communities and Citizen Energy Communities. (1) the "Renewable Energy Act" (No 150/2021)[98] ("Erneuerbaren-Ausbau-Gesetz", short EAG), published in 2019, which, as previously stated, is the direct translation of EU regulation regarding energy communities into national law, and (2) the "Complete Legislation for Electricity Markets and Organization Law" (No. 110/2010)[99] ("Gesamte Rechtsvorschrift für Elektrizitätswirtschafts- und -Organisationsgesetz", short ElWOG).

According to the EAG, a Renewable Energy Community may produce energy from renewable sources that consume, store, or sell self-generated energy. Furthermore, it may be active in the field of aggregation and provide other energy services. A Renewable Energy Community must consist of two or more members or shareholders and be organised as an association, cooperative, partnership or corporation or similar association with legal personality. Its primary purpose may not be financial gain. In the case of private companies, participation must not be their main commercial or professional activity. The renewable energy community has a priority to bring environmental, economic or social community benefits to its members or the areas in which it operates (EAG § 79).

ElWOG defines Citizen Energy Communities as a legal entity that generates, consumes, stores, or sells electrical energy, is active in the field of aggregation or provides energy services to its members, and is controlled by members or shareholders (ElWOG §7, 6a). The supplier of a citizen energy community is a natural or legal person or incorporated partnership that produces electricity available to other natural or legal persons. If energy is made available to the members or the participating beneficiaries from a joint generation plant and within a Citizen Energy Community and a Renewable Energy Community it does not constitute supplier status (ElWOG §7, 45).

98. Renewable Energy Expansion Act No. 150/2021. Available at: https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=20011619
99. Electricity Markets and Organisation Act No. 110/2010. Available at: https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=20007045

According to our interviews, most energy communities are either associations or cooperatives and larger corporations are not involved as yet. The difference between a cooperative ("Genossenschaft") and an association ("Verein") is defined in the Austrian cooperative law (No. 70/1873)[100] ("Genossenschaftsgesetz") and the association law (No. 66/2002)[101] ("Vereinsgesetz").

According to the cooperative law, a cooperative must have a general assembly, a board of directors and a supervisory board in the case of more than 40 members. The supervisory board is bound by law to regularly monitor the board of directors.

According to the Austrian Association Law, an association consists of people with common, idealistic goals. An association must not be profit-oriented. A general meeting must take place at least once every five years. Similar to a cooperative, it needs to establish a board of directors that notifies authorities at least 24 hours in advance of an association meeting, as well as an arbitration board for disputes. Financially strong clubs (>€1 million annual turnover) are required to keep a balance sheet.

The main difference between a cooperative and an association, is that the cooperative may be profit-based, while the association may only pursue idealistic goals.

Most energy communities that were established as associations do not own any infrastructure, they tend to lease infrastructure, or combine members' facilities. On the other hand, energy communities that are run by large cooperatives often own their infrastructure. Ownership and leasing models both have advantages and disadvantages. According to our interviews, most energy communities are cooperatives.

Energy communities need to decide on a static or a dynamic billing model, which is then enforced by the network provider. In a static model, the energy produced within the community is distributed in equal amounts among its members, while in a dynamic model, the distribution is adapted to the energy consumption of each user. Most energy communities sell their energy at a fixed cost with occasional adjustments.

100. Austrian Cooperative Act RGBI No. 70/1873. Available at: https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=10001680
101. Austrian Association Act No. 66/2002. Available at: https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=20001917

EXAMPLE 1: EFRIENDS

In 2015, inspired by other US companies, eFriends[102] was founded before the existence of energy communities in Austria.

The difference between eFriends and conventional energy communities is that the operation of an energy community may not be the main source of income of a company, which it is in the case of eFriends. It also acts as the energy supplier, which is why, from a legal standpoint, it cannot be considered a citizen energy community.

Its customers can obtain energy from other participants at any time and need to register by simply filling out a form. In traditional energy communities the process is a lot more difficult, as customers first need to receive and register their smart meter from their network provider. eFriends members who produce energy can set the price at which they would like to sell their energy, or give it away free of charge to friends and family. Other members can choose from whom they would like to buy their energy. Everything is conducted through an app and eFriends takes over billing and calculations of energy intake and output.

eFriends also leases rooftops for the community. The PVs that eFriends builds on the leased roof belong to the owner after a set amount of time, depending on the contract. The disadvantage of their model is that eFriends only covers about 60% of the electricity needs. The remaining 40% must be purchased from someone else. eFriends also acts as a service provider for energy communities and operates six of them in Austria.

The company is an interesting example as eFriends is an energy sharing community acting outside of the European or national energy community-specific legislation.

EXAMPLE 2: OURPOWER

OurPower[103] is a cooperative that owns more than 250 power plants, producing 60% of its electricity from PV, 20% from wind, and 20% from hydropower. It operates two joint/communal energy communities and one Citizen Energy Community that it has not registered yet.

They want to lease roofs, but the PV then belongs to the energy communities. After 10 years, the plant belongs to the tenant.

102.eFriends (n.d). Austria Shares Green Electricity. Available at: https://www.efriends.at/
103.ourPower (n.d), About us. Available at: https://www.ourpower.coop/

EXAMPLE 3: GRÄTZL ENERGIE

Grätzl Energie[104] is a Renewable Energy Community in Vienna run by the energy service provider Power. Grätzl Energie mostly operates within one district of Vienna, as in the case within all Renewable Energy Communities in Austria, there is a certain proximity criterion due to the reliance on a common substation. Grätzl Energie offers similar leasing models to those of OurPower.

104.Grätzl Energie (n.d). *Become part of the energy transition*. Available at: https://www.graetzlenergie.wien/

What became apparent in talking with Renewable Energy Communities is that most were cooperatives run or owned by another company. The descriptions of each of the examples are rather brief, as their business models are quite similar, and they are bound by proximity.

Most Citizen Energy Communities are run within a family or a small group. In an interview we conducted with a founder of such a family run Citizen Energy Community, the interviewee stated that the purpose of founding the community was simply to share the electricity, which the family produces from their PV with their children, living in another state. The family did not want to include anyone from outside the family within their community. This is in line with what other interview partners have said about the current purpose of Citizen Energy Communities.

Drivers and Benefits

Renewable Energy Communities and Citizen Energy Communities have different advantages under current legislation.

Renewable Energy Communities (RECs) currently offer financial incentives such as discounts from network tariffs for regional use and can receive subsidies from a variety of funding programs. Furthermore, corporate actors benefit from the opportunity to participate and profit from the energy market, adding a new source of revenue to their business model.

Citizen Energy Communities (CECs) havethe advantage of more actors being able to participate than in Renewable Energy Communities, as they are not bound to a single substation, and limited liability companies ("GmbHs") may participate. In the future Citizen Energy Communities may play a big role in the energy transition, especially once bigger corporations decide to invest and become active.

Energy communities combat energy poverty, providing members with less expensive energy and allowing them to contribute to the energy transition without having to purchase necessary infrastructure, such as PV panels.

Though network providers currently kind of pose a barrier to the expansion of energy communities, they may be useful to them in the future, as energy communities reduce the energy load and stabilize the grid, thereby potentially lowering the necessity for grid expansion.

Heat production has not been employed in energy community models in Austria yet. According to an interviewee, the integration of heat production could be an important next step. Renewable heat can come from local heating and an energy community's PV infrastructure could be connected to heating infrastructure.

Austria is currently experiencing increasing resistance from its population when it comes to the construction of hydropower and wind power plants. People are less opposed to being involved and more understanding when being part of the implementation and decisionmaking process by joining an energy community. Energy communities also increase people's awareness of where their electricity comes from.

A social aspect of energy communities is that people get to know their neighbours and develop a feeling for regionality, by becoming a part of a community.

At a larger scale, interviewees have regarded energy communities ascontributing to raising awareness of climate change. By promoting on-site production, they can contribute to the independence from fossil fuels and foster cross-sectoral energy use and storage. Economically, energy communities increase energy autarchy and lessen the national dependence on energy imports.

Legal and practical barriers

Network Operators

One of the main barriers for energy communities is the dependence on the network operator, as there are more than 120 in total and within a Renewable Energy Community all members must be registered with the same operator.

A legal burden is the calculation of energy balance, which is the responsibility of the energy community itself. Should there be any errors or miscalculations in the energy balance, this may have serious legal consequences, especially considering that most energy communities are either cooperatives or associations, meaning they are fully liable.

According to an interviewee, the balance data reported by the network provider is not accurate as the provider has little interest in making this service available to its customers.

It has been repeatedly stated that the biggest issues for the network operators themselves is the IT-infrastructure for calculating and balancing energy intake and output. This is an issue that, according to some interviewees should be dealt with within the next five years.

Legal Classification

The current legal definition of an energy community that prohibits financial profit being an energy community's main purpose, creates confusion among actors regarding what an energy community is and is not allowed to do.

A legal barrier is the necessity of establishing a legal entity. Though there are a plethora of associations in Austria, tax declarations and other obligations associated with operating a legal entity deter many from founding an energy community. Furthermore, an association, the legal entity entailing the least funding cost, is fully liable for any errors incurred in billing and balancing outgoing and incoming energy. As previously mentioned, the network operators' calculations received by an association may be inaccurate, thus the association may bear charges for having billed incorrectly.

Forming a cooperative is more cost intensive. According to interviews, the cost associated with founding a cooperative energy community is high (>€10.000) and hardly feasible for a small group of people.

Smart Meters

Technically, the rollout of smart meters in Austria and the digitalisation of the grid is still lagging. Network operators may also act as barriers in some instances as they currently do not provide sufficient information to customers when looking to join an energy community (e.g., 'which transformer am I connected to?'), making the processes more complicated. Thankfully, more and more network operators are making maps available to their customers, showing them how they are connected to the grid. Another barrier is that in general network operators currently lack incentive to provide services to people interested in joining an energy community in as it poses an administrative burden on them and creates additional competition. The network operator is obligated to provide its customer with a smart meter within two months of the initial request. In one instance an interviewee mentioned that their smart meter was only provided after the exact two-month deadline, as the operator lacked incentive to provide it any sooner. Energy community members must also register with a smart metering portal, for which they receive a user-specific account from their network provider.

According to interviewees, most people are not willing to go through the process of signing up and registering a meter. eFriends, by evading this issue and providing its own service for energy calculations, provides an app, in which any user can monitor their energy intake and output without the user having to obtain any expert knowledge. Nevertheless, eFriends by conventional standard not considered an energy community. In order to make energy communities more popular, eFriends' billing solution may serve as inspiration, in that either an external service provider would need to take care of all billing for energy communities, or legislation would need to adapt to make billing more convenient.

Energy Purchasing Prices

The Processing Center for Green Electricity ("Abwicklungsstelle für Ökostrom", short OeMAG) poses a barrier for individuals producing their own electricity as it currently offers to purchase their electricity for €0,5/kW, which is generally more than what a producer would receive from providing energy to an energy community. Due to a rise in energy costs OeMAG's tariffs are expected to go down in 2023.

Netherlands

Background Information

In the Netherlands there is no single definition of citizen energy communities or renewable energy communities. Most energy communities fit in the definition of the EU Commissions RECs. In the Netherlands, it is recognised by many governmental and civil society organisations that energy communities could be an important actor in the energy transition in the Netherlands, and this shows in the large number of energy communities, which the Netherlands has. However, it is also recognised that communities as of yet still face quite some regulatory and practical barriers to set up their energy communities. This need is recognised and there are new laws in the process of being made that lower barriers and improve opportunities for energy communities.

In the Netherlands, the first local energy communities emerged in the late 1980s. These first communities often owned one or more wind turbines together, and their aim was to live an independent and environmentally friendly lifestyle. These communities were made possible by the 1989 Electricity Act Experiments Scheme. This was a scheme that explicitly made space for experiments like energy communities in the legislative framework. The scheme gave these communities grid access and guaranteed a standard price (Oteman, Kooij & Wiering 2017).[105] In the early 1990s, the number of communities grew to 25. The complete liberalisation of the energy market in 2004 increased the opportunities for local initiatives, and their establishment has accelerated since 2010 (Kooji et al 2018).[106]

In the 2010s, the main stimuli for renewable energy were the SDE+ subsidy programme (successor of the SDE, Stimulation of Sustainable Energy production) and the two schemes that made experimentation possible again: The new Electricity Act Experiments Scheme (which ran from 2015 to 2018), and the Dutch Green Deals. The SDE+ was only available for companies and organisations.

In 2013, the Energy Agreement (Energie Akkoord) was signed, in which a small part was dedicated to community energy, specifically the 'zip code rose project'. Through this project, energy consumers receive an energy tax deduction for energy produced within a collective renewable energy project situated in their zip code area. This stimulated the realisation of more local energy communities (Oteman, Kooij &

105. Oteman, M., Kooij, H.-J. and Wiering, M. (2017) 'Pioneering renewable energy in an economic energy policy system: The history and development of Dutch grassroots initiatives', Sustainability, 9(4), p. 550. doi:10.3390/su9040550.

106. Kooij, H.-J. et al. (2018) 'Between grassroots and Treetops: Community Power and institutional dependence in the renewable energy sector in Denmark, Sweden and the Netherlands', Energy Research & Social Science, 37, pp. 52–64. doi:10.1016/j.erss.2017.09.019.

Wiering 2017).[107] The new Electricity Act Experiments Scheme is an example of experimental regulation. It was opened annually from 2015 to 2018, each time for one year. It specified which articles of the earlier Electricity Law specifically were to be experimented with, and cooperatives could apply for these specific exemptions. The Electricity Law did not have a set ending, but it is being updated: the follow-up Energy Law is currently being written, mainly because of changes to the energy system due to the energy transition. For the Green Deals, projects can apply and get support from the governments to eliminate barriers that are specific to their projects; these can include regulatory, market and social network barriers. Currently, there are almost 700 cooperatives and more than 110,000 people are member of local energy cooperatives (HIER, 2022).[108]

Models for Energy Communities & National Legal Framework

Models for Energy Communities

Energy communities in the Netherlands can organize themselves in various ways. The main forms of organisations are: a cooperative, a foundation, an association of owners (Vereniging van Eigenaren), and sometimes a company. For the main available subsidies for energy communities, often the requirement is in place that the community needs to be organised as a cooperative or a foundation.

A cooperative is currently seen as a private company, which limits its possibilities for action on the energy market. CECs are currently not implemented in the Dutch law. As this is not in line with the EU Commissions definition of CECs and RECs, these regulations will change when the new Energy Law is approved.

Historically, energy communities in the Netherlands have mainly been centred around the concept of sharing electricity supply and batteries. Lately, communities that integrate heat supply are increasingly common as well. This is encouraged, as communities with district heating could use that as an alternative to gas.

National Legal Framework: The new Energy Law

Currently a new law is developed in the Netherlands that will replace the Electricity Act as well as the Gas Act. It is called the Energy Law and will encompass all energy carriers. Currently, this law does not include an experimentation clause like the one in the Electricity Law, which allowed for Experimentation Schemes to be implemented in the future. It was left out partially because the ministry of

107. Oteman, M., Kooij, H.-J. and Wiering, M. (2017) 'Pioneering renewable energy in an economic energy policy system: The history and development of Dutch grassroots initiatives', Sustainability, 9(4), p. 550. doi:10.3390/su9040550.
108. HIER (2022). Local Energy Monitor 2021. Available at: https://www.hieropgewekt.nl/uploads/inline/Lokale%20Energie%20Monitor%202021_def_digitaal.pdf

Economic Affairs and Climate is in doubt whether it has added value, especially since the room for experimentation under the Electricity Act Experiments Scheme was not always necessary for innovative projects to reach their goal.

The Ministry of Economic Affairs and Climate organised a public consultation on the new Energy Law last year, which included a question about whether the law should include the explicit space for experiments in the form of an experimentation clause. The majority of the respondents to this consultation responded in favour of adding the space for experimentation. The main reason for this is that innovation is unpredictable, so it might be smart to include some space to divert from the legislation in case the need arises. The main argument against including an experimentation clause is that it was not the Electricity Act that was the limiting factor for the experiments, but other legislation was. So experimentation should (also) be included in other legislation.

Legal and Practical Barriers

Legal Barriers

Under the old Electricity Law and the old Gas Law, it was practically impossible to share energy with fellow members of an energy community – except if this was made possible through being part of the Experiments Scheme. Currently, members sell their energy to the energy provider and they sell it back to the community. In the new Energy law, there will be more space for selling and buying electricity within a community. However, energy communities remain critical of the fact that communities are subject to the same requirements as any other market parties like energy providers. Energy communities currently also sometimes adopt solutions to take a smaller connection to the electricity grid. Normally, the connection is based on the peak demand from, or peak supply to the grid. With peak shaving, the electricity demand and/or supply is stabilized in the community. This is done through e.g., purchasing a battery as a community, or disabling part of the electricity supply (turning off a wind turbine, shading a solar panel). Another possible solution is to move the solar panels from a South-focused orientation to an East-West orientation.

Practical Barriers

First of all, there are several **financial barriers** for energy communities in the Netherlands. It can be challenging for energy communities to secure sufficient upfront investments. The main reason for this is that their business model is highly reliant on energy prices, which can be rather volatile. Finding subsidies for the new Subsidy for Cooperative Energy Supply (Subsidieregeling Coöperatieve Energieopwekking) provides more stability regarding the electricity prices, through establishing an energy price range for energy communities within which the electricity is guaranteed to stay.

Secondly, a barrier for energy communities is **their dependence on other actors**. Energy communities rely on other actors to help them set up their communities and the infrastructure needed for it: municipalities, DSOs and private companies. As these other actors often have more actual power, knowledge and dedicated time than the volunteers of the communities, there is a power distance between the organisations. This could lead to unequal negotiations, in which communities cannot build their preferred energy systems.

A related barrier is the **lack of knowledge among starting communities**. A lot of technical, organisational, and regulatory knowledge is required to properly to set up an energy community. Starting communities need to invest large amounts of time, energy and money to achieve their goals. Some energy communities therefore ultimately fail in realizing their envisioned communities. Therefore, not only regulatory barriers need to be reduced for starting communities, but also financial, organizational, and knowledge barriers.

Finally, energy communities require **high investment upfront**, which can create barriers. Setting up an energy community currently takes a lot of time from volunteers. According to an interviewee from a DSO, scalability of the energy communities – i.e. to start new communities in other neighbourhoods – remains one of the main challenges in the Netherlands. Even if the communities were allowed legally, before through the experimentation room, and with the new Energy Law there will be space for energy communities in the law, setting up new communities is not sufficiently easy to make it scalable. Therefore, DSOs and representatives of the energy communities are developing simple concepts that neighbourhoods can adopt easily for starting their own community. Energy communities need time to grow as an organisation. A representative of energy communities argued therefore that communities should get a "right to grow up": a period of time in which they are allowed to learn and grow as a community.

Drivers and Benefits

Drivers

One of the main drivers for the establishment of energy communities in the past years is that the energy prices are currently very high. This makes the business models for local energy supply more attractive.

Another main driver in the Netherlands is the active representative body for Dutch energy communities. Energy communities in the Netherlands are represented by a highly active representative organisation, called Energy Together (Energie Samen) [109]. Energy Together is a fusion of various representative organisations, representing not only energy communities but also citizens with the aim of making their homes more sustainable, and private wind turbine operators. Energy Together successfully represents the interests of these groups at national and regional level, with the civil servants as well as the parliament. Energy Together is successful in representing the energy communities partially because they have established contact with government officials who are willing to change legislation, or make it more flexible. This way, more innovative initiatives like energy communities are able to start.

109.Energie Samen (n.d) *Collaborate on the energy transition.* Available at: https://energiesamen.nu/

Another driver for the development of energy communities are the Dutch Regional Energy Strategies[110] (instead of national). The Netherlands has set up Regional Energy Strategy regions, where local governments and local organisations collaborate for the energy transition. Reaching out to regional energy strategists is more convenient for local energy community initiatives. Here, regional culture that isused to local initiatives also play a role in how easily community members decide to start an energy community. When the regional culture is one in which local initiatives are regularly set up for a variety of topics, the local citizens are more likely to start their own energy communities as well (National Programma RES, 2022).

Finally, a supporting factor in the Netherlands for energy communities is that most DSOs see the benefits of energy communities. Many of the energy communities have been enabled or supported by their local DSOs. DSOs are actively involved in driving the transition to more energy communities in the Netherlands.

Benefits

For members, there are several social, financial and environmental benefits of energy communities.

Social benefits are related to autonomy, democracy, social cohesion, and local profits. The autonomy of an energy community ensures that the ownership of the energy supply is in the hands of the members of the energy community. That means that the energy supply can be adapted precisely for the purposes of the end users of the energy. Furthermore, some interviewees mention that one of the biggest benefits of energy communities is how democratic these communities are. Local citizens are able to join and have a say about the energy community, and what would be a fair and smart allocation of resources within the community. As such, citizens are more likely to be engaged in the local democratic processes as well, because they feel agency and ownership over their neighbourhoods.

Energy communities are also beneficial for the social cohesion of communities and neighbourhoods. The interviewees who are a member of their energy community comment that they value the social cohesion that comes with being part of the energy community. Neighbours who did not have a reason to talk to each other before now get to talk because they are part of the same community. Vulnerable or lonely neighbours can be included in the community and get access to more support and social interaction. Profits of energy communities are often used to invest in the neighbourhood. Multiple interviewees mention that they like that the profits of their energy supply are used to invest in the neighbourhood, rather than to increase the profits of a big (energy) company.

110. Nationaal programma RES (2022). Why have a Regional Energy Strategy (RES)?. Available at: https://www.regionale-energiestrategie.nl/english/default.aspx

Financial benefits for community members include lower energy prices for locally supplied energy. Also, when their energy community is profitable these profits can be used locally, as described above.

There are also environmental benefits for energy community members. First, members can support the energy transition. Members of energy communities hope to increase the share of renewable energy on the grid, and to minimize the need for grey (back-up) energy supply. Second, they can contribute to the increased acceptance of renewable energy. When a local community exploits renewable energy such as a wind turbine, the acceptance is significantly higher than is the case for commercial wind projects. Lastly, many energy communities report a lower total energy consumption in their communities. Because energy communities plan the energy structure in their community ahead, and because they are more aware of the consequences of their own energy consumption, they are likely to have a lower energy consumption per person.

There are also several benefits for the economy. A technical benefit is that energy communities can help alleviate local grid congestion. Because the energy communities use the locally supplied energy locally as well, the energy communities can play an important role in balancing the local electricity net. Energy communities can also help balance the (local) energy grid. Energy communities can support to balance the energy system through using the own energy as much as possible and decrease the size of their connection to the grid. This decreases peaks of energy supply and demand on the grid.

Energy communities are also seen as an opportunity for innovation. An interviewee from the government side mentioned that they see the energy communities as an excellent opportunity to innovate in collaboration with various actors including citizens. Finally, local energy supply contributes to higher energy independence from other countries.

Examples of Real-life Communities

In the following some real-life examples of energy communities in the Netherlands are presented:

- Example 1, the **Republica Papaverweg**, represents a pioneer community that consists of various types of buildings that share a smart grid with batteries.
- Example 2, **Schoonschip**, is an example of a community of water houses that use a smart grid to become self-sufficient.
- Example 3, **Earth Houses** (Aardhuizen) is an example of a community that make use of communal areas and a common battery.

EXAMPLE 1: COOPERATIVE REPUBLICA PAPAVERWEG

The aim of this Amsterdam-based cooperative is to create a sustainable town within the city of Amsterdam, that includes both rental and owner-occupied houses, business spaces and a hotel. Circularity and renewable energy supply are the basis of the project. There will also be a smart grid with batteries that balances the local energy supply and demand.

Source: www.republica.amsterdam/en/home

EXAMPLE 2: OWNERS ASSOCIATION SCHOONSHIP

Owners association **Schoonship**: This association will build 46 water houses in North Amsterdam. The houses use an advances smart grid in order to become self-sufficient in the area of energy. The smart grid will be developed with research and private institutions such as Fraunhofer, Metabolic, Spectral Utilities and CWI.

Source: schoonschipamsterdam.org

EXAMPLE 3: OWNERS ASSOCIATION EARTH HOUSES (AARDHUIZEN)

Owners association **Earth houses** consists of 23 earth houses and a communal house that have been built in collaboration between the University of Twente, the network operator Enexis and the owners' association. Solar panels and a battery should make the Earth houses self-sufficient.

Sources: www.aardehuis.nl/index.php/nl

Germany

Background Information

In Germany, there is no single definition of citizen energy communities (CEC) or renewable energy communities (REC). Energy communities comprise a broad variety of different legal models, associated actors and business models. However, all focus is on renewable energy and operate mainly on a local level. Thus, German energy communities rather fit into the EU definition of REC (EU Directive 2018/2001) (Deutsche Energie-Agentur , 2022).[111] [112]

Energy communities in Germany engage with around 86 % primarily in electricity energy production (electricity (photovoltaics, wind) and heat (biomass)), but also in energy distribution, as well as investments in renewable energy. Less often energy communities act as grid operators (bioenergy villages, "Bioenergiedörfer").

Historically, there is a long tradition of the collaborative organisation of energy supply in Germany: In the early 20th century, electricity cooperatives ("Strom-Genossenschaften") contributed to organising the electricity supply in rural areas in Germany. Since 1995, the number of energy communities with a focus on renewable energies increased. Particularly, in the years 2006 to 2013 890 energy cooperatives were founded, many of them with focus on photovoltaic (Frick et al, 2022).[113] Thisdevelopment were favoured by regulatory changes. First the so-called Renewable Energy Sources Act ("Erneuerbare-Energien-Gesetz (EEG)) was introduced in 2000 and included fixed feed-in tariffs and priorities of renewable energies, which made investments in renewable energies more predictable and profitable. Further, an amendment of the law on cooperatives, the main legal form of energy communities in Germany, facilitated the establishment of cooperatives focusing on simple corporate structures and the possibility of democratic participation of the members. Yet, since 2013 there is less growth in the sector driven by a decrease in photovoltaic based energy communities. This is due to significant lower feed-in tariffs, which make investments less attractive and less plannable. Further, the introduction of tendering in 2017 pose another constraint to energy communities.

111. EU-Directive 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (Renewable Energy Directive (RED II)). http://data.europa.eu/eli/dir/2018/2001/oj
112. Deutsche Energie-Agentur (Hrsg.) (2022). *Energy Communities: Beschleuniger der dezentralen Energiewende*. https://www.dena.de/newsroom/publikationsdetailansicht/pub/dena-analyse-energy-communities-beschleuniger-der-dezentralen-energiewende/
113. Frick, V., Fülling, J, Anger, K., Knörzer, U., Tornow, M., Schnee, H. (2022). Mit Suffizienz zur Energiewende. Schriftenreihe des IÖW, 224/22.

Although numbers vary slightly across data sources, there are around **1,700 energy communities in Germany** (as of 2016). The biggest group (55%) of energy communities are organised as cooperatives ("Genossenschaften") mainly focusing on photovoltaic. Another important group (37%) are organised as limited liability companies (GmbH/UG & Co. KG) and operate mainly wind parcs (Kahla et al, 2017).[114]

Energy communities in Germany are regulated by the federal government and EU-bodies (and the respective laws, guidelines, and regulations) as well as the federal grid agency ("Bundesnetzagentur") on an implementation level. Federal states are not relevant for the regulation. Further actors that can play an important role are municipalities, at times directly involved in energy communities ("(see the example of "Regionalwerke"), and financial institutions. Energy suppliers (especially green energy suppliers) are often partners for energy communities with regards to grid operation and energy distribution (see example of "Elektrizitätswerke Schönau").

Models for Energy Communities & National Legal Framework

The legal framework of energy communities in Germany is determined by the EU directives on CEC, but mainly REC (Electricity market directive and RED II), and national laws. The most important national regulation is the Renewable Energy Sources Act ("Erneuerbare-Energien-Gesetz" (EEG)). The EEG was introduced in 2000 to increase the share of renewable energy sources in the German energy supply and included a feed-in tariff scheme to foster renewable energy. Since then, the law was amended several times, with new regulations entering in force in 2023. Furthermore, the Energy Industry Act ("Energiewirtschaftsgesetz") as well as laws on particular legal company models, such as the law on cooperatives ("Genossenschaftsrecht") play important roles with regards to energy communities.

Regarding the EU directives and guidelines for CEC and REC, Germany has not yet implemented parts of it. Germany is especially lagging behind in the implementation of energy sharing (Boos, Hummel & Wegerich, 2021).[115] RED II permits the joint production and consumption of renewable energy via the local electricity grid. However, its implementation to national law is challenged by difficulties. According to the interviewees, the implementation of energy sharing should provide financial incentives to consume the electricity produced by the cooperative's or one's own RE plant.

114. Kahla, F., Holstenkamp, L., Müller J.R. & Degenhart, H. (2017). Development and State of Community Energy Companies and Energy Cooperatives in Germany. MPRA, Working Paper Series in Business and Law, 27, 81261.
115. Boos Hummel & Wegerich, 2021.

In Germany, the legal framework for the organisation of an energy community depends on the size and the sector of the project to be implemented. The most common legal frameworks for energy communities in Germany are cooperatives ("Genossenschaften"), limited liability companies (GmbH/UG & Co. KG), and private corporations ("Gesellschaft bürgerlichen Rechts").

Cooperatives are the most frequent organisational form of renewable energy communities in Germany (around 55%) and produce 3.5% of the renewable energy of the country (DGRV, 2021).[116] Since 2006, 896 energy cooperatives have been founded in Germany. 95% of their members are private individuals, they furthermore include banks, farmers, as well as municipalities, public institutions, and churches. The minimum amount of investment of the members differs among the energy cooperatives, on average it is €560. This rather low amount allows different income groups to participate. Most energy cooperatives ("Genossenschaften") are engaged in solar energy production (80%), but they are also active in the field of electricity distribution (36%) and wind energy production (30%) (DGRV, 2021).[117]

In general, cooperatives are a very established legal structure in Germany and have been used for the organisation of (then fossil) electricity supply in rural areas since the early 20th century (Holstenkamp & Müller, 2013).[118] The long tradition of cooperatives leads to a clear and well-developed legislation, which facilitates the foundation of cooperatives, and ensures a high acceptance in society. The low rate of bankruptcy among cooperatives furthermore increases the attractiveness of the model. Yet, more bankruptcies can be observed since 2009 due to external factors, such as changing economic forecasts, or projects that do not unfold as planned (Kahla et al, 2017).[119]

According to the interviewees, there are two important approaches of cooperatives that ensure long-time market participation and stability: First, some cooperatives offer important services for their members and act as social entrepreneurs (e.g., "regionalwerke"). Second, cooperation with established, larger energy suppliers offers guarantees for stability (e.g., BürgerEnergie Berlin with Elektrizitätswerke Schönau).

- Energy communities focussing on wind energy production are often organised in the legal form of limited liability companies (GmbH, UG, GmbH & Co. KG) as the construction of wind parks requires more capital. These companies can be regarded as citizen energy communities if the limited

116. DGRV (2021). Energiegenossenschaften 2021. Jahresumfrage des DGRV. https://www.dgrv.de/wp-content/uploads/2021/06/20210621_Kurz_DGRV_Umfrage_Energiegenossenschaften_2021.pdf
117. DGRV (2021). Energiegenossenschaften 2021. Jahresumfrage des DGRV. https://www.dgrv.de/wp-content/uploads/2021/06/20210621_Kurz_DGRV_Umfrage_Energiegenossenschaften_2021.pdf.
118. Holstenkamp, L. & Müller, J.R. (2013). On the State of Energy Cooperatives in Germany. A Statistical Overview As of 31 December 2012. Working Paper Series in Business and Law, 14.
119. Kahla, F., Holstenkamp, L., Müller J.R. & Degenhart, H. (2017). Development and State of Community Energy Companies and Energy Cooperatives in Germany. MPRA, Working Paper Series in Business and Law, 27, 81261.

partners ("Kommanditisten") are private citizens.

- For small projects, energy communities are often organised in the legal form of private corporations ("Gesellschaft bürgerlichen Rechts"), which are rather simple to register and found, yet yield the risk that members are liable with their personal assets.

There are differences in the scope of (financial) participation in the forms of energy communities in Germany: While energy communities organised on the municipality level (e.g., "regionalwerke") ensure participation of all citizens, renewable energy communities organised as cooperatives or limited liability companies (GmbH & Co. KG) require often larger investments and hence, are not by design open for all income levels. Therefore, some of the interviewees deemed it important to ensure burden sharing and participation of different income groups to guarantee equal opportunities to participate. The organisational form of cooperatives furthermore ensures equal voting rights independently of the financial contribution to the project,[120] whereas in limited liability companies the shareholders' votes are weighted by their investments (Ahlemeyer et al, 2022.

Since 2013 there is a shift in the predominant legal form of the energy communities from cooperatives to limited liability companies. While the foundation of cooperatives is decreasing, limited liability companies have increasingly been established. This change is driven by the predominant electricity generation technology. While between 2009 and 2012 the focus lay mostly on electricity production via photovoltaic and was mainly implemented by cooperatives, wind projects have increasingly been set up in form of limited liability companies since 2013. This is also due to changes in the EEG law (Kahla et al, 2017).[121]

Furthermore, there are differences in the frequency of the legal forms of energy communities between urban and rural areas: While in rural areas energy communities are often organised as cooperatives, in cities the legal form of private corporations is more often chosen, as the projects are mainly on a smaller scale.

The predominant business field of energy communities in Germany is electricity energy production (86%). Also, around 100 communities operate their own grid (e.g., bioenergy villages (Bioenergiedörfer) and around 150 operate grids and distribute heat and electricity but do not produce electricity. A minority of the energy communities distribute electricity or heat without operating their own grid (Ahlemeyer et al 2022).[122]

120. Ahlemeyer, K., Griese, K. M., Wawer, T., & Siebenhüner, B. (2022). Success factors of citizen energy cooperatives in north western Germany: a conceptual and empirical review. Energy, Sustainability and Society, 12(1), 1-14.
121. Kahla, F., Holstenkamp, L., Müller J.R. & Degenhart, H. (2017). Development and State of Community Energy Companies and Energy Cooperatives in Germany. MPRA, Working Paper Series in Business and Law, 27, 81261.
122. Ahlemeyer, K., Griese, K. M., Wawer, T., & Siebenhüner, B. (2022). Success factors of citizen energy cooperatives in north western Germany: a conceptual and empirical review. Energy, Sustainability and Society, 12(1), 1-14.

Legal and Practical Barriers

Energy communities in Germany face a number of **practical as well as regulatory challenges**.

The **regulatory framework and the bureaucracy** in Germany represent barriers for energy communities (Deutsche Energie-Agentur, 2022).[123] The interviewees emphasised the high relevance of the transfer of European political decisions to national guidelines. This is not been conducted to a sufficient extent in Germany. In particular with regards to energy sharing the lack of guideline poses an obstacle to energy communities. Energy sharing allows members of energy communities to consume the electricity generated by the community. Energy sharing focuses on the common, regional production and usage of renewable energy by using the local electricity grid and is often confounded with landlord-to-tenant electricity ("Mieterstrom") and joint self-supply ("gemeinsame Eigenversorgung") which describe the energy use of a commonly owned renewable energy plant by consumers with a joint grid connection (Bündnis Bürgerenergie e.V. 2021).[124] So far, there is no legal framework for energy sharing or landlord-to-tenant electricity in Germany. It is even further complicated as, according to the interviews, grid connection, especially in apartment blocks, is very difficult as many actors are involved and regulations are not easily comprehensible. Overall, this poses significant boundaries and insecurities to the members' possibilities to benefit from the electricity generated by the community.

Furthermore, the amendment of the renewable energy sources act (EEG) in 2014 **reduced** the **support measures for renewable energies**. As part of this reform the fixed feed-in remuneration was replaced by a tendering procedure for electricity generation capacities (Frick et al, 2022).[125] Since then, the national Renewable Energy Sources Act includes the preservation of actor diversity as a requirement of tendering to ensure that energy communities can participate in tendering (Hauser et al 2015).[126] Nevertheless, energy communities often face difficulties to win larger projects or relevant areas for the development of renewable energy projects. Economically relevant projects and interesting locations are often won by professional actors and larger companies, not by energy communities. The acquisition of projects is particularly difficult in cities. On the other hand, there are often not enough applications fortenders, owing to risk and insecurity and low

123. Deutsche Energie-Agentur (Hrsg.) (2022). Energy Communities: Beschleuniger der dezentralen Energiewende. https://www.dena.de/newsroom/publikationsdetailansicht/pub/dena-analyse-energy-communities-beschleuniger-der-dezentralen-energiewende/.
124. Bündnis Bürgerenergie e.V. (2021). Konzeptpapier Energy Sharing: Partizipation vor Ort stärken & Flexibilität aktivieren. https://www.buendnis-buergerenergie.de/fileadmin/user_upload/BBEn_Konzeptpapier_Energy_Sharing_Stand_vom_07.10.21.pdf.
125. Frick, V., Fülling, J, Anger, K., Knörzer, U., Tornow, M., Schnee, H. (2022). Mit Suffizienz zur Energiewende. Schriftenreihe des IÖW, 224/22.
126. The diversity of players in electricity generation from renewable energies is to be preserved in the changeover to tenders („Bei der Umstellung auf Ausschreibungen soll die Akteursvielfalt bei der Stromerzeugung aus erneuerbaren Energien erhalten bleiben")" in Hauser et al., 2015.

prices/remuneration (Agentur für Erneuerbare Energien, 2022).[127] This is a major problem for the expansion of renewable energy sources in Germany. When the new EEG regulation enters into force in 2023, energy communities will be exempt from tenders, a decision which is supported by citizen energy associations.[128] Some of the experts expressed their concerns regarding current plans to extend renewable energy sources without special conditions for smaller suppliers (and hence energy communities). According to the interviewees, there should be conditions to prevent new barriers for energy communities.

While digital technologies have a high potential to improve the processes of energy communities, the **lack of digital infrastructure** in Germany is one of the main barriers for renewable energy communities (Deutsche Energie-Agentur, 2022).[129] According to the interviewees, the slow rollout of smart meters in particular hinders the implementation of energy communities. The current German government seems to be aware of this problem and is drafting a new regulation to facilitate the digitisation of the renewable energy sector and in particular the rollout of smart meters (Tagesspiegel, 2022).[130] Furthermore, grid operators do not always provide the necessary infrastructure, such as bidirectional meters. The shortage of specialists, who are able to install renewable energy systems is a further barrier for energy communities (Kahla et al, 2017).[131]

According to the interviews, **financial barriers** are not the main challenge of energy communities in Germany. The membership fees at least in cooperatives are often not very high and some forms of cooperatives, such as "regionalwerke" even offer free membership for the citizens of the involved municipalities. The capital required for participation in larger wind projects and limited liability companies are often higher and thus more exclusive. Overall, the financial risk of energy communities is not as high or are well mitigated by the legal form (for instance, in limited liability companies (GmbHs) the members are not liable with private assets). For municipal energy communities there is no high financial risk, but they sometimes face problems to convince local citizens or officials thereof.

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127. Agentur für Erneuerbare Energien (2022). Ausschreibungsrunde Wind an Land erneut deutlich unterzeichnet. Politisches Versagen im Süden. https://www.unendlich-viel-energie.de/presse/branchenmeldungen/ausschreibungsrunde-wind-an-land-erneut-deutlich-unterzeichnet-politisches-versagen-im-sueden; https://www.ihk.de/schwaben/produktmarken/energie/erneuerbare-energien/pv-anlagen/ausschreibungen-ee-anlagen-4902030.
128. See e.g., https://blog.naturstrom.de/energiewende/buergerenergie-im-eeg-2023/.
129. Deutsche Energie-Agentur (Hrsg.) (2022). Energy Communities: Beschleuniger der dezentralen Energiewende. https://www.dena.de/newsroom/publikationsdetailansicht/pub/dena-analyse-energy-communities-beschleuniger-der-dezentralen-energiewende/.
130. Tagesspiegel Background, 08.12.2022.
131. Kahla, F., Holstenkamp, L., Müller J.R. & Degenhart, H. (2017). Development and State of Community Energy Companies and Energy Cooperatives in Germany. MPRA, Working Paper Series in Business and Law, 27, 81261.

Drivers and Benefits

According to the interviews, energy communities need political support, special conditions and regulations that facilitate their establishment and operation. As they are often of smaller scale, they cannot compete with larger companies and/or energy suppliers. These specific characteristics and conditions of energy communities are partially recognised in Germany, e.g., small energy communities do not have to participate in tendering, which leads to less uncertainties and bureaucracy for the communities. Furthermore, political incentives, such as low barriers to market access or guaranteed feed-in tariffs make energy communities more profitable and plannable.

Moreover, clear regulations and legislations encourage the establishment of energy communities. For instance, the well-established law on cooperatives ("Genossenschaftsgesetz") in Germany facilitates founding energy communities and reduces uncertainties.

Other drivers of energy communities are associations between small energy cooperatives or cooperation with energy suppliers. Several renewable energy suppliers cooperate with citizen energy communities, for example Naturstrom, Green planet energy and Elektrizitätswerke Schönau (EWS), the latter being the oldest citizen energy community in Germany. The renewable energy suppliers organise the marketing of the generated energy and provide customer support. An alternative to organise the distribution of the electricity produced by energy communities is represented by Bürgerwerke, the largest association of energy cooperatives in Germany. Bürgerwerke organises the marketing and accounting of the energy produced by its members and is a not-for-profit cooperative owned by energy cooperatives.

The main socio-economic benefits of energy communities in Germany are based on the participation of citizens in the energy transformation enabled by the communities. This holds true in particular if they are organised in cooperatives. According to the interviewees, energy communities contribute to the democratisation of the energy system and a more equal distribution. Furthermore, due to the regional focus of energy communities in Germany, the positive impacts benefit local citizens and municipalities. Energy communities can contribute to **loca**l job and value creation and lower the electricity prices in the community. Alsor, energy communities often provide the required know-how and thus security (e.g., for new business models, regulations, legislations, which is more difficult to acquire as individual person.

- The opportunity to participate financially and to contribute to shaping the local energy system also increases the acceptance of renewable energy systems. Members of renewable energy communities often participate for non-financial, idealistic reasons. Being directly involved in the projects and having voting rights is assumed to increase the acceptance, even though there is no quantitative evidence that more (financial or non-material) participation leads to a higher acceptance. Acceptance of renewable energies is crucial for the expansion of these technologies as it prevents conflicts and legal suits which have a high potential to hinder the expansion of renewable energies. On the contrary: Energy communities provide incentives for citizens and municipalities to support the expansion and establishment of renewable energies systems. This allows mobilising private capital and reduces the need for public funding and subsidies for the development of renewable energy projects.

Moreover, energy communities in Germany yield benefits for the energy system. By supporting local production and distribution of renewable energy, energy communities promote the establishment of a decentralised energy system. A decentralised structure of the energy system is less vulnerable (e.g., to cyber-attacks) and more reliable. Furthermore, the rollout of renewable energy contributes to increasing the independency of fossil fuels and the associated export nations. Hence, energy communities can be seen as beneficial regarding energy security.

For a completely renewable electricity market, it is necessary to adapt energy usage/demand to energy supply. Energy communities can contribute to balance energy supply and demand. To use the possible benefits of energy communities to the electricity market, the implementation of energy sharing is crucial. However, as explained above, Germany has not yet implemented the EU guidelines regarding energy sharing. Energy sharing provides incentives to adapt energy consumption to energy production, i.e., consume energy when it is produced. Energy sharing could be implemented by introducing two separate tariffs/ electricity prices for the electricity produced by the energy community and a market price. It has the potential to reduce the burden of the electricity grid, especially when future electricity demand increases due to the increasing dissemination of electric cars and heat pumps.

Examples of real-life Energy Communities in Germany

In the following some **real-life examples of energy communities in Germany** are presented:

- Example 1, the "**Elektrizitätswerke Schönau**", represents a pioneer of energy communities and is active in various sectors.
- Example 2, **BürgerEnergie Berlin**", is a typical cooperative energy community focusing of diverse aspects, not only energy production.
- Example 3, "**Bioenergiedorf Jühnde**", is active as heat grid operator.
- Example 4, "**regionalwerke**", is a visionary approach towards municipal energy communities.

EXAMPLE 1: REC PIONEER "ELEKTRIZIÄTSWERKE SCHÖNAU (EWS)"

Elektrizitätswerke Schönau (EWS) is a pioneer in the field of renewable energy cooperatives in Germany and active in various sectors. It was founded in 1994 in reaction to the Chernobyl disaster. Since 1996 EWS is the grid operator and electricity provider in Schönau in South Germany. Since 1998 EWS provide electricity from renewable energy sources nationwide. Furthermore, EWS offers biogas from renewable sources, engages in electric mobility by providing charging cards for electric cars and is operating heat grids in several parts of Germany. It was the first renewable energy cooperative in Germany and acts as a partner and mentor for many younger and smaller energy cooperatives in Germany. The cooperation between EWS and other REC can be organised in different ways. However, in all cases EWS provides customer support, and the REC receives financial benefits for every recruited customer. This ensures the development of local renewable energy projects.

The complex organisational structure of EWS reflects the variety of the cooperative's engagements: The cooperative Elektrizitätswerke Schönau eG owns several subsidiary companies and holdings of other companies. The subsidiary companies are responsible for the grid operation and electricity distribution, as well as the development of new renewable energy projects. Two wind parks are operated by subsidiary companies of EWS. All subsidiary companies are organised in the legal form of limited liability companies (GmbH or GmbH & Co. KG).

Source: https://www.ews-schoenau.de

EXAMPLE 2: RENEWABLE ENERGY COOPERATIVE "BÜRGERENERGIE BERLIN"

BürgerEnergie Berlin eG was founded in 2011 to re-municipalize the electricity grid in Berlin. After several years of legal dispute, the federal state of Berlin acquired the electricity grid from the energy corporation Vattenfall. Now, BürgerEnergie Berlin campaigns for direct citizen participation to facilitate financial benefits for citizens as well as the democratisation of the electricity grid.

BürgerEnergie Berlin eG engages in the development of citizen energy projects in Berlin and Brandenburg. They support several landlord-to-tenant electricity projects in Berlin. In these projects BürgerEnergie Berlin finances the construction of the photovoltaic system and sells the generated electricity at low prices to the tenants living in the building. To ensure the electricity supply for the tenants when the PV system does not generate energy, BürgerEnergie Berlin cooperates with Elektrizitätswerke Schönau (EWS), an established energy cooperative and energy supplier. Via this cooperation, BürgerEnergie Berlin provides electricity from renewable energy sources and collects financial means to support the expansion of renewable energy systems in Berlin.

BürgerEnergie furthermore engages in renewable energy projects in Brandenburg: In cooperation with other renewable energy cooperatives, BürgerEnergie Berlin built photovoltaic systems in Brandenburg.

Sources: Interview, https://www.buerger-energie-berlin.de

EXAMPLE 3: BIO-ENERGY VILLAGES "BIOENERGIEDORF JÜHNDE"

Bioenergy villages are able to cover at least 50% of the local energy demand (heat and electricity) using regionally generated bioenergy. Jühnde, a village in the south of Lower Saxony, was the first bioenergy village in Germany. Since 2005 the energy demand of the village has been entirely covered by the renewable energy produced in the local biogas plant and distributed via the local electricity and heat grids. The local energy generation has positive effects for the local agriculture which produces the biomass and manure as well as wood chips for the biogas plant. Until 2019, Bioenergiedorf Jühnde was organised as a cooperative. Due to financial reasons, in 2019 the cooperative sold the local heat network and its biogas system to EAM, a limited liability company owned by 12 counties and several municipalities.

Sources:
bioenergiedorf.fnr.de
www.eam.de/ueber-uns/pressemitteilung/die-eam-uebernimmt-waermeversorgung-in-juehnde

EXAMPLE 4: VIRTUAL (ENERGY) COMMUNITIES OF "REGIONALWERKE"

irtual (energy) communities are developed, implemented developed by the Bavarian company "regionalwerke". It is based on the idea that several municipalities found a public agency ("Anstalt des öffenltichen Rechts") to jointly conduct economic activities in diverse fields, including the supply and operation of energy and electricity grids amongst others. For each of these fields, the municipalities, as joint public agency, found a subsidiary (GmbH & Co. KG). Hence, electricity production and energy distribution are each organised as subsidiaries.

The benefits of this form of energy communities are that all citizens can be included (independently of investments). Further, citizens of municipalities make local and democratic decisions with regards to energy supply and distribution in the region. This increases the acceptance of renewable energies and offers a possibility that citizens benefit financially from the profits of the energy system. On the level of municipalities, they benefit as they can work together, share bureaucratic and administrative burdens and transfer knowledge. It also allows determining electricity prices on the municipal level.

"Regionalwerke" is currently being implemented in Landshut, Bavaria. 35 municipalities are working on creating a blueprint for the above-described idea of virtual (energy) communities. Motivating factors for founding such a community are the possibility to be independent of energy supply and grid operating companies and to increase local value creation. According to the interview, there is an increasing demand and interest of other municipalities to establish virtual (energy) communities (Regionalwerke, 2022). [132]

132. Regionalwerke,(2022). Our home town Our Responsibility. Available at: https://regionalwerke.com/.

Example of Energy Sharing in Spain

Through the royal decree 244/2019 Spain has provided a framework for energy sharing through two main ways, cooperatives, or collective self-consumption.

Collective self-consumption (CSC) is defined in article 4 of royal decree 244/2019 and consists of several consumers associated with renewable energy units, either through an internal network or using the public grid. CSC is not exclusive to energy communities but can be used by them.

The shared production installation needs to meet at least one of the following criteria to be eligible for CSC (notably being an EC is not one):

- Being connected to the internal network of associated consumers
- Being connected to a low-voltage network of the same transformation centre
- Have a maximum distance of 500 meters between the production installation and consumers (1 000 meters if the installation is on a roof)
- The installation and consumers must share the initial 14 digits in their land registry numbers

CSC can belong to either the modality of self-consumption with surplus or the modality of self-consumption without surplus.

If the CSC employs self-consumption without surplus the generation unit is prevented from injecting surplus energy into the transmission or distribution grids. Self-consumption with surplus mean that the generation unit can inject surplus energy into the transmission or distribution grid and this category is further divided into two subcategories, whether it is subject to compensation or not for the injected electricity.

In the first subcategory, modality of surplus with compensation, the producer and consumer choose to benefit from a simplified compensation mechanism using a bidirectional meter. In each billing period, the value of the consumption deficit (taken from the grid) will be compensated with the value of the surplus generation (fed into the grid). This option is only possible when the unit meets certain conditions such as: The energy source is renewable, the total production of the installations does not exceed 100kW.

In the second subcategory, modality without compensation, the surplus generated can be sold on the electricity market. The residents will be required to either sign a contract with a retailer or register as an energy producer, making this option more complex than the previously mentioned subcategory.

About this Publication

Energy Communities

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http://doi.org/10.6027/NER2023-03

Cover photo: iStock
Layout: Mette Agger Tang

Published: 16.08.2023

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