

The role of ecovillages for sustainable rural development: A case study of Fri og Fro in Odsherred municipality



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Abstract

This study aims at understanding how the ecovillage Fri og Fro (FoF) contributes with its practices and community-led initiatives to sustainable development in the Egebjerg peninsula and more broadly in Odsherred municipality, in Denmark. For the purpose of this research, we conceptualize the ecovillage as a green niche, which can promote socio-political and physical infrastructures that enable sustainable initiatives and behaviours. We, therefore, identify three different pathways as the framework through which these initiatives can be propagated into a broader context: replication, scaling up and translation. The data was mainly collected on a ten-day fieldwork where various qualitative and quantitative methods were applied. Our findings reveal a substantial contribution of FoF at the local level, inspiring the construction of a new ecovillage in the area and being a pioneer for several sustainable community-led initiatives in the Egebjerg peninsula. However, at the municipal level, the contributions remain limited.

Key words: ecovillage, sustainable practices, regional sustainable development, grassroots innovations, Denmark

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List of Acronyms

CF	Carbon Footprint
EF	Ecological Footprint
FGD	Focus Group Discussion
FoF	Fri og Fro
GEN	Global Ecovillage Network
gha	Global hectares
GFN	Global Footprint Network
KCL	Potassium chloride
Ν	Nitrogen
Р	Phosphorus
PVC	Polyvinyl chloride
SSI	Semi-structured Interviews
WCS	Wastewater Cleaning System

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1. Introduction

During the last decades, the gap between rural and urban areas has significantly increased in the Global North due to diminishing and ageing populations, withdrawal of public and private services, and agricultural restructuring or closure (Pain & Hansen, 2019). The widening of such a gap was initially driven by a strong liberal agenda where limited state intervention meant that rural populations saw a decrease in the public sector involvement for rural development. Moreover, fast-growing urbanisation trends captured the attention of the public sector as they became the hotspots in a globalised world, dominated by values such as materialism, consumerism and profit-making (Pain & Hansen, 2019).

In an attempt to refuse these global trends, counter-urbanisation took place in Denmark during the mid-1990s, with an increasing number of urban dwellers choosing to relocate to the Danish countryside (Herslund, 2012). The reasons for this out-migration to rural areas were mainly attributed to lower property costs and to a post-productivist countryside transition, characterised by a land-use change from agricultural production to different consumption purposes like residence and recreation (Herslund, 2012; Ilbery & Bowler, 1998; Marsden et al., 1993). Such counter-urbanisation trends were increasingly driven by new and alternative lifestyles, witnessing the emergence of ecovillages in rural areas (Herslund, 2012).

A growing number of intentional communities in Denmark began looking beyond the social benefits of co-housing to the environmental benefits of a more thorough redesign of human habitats (Bates, 2003). As of today, the National Association of Ecovillages (Lansforeningen for Økosamfund) counts more than 30 ecovillages and many on the horizon, making Denmark the country with most ecovillages per capita (Landsforeningen For Økosamfund, n.d.). This is not surprising as Denmark was a forefront in the global ecovillage movement, which emerged globally during the 1980s as a result of the action of engaged people that shared the intent to live more sustainably (Dawson, 2006). The element of intentionality is key to understanding what ecovillages are at their core: "traditional villages or intentional communities where residents are committed to living more sustainably regarding environmentally responsible practices to regenerate their social and natural environments" (GEN, n.d.). Today, ecovillages are increasingly examined as potential actors of community-led rural development targeting a sustainable future (Boyer, 2015; Moravčíková & Fürjészová, 2018).

To begin with, ecovillages have lower environmental impact which is enabled by the combination of physical and social capital with shared principles and goals (Daly, 2017; Marckmann et. al, 2012). The element of co-housing constitutes an important element of why Danish ecovillages are more sustainable, providing mutual support for everyday sustainable practices with members challenging and inspiring each other (Marckmann et. at., 2012). Yet, the potential use of these practices outside such intentional communities remains unclear. In an attempt to understand this, Trifonova & Pardi (2018) identify the potential of Danish ecovillages to transfer skills and knowledge, by showing good practices, alternative organisational forms and low-tech solutions. However, they find that the role for green transitions of broader Danish society remains limited, as mainstream neo-liberal ideas fail to address social, environmental and economic injustices. Many have indeed questioned the potential of achieving such a sustainable lifestyle outside a community of like-minded individuals, ultimately challenging the adoption of their sustainable practices to broader society. Indeed, Meijering et al. (2007), argue that members of some ecovillages in the global North believe that they are not able to change mainstream norms and values and thereby choose to distance themselves from them.

In order to contribute to the existing literature, a case study of the Danish ecovillage Fri og Fro (Free and Happy, FoF), situated in the region of Odsherred, is presented. The land was bought from the municipality in 2004 by a group of people who were committed to living in a community centered around sustainability (Fri og Fro, n.d.). Since then, the number of families has increased up to 16 today. A few hundred meters away from FoF, the construction of a new ecovillage, Egeskoven, has been set up. The project consists of 25 equal size plots, where 18 families have already started to build their houses.

This case is relevant to study because it is contextualised within Odsherred municipal strategy that values the environment and its role for rural livelihoods. Examples are slogans like "Time for life" (Tid til livet) and "Natural Community" (Naturligt fællesskab) within Odsherred vision 2025 (Odsherred Kommune c, n.d.). These slogans are related to a municipal attempt to shift the discourses of peripheral Denmark (Udkantsdanmark) through the idea of the rural as a place of imagination where relationships between people and their surroundings allow for a lifestyle that can be anything that the urban is not (Pain & Hansen, 2019). Among other projects, the municipality has committed itself to reducing CO2 emissions amongst its citizens and companies by 20%. It also aims to battle its increasing risks of flooding and further the preservation of its unique landscape, being situated in the

waterfront of Northern Zealand (Odsherred Kommune, n.d.). These initiatives are part of a sustainable development strategy of the region, defined as "the integration of the environmental, economic, and social dimensions of sustainable development on the regional level" (Jovovic, 2017). Within this bigger picture, FoF and its contributions to rural sustainable development in the municipality become our focus of analysis.

1.1 Problem Statement and Research Question

Many studies in Denmark have been conducted on ecovillages as a single unit of analysis while their relationship to rural development remains unclear. Our research becomes relevant because many studies have individuated a potential in ecovillages, however, a few have presented empirical accounts of the specific spaces and circumstances in which ecovillages can spur rural sustainable development (Boyer, 2015; Moravčíková & Fürjészová, 2018). This will be done by combining an empirical analysis of the sustainable practices inside an ecovillage and their diffusion to a wider public. Through a single case study of FoF, we firstly identify the sustainable practices taking place inside FoF and how they are enabled. This will then be followed by an analysis of how FoF diffuses sustainable initiatives, thereby contributing to the sustainable development of the Egebjerg peninsula and Odsherred region more largely. To do this, our paper will answer the following research question:

How is the ecovillage Fri og Fro contributing to sustainable development in Odsherred municipality?

The subsequent working questions will help in guiding our research:

- How are sustainable practices enabled within FoF?
- How does FoF diffuse sustainable initiatives in Odsherred municipality?

2. Theoretical Framework

In order to frame our research, we make use of the two following theoretical strands: "socio-political infrastructures" and "physical infrastructures" enabling sustainable practice (Gausset, 2020, p. 53; Hansen, 2020) and ecovillages as green niches for sustainable development (Boyer, 2015; Seyfang, 2010; Seyfang & Smith, 2007).

In line with the grassroots innovations literature, we conceptualise ecovillages as green niches that can inform sustainable development in wider society (Boyer, 2015; Seyfang, 2010; Smith, 2007; Smith & Seyfang, 2007). As "sustainability experiments" (Seyfang & Smith, 2007, p. 589), niches develop and adopt greener organisational forms and sustainable practices (Smith, 2007). These novel, bottom-up solutions - so-called grassroots innovations - are context-dependent and supported by certain values (Smith & Seyfang, 2007). Such values and norms can be understood as socio-political infrastructures, which organize life in a community. Besides being social, they are also political in the sense that they entail a distribution of duties and responsibilities (Gausset, 2020). According to Gausset (2020) and Hansen (2020), it is these socio-political infrastructures that allow for sustainable practices to happen inside ecovillages. This is because ecovillage residents commit to a set of common goals and guidelines that influence and encourage sustainable behaviour. Sustainable practice is moreover facilitated by physical infrastructures, such as shared facilities (Gausset, 2020; Hansen, 2020).

Going beyond the niche boundaries of ecovillages, socio-technical regimes (further called 'regimes') and socio-technical landscapes (further called 'landscapes') shape the possibilities of niche contributions to wider society. Regimes are represented by mainstream actors, societal institutions, and regulations, while landscapes are exogenous environments of slow-changing processes, like climate change, and sudden shocks, like flooding, beyond actors' direct influence. Societal change is thus a result of the interplay between the three levels: grassroots innovations are created in niches and gain increasing strength; niches and landscape exert pressure on the regime; the destabilisation of the regime creates windows of opportunity for the diffusion of grassroots innovations (Geels, 2019; Geels & Schot, 2007).

Ecovillages as green niches may contribute to sustainable development through different pathways. Our point of departure will be the framework proposed by Seyfang (2010), who identifies three such pathways: replication, scaling up and translation. Replication takes place at the same scale - within the niche and like-minded individuals - through, i.e., the spreading of green buildings, education programs, publications, and media performance. Scaling-up goes beyond the core niche to include a broader group of individuals. Examples may be partnering up with non-ecovillage organisations to implement practices in new contexts, and training individuals within an ecovillage who then transport certain practices to new contexts. Niche-to-regime translation refers to the institutional adoption of niche practices potentially leading to structural changes in the regime, which is facilitated by pre-existing conditions of

crisis (Boyer, 2015; Seyfang, 2010). However, barriers to diffusion may be regime challenges like lock-ins, which are established and entrenched institutional structures impeding alternative solutions (Seyfang & Smith, 2007).

Applying this conceptualisation to our case study, FoF represents the green niche which internally creates sustainable practice supported by socio-political and physical infrastructures. We understand sustainable practices as environmentally sustainable practices. In order to answer our research question, we aim at identifying these sustainable practices, the socio-political and physical infrastructures underpinning them, and potential diffusion of such infrastructures encouraged by the ecovillage. The regime is represented by Odsherred municipality on the institutional level and the surrounding peninsula, Egebjerg, on the community level. And finally, the landscape pressure manifests through demographic as well as sustainability challenges to Odsherred municipality. Replication is operationalised as the spread of sustainable practices done by ecovillages at the same scale of like-minded individuals. Scaling up to a broader audience may happen at the community level of Egebjerg peninsula, and translation may take place at the higher institutional level of Odsherred municipality.

3. Methodology

3.1 Type of Study

The type of study conducted in this research is a holistic single case study which enabled us to gain a deep understanding of the social phenomenon under investigation (Bryman, 2015). The aim of our case is not to generalise and make universal claims but to "enter an academic dialogue where the research resonates with others" (Lund, 2014). As shown in Figure 1, we understand FoF not as an isolated unit of analysis but as an interactive community that interacts with residents of Egebjerg village, the initiators of Egeskoven and is embedded in the Egebjerg peninsula and in the broader municipality of Odsherred. Ultimately, we used a mixed-methods approach, where both quantitative and qualitative data was integrated and triangulated in order to reach an empirically-based conclusion.



Figure 1. Holistic single case study. FoF examined as our main unit of analysis embedded in its wider context of Egebjerg Peninsula and Odsherred Municipality.

3.2 Data collection

In the following, the various data collection methods used during the field-work period are presented. Data was collected specifically in FoF and more broadly Egebjerg peninsula (Figure 2 and 3). An overview of the applied methods and collected data is provided in Appendix 1.



Figure 2. Study site. Fri og Fro, Egebjerg and Egeskoven retrieved from Google Earth (2021).



Figure 3. Egebjerg Peninsula. Retrieved from Google Earth (2021).

Semi-structured interviews

We conducted 17 semi-structured interviews (SSI) as one of our primary methods with different stakeholders of the study populations of interest to our research (Bryman, 2015): FoF, Egeskoven, Egebjerg and Odsherred municipality. Accordingly, SSI were conducted with six FoF residents, two future Egeskoven residents and five Egebjerg residents. They were primarily selected based on convenience and snowball sampling (Bryman, 2015). These sampling approaches appeared to be the most practical and convenient since we did not have any previous information on FoF and Egeskoven residents, except from two initial contacts. Our Egebjerg participants mainly reached out to us, i.e. by leaving their contact details for a follow-up interview in our survey, rather than us actively selecting them. Expert interviews, as a form of SSI, were conducted with municipality representatives and local politicians. Those were purposefully selected based on their political and administrative relevance for our research topic (Guest et al., 2013) and on their different political affiliation, in order to gain different perspectives. Regarding the municipality representatives, interviews were conducted with the Odsherred Mayor Thomas Adelskov (Socialdemokraterne) and a member of the Planning committee of the Odsherred Center for Environment and Technology, who is also responsible for the construction of Egeskoven. The two local politicians interviewed are Clark Pratt (Enhedslisten) and Mathias Hansen (Venstre).

We prepared standard interview guides for these different stakeholders in advance and adapted them according to previous information we had on certain individuals. Also, we asked for informed consent to conduct and record each interview and assured all respondents of their anonymity. To end an interview, we always gave the interviewee the opportunity to ask us questions in return and we offered to share our findings.

Focus Group

To gain a better understanding of Egebjerg and the interactions taking place within its community, we conducted a focus group discussion (FGD). In order to identify their motivations and perceptions of living in a community such as Egebjerg, potential participants in the FGD were approached through Egebjerg Facebook group. We gathered a small group of three people, in order to respect Covid-19 restrictions and to be able to have an interpreter with us during the session. We chose to adopt this method and to conduct it in person, in an attempt to keep a more dynamic debate and an effective communication. According to

Bryman (2015), looking at how people interact and discuss with each other makes it possible to unveil certain insights and emotions which would not be obtained through regular interviews. During the discussion, people helped each other remembering events and gained more confidence when elaborating their answers.

The preparation of the FGD consisted in developing a series of small exercises, to help the participants to develop more confidence and clarity expressing their thoughts and perceptions. In particular, we used post-its and a timeline that could be filled out by the participants (Figure 4).

The first exercise with post-its involved finding key words describing Egebjerg and what makes it a special place. After everyone wrote the number of words they wished on different post-its, we grouped together the words within the same topic (for example, one topic could be 'nature') asking the participants to rank them in order of preference.

The second exercise consisted of creating a timeline which could include events and experiences that marked a significant change - both positive or negative - in Egebjerg.



Figure 4. Focus group exercises. Post-its and timeline filled out by the participants regarding their perceptions on Egebjerg.

The exercises were useful in order to let them express themselves freely and to have a clear understanding of the evolution of the village and the community - also in relation to FoF and the new ecovillage under construction.

Using the FGD gave us a good final overview and a useful combined perspective on Egebjerg, which was described several times during the interview as special and standing out within Odsherred Kommune.

Netnography

Netnography was used to complement our data and it was useful due to its ability to give us a wider group for observation. Such a form of online participant observation acted as a great source to complement the inability to observe communal activities in the peninsula due to Covid-19. The data collection was done through the use of the active facebook group 'Egebjerg – i Odsherred'. The group consisted of approx. 2200 members from Egebjerg and the surrounding areas, with a purpose to share 'experiences, ideas and collaboration'. The observations were done using keyword searches: "økosamfundet", "Fri og Fro", "Egeskoven" and "tilflytter". The keyword searches from years 2013-2021 were then systematically gone through to evaluate their relevance, and the framing around these keywords was analysed. The nature of the netnographic data collection was passive, in which we did not actively partake in data co-creation.

To best utilize the benefits and improve the trustworthiness of this method we aimed to use it mainly to triangulate our data gained through other methods (Costello, 2017). Most of the netnography was conducted before the fieldwork period, but also throughout and was helpful in allowing us to gain a better understanding of the prevailing perspectives and potential sources of conflicts within the community. It hence also guided us in understanding which kinds of perspectives we could be missing through our interviews, and assisted us in aiming for a wider range of perspectives. The online data collection also deepened our understanding of existing networks and guided the identification of key informants for further interviews.

Web-based Survey

Ecological Footprint Calculator

We conducted a web-based survey based on the questions derived from the Ecological Footprint Calculator by the Global Footprint Network (GFN) (Ecological Footprint Calculator, n.d.). It provided a calculation of both ecological footprint (EF) (in global hectares) and carbon footprint (CF) (in CO2 emissions in tonnes per year), the CF being the largest part of the EF (Daly, 2017). Global hectares (gha) refer to the biologically productive area required to provide for individual consumption (Ecological Footprint Calculator, n.d.). Both footprints are widely accepted as appropriate measures for environmental sustainability (Daly, 2017). Since the CF is only a part and not as holistic as the EF, we refer to the EF as our measurement of environmental sustainability throughout this paper.

Furthermore, this calculator divides the calculated EF into individual contributions from certain consumption categories (food, shelter, mobility, goods and services). While the categories "food", "shelter", "mobility", and "goods" are influenced by individual lifestyle choices, "services" is societal and is thus shared by every person within the same society (Ecological Footprint Calculator, n.d.). These consumption categories are later reflected on in the analysis, where we allocate sustainable practices done by FoF to each category. While it is relatively straightforward to allocate the identified practices to the categories "food", "shelter", "mobility" and "goods", we struggled with the category "services". The GFN defines it as contributing through "services, such as government assistance, roads and infrastructure, public services, and the country's military". Due to the lack of clear information of how which questions relate to which category, we were not able to further elaborate on which practices might contribute to this category.

Planning and conducting the survey

The target population of our survey was FoF and Egebjerg and the selected units were households. By sampling both, we were able to compare the average EF between the ecovillage and Egebjerg residents. With the goal of reaching as many responses as possible, we created a survey with the programme SurveyXact. We published the link to the survey on Egebjerg's Facebook group, and distributed it by email through a contact person to the inhabitants of FoF the week previous to our field trip. On the first two days of our field trip, we distributed around 120 QR code flyers that led to the survey in all the residential mailboxes in Egebjerg village and FoF. From a total of 38 completed surveys, 11 were from FoF and 27 from Egebjerg.

The questionnaire consisted of two parts. Firstly, the EF survey, which was also the largest part of the survey and consisted of only close-ended questions where respondents had to choose from a set of predefined answers. Secondly, there was a short follow-up survey with

questions about the participants' perception of FoF and Egeskoven and their impact on Egebjerg, environment and economy. This part of the survey was optional and only for respondents indicating at the beginning of the survey that they were living in Egebjerg. These follow-up questions were formulated as a combination of closed-ended and open-ended questions with the main purpose of providing us with first general perceptions to use as input in the SSI and the FGD. The survey gave the respondents the possibility to add their contact information if they were willing to participate in follow-up interviews.

To calculate the EF, we manually entered all of the results from the first part of the survey into the online calculator of the GFN. To calculate if there was a significant difference between the averages of the EFs from FoF and Egebjerg, we used a two-tailed t-test assuming unequal variance.

The use of the same questions used in the GFN presented the advantage of using a tested footprint calculator without the necessity of creating one. But a shortcoming that we experienced was the potential inaccuracy when trying to compare footprints of an ecovillage with a regular village. The EF calculator by the GFN is designed to capture broad differences in living standards and quality, and present the calculated footprints on a globally comparable level (Ecological Footprint Calculator, n.d.). However, certain practices in FoF such as the communal dinners, the used building materials and common facilities were not considered in this calculation of the EF, regardless of whether this might be a positive or negative contribution.

Archival source

We made use of one central archival source, namely the *FoF Articles of Association* (Vedtægter for Andelsforeningen Fri og Fro, 2019). The articles define the rules and norms that frame and organise life in the ecovillage. This document is highly relevant for this study as it reflects the socio-political infrastructure that enables sustainable living inside FoF.

Soil sampling

The wastewater cleaning system (WCS) in FoF involves pumping the wastewater into two fields the size of about 90 m x 8 m growing willows. Both fields are divided into 3 segments. The wastewater goes through a filter tank to extract solid waste and is then applied to the soil at a depth of about 1,5 m. A plastic membrane stretching below the entire field serves as a way of keeping all the wastewater in the system as to avoid nutrient leaching and possible

contamination of nearby water bodies. The nutrients are assimilated by the trees serving as a fertilizer and the then cleaned water is removed by evapotranspiration. Every two years the trees are cut, and the wood is used as material for various constructions. At the point of our research, one side of the willows in both fields had been recently cut. We took our samples from the recently cut side.

Through an interview with one of the FoF residents we were able to find out that during heavy rainfall the wastewater overflows, running downhill into the soil and potentially the nearby protected lakes. This finding encouraged us to conduct a soil analysis to assess nutrient contents of the soil in the WCS and to see if the overflow has a noticeable effect on nutrient content in the soil outside of the WCS.

Nitrate and water-extractable phosphorus analysis

We took a total of 14 soil samples in and around the wastewater treatment system at a depth of about 30 cm. Four samples were taken from each willow field, two samples outside the field at the downhill end to investigate a possible overflow of nutrients and four samples outside the field at the uphill end as a control. Figure 5 shows a picture of the willow field site. We tried taking samples within the willow field with a distance of about 20 m to each other and from each segment. However, as one segment in one field was completely frozen this was not always possible. Each sample consisted of three pooled soil samples taken within an approximately one-meter radius of each other. After extraction, the samples were kept cool at 4°C until the analysis in the lab in the following week.



Figure 5. Wastewater cleaning system. Shows one of the two willow fields (the other field is seen in the left corner of the picture). Red markings indicate the recently cut area from which we took our samples

To be able to relate the nutrient content to the dry soil weight we weighed small samples of each sample before and after being dried. Samples were left to dry overnight at 100°C. The water content of each sample was calculated as the difference of dry and wet weight. In preparation for the nitrate analysis, we mixed 10 g of each soil sample with a 40 ml KCL solution. The mixed solutions were shaken with the end-over-end shaker for an hour and then around 10 ml of solution were filtered through filter paper. For the preparation of the phosphorus analysis we added 45 ml of purified water to 0,95 g of each soil sample and repeated the same procedure of shaking and filtration. The solutions were analysed by flow injection analysis and measured concentration provided to us by the supervisors. Results were calculated in mg nitrate-N/kg dry soil or mg water-extractable P/kg dry soil, respectively.

4. Analysis

In order to answer our research question, the following sections first analyses how sustainability is enabled inside FoF. After having identified FoF's sustainable practices as well the infrastructures underpinning them, we move to look into how FoF contributes to sustainable development more largely. By using the three diffusion pathways, we look into the potential contribution of infrastructures promoted by FoF to enable sustainability in the wider municipality.

4.1 Identifying sustainable practices inside FoF

With the establishment of FoF in 2004, a space was created for like-minded people to live communally, build in a cheap and sustainable way and live a sustainable lifestyle (F4, F6; Vedtægter for Andelsforeningen Fri og Fro, 2019). This shared vision can be understood as "socio-political infrastructure", which organises everyday life and enables sustainable practices in ecovillages (Gausset, 2020, p. 55; Hansen, 2020). Ecovillages can, therefore, be understood as "grassroots innovations and communities of practice for sustainable living" (Temesgen, 2020, p. 5). Taking this as our point of departure, in the following part we identify such sustainable practices and how they are enabled in FoF. We assess the sustainability of these identified practices based on our EF calculations in FoF and use Egebjerg as a point of comparison. By allocating each practice to these predefined consumption categories, we are able to see their contribution towards the total EF (Figure 6). An overview of all practices and their allocated consumption category is presented in table 1.

 Table 1. Sustainable practices in FoF. Shows the identified sustainable practices in FoF and the corresponding consumption categories. Source indicates where we obtained information from.

What	Consumption Category	Source
Renewable energy	Shelter	F1, F2, F4, WBS
Sustainable building materials	Shelter	EG2, F1, F2, F3, F4, F5, FG2, FG3, WBS
Sustainable consumption	Food, Goods	F1, F3, WBS
Wastewater cleaning system	Not captured	EG2, EK1, F1, F3, F4, F5



Figure 6. Contribution of each consumption category to the total EF for FoF and Egebjerg. Sample size of FoF is 11 and for Egebjerg 27. The error bars represent the standard deviation. The difference between the averages of FoF and Egebjerg for the categories shelter, mobility, goods and services are significant (p < 0.05).

Presenting FoF's Ecological Footprint

The average EF in FoF households is 2,9 gha and 5,5 gha in Egebjerg (Figure 7). The difference in EF between FoF and Egebjerg households is statistically significant, with the EF in FoF being almost half as high as in Egebjerg. From this, we conclude that FoF households are on average, more environmentally sustainable than their neighbours in Egebjerg, which is in line with the wider literature (Daly, 2017; Hansen, 2009).



Figure 7. Average gha calculated for FoF, Egebjerg and Denmark (2016). Sample size of FoF is 11 and for Egebjerg 27. Sample size of Denmark (2016) is the entire population. The error bars represent the standard deviation. The difference between the averages of FoF and Egebjerg are significant (p < 0.05).

To put this into a broader perspective, we take into account the Danish average EF. The GFN calculated a Danish average EF of 6,9 gha in the year 2016.

In the following sections, we argue that the lower EF in FoF is a result of certain sustainable practices that are facilitated by socio-political and physical infrastructures.

4.1.1 Individual sustainable practices

Sustainable Building

The shared vision of FoF defined a set of goals which determined how to live sustainably in the ecovillage (Vedtægter for Andelsforeningen Fri og Fro, 2019). At the core of this vision was the idea of sustainable building where only natural and recycled materials are allowed, while environmentally harmful materials, such as PVC, impregnated wood and rainforest timber are prohibited (Vedtægter for Andelsforeningen Fri og Fro, 2019). By choosing to live in an ecovillage, members commit to a set of rules, which promote sustainable behaviour (Hansen, 2020). We are able to see this in FoF, where the whole community adhered to the sustainable building guidelines, resulting in highly unique houses according to the residents' personal building philosophies (F1, F2, F4, F5). While all our survey respondents from FoF indicated to use only natural building materials, the vast majority of Egebjerg respondents

used brick/concrete as their primary building materials (Figure 8). By allocating sustainable building practices to the consumption category 'shelter', our EF calculations show that this category contributes significantly less to FoF's total EF than compared to Egebjerg (Figure 6). From this we conclude that their building practices is one of the main factors contributing to the lower EF in FoF, which means that their building practices are more environmentally sustainable than the ones in Egebjerg.



Figure 8. Building materials. Amount of participants from FoF and Egebjerg indicating what material their house is made from in percentage. Number of respondents for FoF is 11 and for Egebjerg 27.

Sustainable lifestyle

Buying locally and cheap, having a general awareness of what is consumed and reusing over buying new things (F1, F3) are other practical manifestations of FoF's initial vision of living a sustainable lifestyle. Indeed, we can see how this environmentally-oriented objective encouraged the individual commitment to sustainable everyday practices (Marckman et al., 2012).

In the case of FoF, this can be exemplified by figure 9, showing that more households from FoF buy less new clothes as compared to Egebjerg households. Moreover, we found that recycling is a more common practice in FoF compared to Egebjerg as 80-90% of the survey respondents from FoF indicated that they recycle most or all their paper and plastic (Figure

10). We linked these practices to the 'food' and 'goods' consumption categories, where only 'goods' show to contribute significantly less towards FoF's lower EF compared to Egebjerg (Figure 6). This means that in terms of daily practices, FoF is more environmentally sustainable than Egebjerg.



Figure 9. New clothing purchases. Shows the amount of FoF and Egebjerg households buying new clothing/footwear/sports goods in a month in percentage. Number of respondents for FoF is 11 and for Egebjerg 27.



Figure 10. Paper (a) and plastic (b) recycling. Shows the amount of FoF and Egebjerg households recycling paper and plastic in percentage. Number of respondents for FoF is 11 and for Egebjerg 27.

Going beyond the vision

What starts with a set of original goals defined by the ecovillage can be seen to expand over time to include more and more sustainable practices (Gausset, 2020). In FoF, this is the case with energy efficient housing which goes beyond the idea of using sustainable building materials. While one resident highlighted straw bale as the most sustainable and energy efficient material, another followed a specific efficiency-oriented design by using a greenhouse model aiming at having free energy, an independent heating system and living off-grid in the long-term (F2, F5). The relevance of energy efficient housing in FoF contributes to its lower EF, as the survey data shows a slight tendency of FoF participants indicating to have more efficient houses compared to Egebjerg participants (Figure 11). An additional way of making houses more energy-efficient is the use of renewable energy (66%), as compared to the average Egebjerg household (29%) (Figure 12). In this regard, some FoF respondents reported to use solar panels (F4, F5). Ultimately, both the energy efficient housing design and renewable energy contribute towards the EF through the consumption category 'shelter'.

We are able to see that reducing energy consumption in FoF homes goes beyond the vision of using sustainable building materials. This shows how an initial set of shared environmental goals could encourage further sustainable practice at the individual level (Gausset, 2020).



Figure 11. Energy efficient housing. Shows the indicated level of efficiency of their homes from participants in FoF and Egebjerg in percentage. Number of respondents for FoF is 11 and for Egebjerg 27.



Figure 12. Renewable Energy. Shows the average percentage of renewable energy used in a household in FoF and Egebjerg. Number of respondents for FoF is 11 and for Egebjerg 27. The error bars represent the standard deviation.

4.1.2 Communal sustainable practices

Shared facilities, such as communal houses or a common sewage system, are part of the physical infrastructures of ecovillages enabling sustainable living (Gausset, 2020; Hansen, 2020). An example of such in FoF is the WCS, which played a big role in framing the residents sustainable lifestyle (EG2, EK1, F1, F3, F4, F5). This system was created in the beginning of FoF's set-up as an environmental alternative to using the local sewage system of Egebjerg. One respondent explained that communal working days were vital for the construction and maintenance of the WCS (F4). This is in line with Gausset (2020), stressing the role of socio-political infrastructures, such as voluntary work, in the maintenance of common facilities.

Many respondents thought it was a well-working system with the benefit of being cheaper than using the sewage system of Egebjerg (EK1, F4, F5). However, not everyone shared the same view. Two respondents voiced concerns about the WCS overflowing during heavy rainfall and running downhill into the nearby protected lakes (EG2, F3).

With this information in mind, we decided to conduct a soil analysis for phosphorus and nitrate in and around the willow field, to see if there is such overflow into the outside environment. Considering that the WCS is not captured by the EF, the soil analysis becomes the measurement of sustainability of this specific practice.

The results are presented in Table 2 and the sampling scheme is shown in Figure 13.

Table 2. Sampling results for phosphorus and nitrate in mg/kg soil. C(avg) represents the average of the four control samples (C1-4). Significant increases in phosphorus and nitrate are highlighted.

	W1.1	W1.2	<mark>W1.3</mark>	<mark>W1.4</mark>	<mark>W2.1</mark>	W2.2	W2.3	W2.4	01	<mark>O2</mark>	C(avg)	STDEV C(avg)
Phosphorus in mg/kg soil	5,2	2,4	<mark>30,6</mark>	<mark>34,5</mark>	<mark>74,2</mark>	12,1	4,6	5,8	8,1	<mark>19,2</mark>	5,5	1,9
Nitrate in mg/kg soil	1,3	0,2	<mark>14,4</mark>	1,2	<mark>24,9</mark>	5,3	0,0	0,0	2,3	4,8	2,6	1,6



Figure 13. Soil sampling scheme of the FoF WCS. Red triangle indicates the slope direction. W=Willow, O=Overflow, C=Control, PL=Protected Lake. Image retrieved from Google Earth (2021). In this outdated satellite image (2018) trees have not been cut yet. Sampling was done on the spots where the trees were already cut down.

A certain tendency becomes evident when looking at the nutrient content in both willow fields. Soil samples taken from the lower end of the sloping fields (W1.3, W1.4, W2.1) show significantly higher phosphorus and nitrate values than sampling points on the other end of the slope and the controls. Additionally, one of the overflow sampling points (O2) shows higher values for both phosphorus and nitrate, indicating a possible overflow of nutrients from the willow fields. This most likely occurs, as also reported by one respondent, after heavy rainfall. A report from the Danish Ministry of Environment (Miljøstyrelsen, 2003, p. 86) states that high levels of phosphorus as seen in W1.3, W1.4, W2.1 and O2, can be associated with a higher risk of leaching or runoff. A potential leaching of accumulated nutrients outside the WCS or runoff into the nearby protected lakes can therefore not be excluded. Nitrate levels are generally not high, however this could be, among others, because of nutrient uptake from the willows. Willows have been shown to have an efficient nutrient uptake (Jerbi et al., 2015). Considering the possible runoff and leaching of nutrients, the system might not be considered as particularly environmentally sustainable and thereby confirms the worry of certain respondents.

A possible explanation for the WCS not working as intended could be the fact that participation in communal working days has decreased (F1, F3, F4). This may indicate that the community does not share the same values and vision anymore.

4.1.3 Conclusion of the chapter

The socio-political and physical infrastructures that come with living in an ecovillage paved the way for the adoption of a sustainable lifestyle in FoF, supporting the findings of existing studies on ecovillages (Gausset, 2020; Hansen, 2020; Marckman et al., 2012). Almost all practices are found to be contributing to their lower EF, making them more sustainable compared to Egebjerg. Regarding the WCS, however, we see that there are some issues with potentially harmful consequences for the environment. Overall, we can conclude that most of FoF's practices are environmentally sustainable and enabled by a shared vision and common guidelines based on the values of sustainability and community. Compared to Egebjerg's higher EF, we can further see that living in a community of like-minded people and following certain communal guidelines seems to make it easier for ecovillage residents to adopt sustainable practices (Hansen, 2020).

Nevertheless, strong concerns were voiced about the loss of the vision and sense of community over the years (F1, F3, F4, F6). One respondent expressed that they do not "have a vision anymore, it disappeared years ago", and added: "we don't speak the same language anymore, we don't need each other" (F3). However, the presented sustainable practices remain intact. We can therefore see that life in FoF, where residents initially shared the same vision, allowed them to engage more effectively in individual sustainable practices. These practices were able to be sustained although a sense of community seems to have been decreasing.

4.2 Diffusion pathways

After looking at the socio-political and physical infrastructures enabling sustainable living inside FoF, we move on by looking into the ecovillage's contributions to sustainable development in the wider municipality. We want to expand our analysis to community-led initiatives in Egebjerg that could contribute to environmental sustainability more broadly. We assess this by looking into initiatives that promote environmental sustainability driven by or with active participation of FoF more broadly, and their implications on Egebjerg and Odsherred municipality. Our focus extends to also include indirect environmental benefits, through e.g. education, environmental awareness-raising and increased engagement of other stakeholders (Smith & Seyfang, 2007).

4.2.1 Replication

We identified a variety of ways through which FoF shares knowledge and practices within a network of like-minded people. This type of diffusion is defined as replication because it delimits its circulation among those who share a common interest in green transitions (Boyer, 2015). An example of how such replication occurred in FoF is through guided tours of the ecovillage, where interested people learnt about the use of alternative building materials, shared activities, and its principles. An approach of learning-by-doing was also promoted by FoF members who carried out summer courses for students all over Europe to learn about different building techniques (F5).

The most evident example of replication of FoF is the construction of Egeskoven. The existence of FoF inspired the idea of creating a second ecovillage in the area and provided a network of like-minded people (EG5, EK1, F6). It is important to highlight that with the term replication, we do not mean a mere copy of the already existing ecovillage, but the adaptation of sustainable practices developed by FoF to a new context. Indeed, those in charge of its construction explained that many new elements will be incorporated in Egeskoven (EK1, EK2). The underlying principle of the ecovillage will be the concept of permaculture, which can be understood as the socio-political infrastructure of Egeskoven (Gausset, 2020). This will facilitate the planned sustainable practices and physical infrastructures, such as a more efficient WCS than FoF's, where the water can be purified and re-used, a communal forest garden, a common recycling system and shared facilities (EK2, EK1, Økosamfundet Egeskoven, n.d.).

Even though we acknowledge the fact that these elements are yet to be realised, we find them relevant for our case because they exemplify that ecovillages have the potential to spur sustainable development. With the creation of Egeskoven we cannot only see environmentally sustainable practices to be diffused through replication, but also the socio-political infrastructures of pursuing a sustainable lifestyle (Gausset, 2020; Seyfang & Smith 2007). Thereby, the new ecovillage will create a novel space for the improvement and further development of these practices. In addition, the new residents moving to Egeskoven could bring more of the sustainable initiatives into the area and encourage more people to participate in community-led activities.

4.2.2 Scaling up

As presented in the literature, scaling up is the application of niche-internal practices to a broader audience beyond the niche (Boyer, 2015; Seyfang, 2015). Based on this narrow understanding of scaling up, we found no indication of FoF advancing specific internal practices to the wider Egebjerg community. Therefore, we broaden up the concept of scaling up by presenting the main community-led initiatives which promote environmental sustainability outside of FoF, which FoF started or was actively involved in. These initiatives can be understood as socio-political and physical infrastructures promoted by FoF in the wider Egebjerg community. This mainly comes down to a few FoF residents, such as one given the nickname "foreign minister of FoF" (EG1). We acknowledge that not everything was born out of FoF, but we do see that FoF has been a "catalyst" (EK1) of many community-led initiatives that promote environmental sustainability.

Firstly, a central project, initiated by a FoF resident, is the community heating system that was set up two years ago and to which 60% of Egebjerg village is now connected to (EG3). Through the installation of this community heating system, a transition from oil heating to woodchips took place in Egebjerg (EG4, F4). Surplus local wood, unsuitable for producing furniture, is used to generate heat (EG3, EG4). Instead of having a chimney in every house, the heat is produced in one place and transported to the connected households (EG3). Therefore, it is widely perceived as environmentally friendly (EG1, EG3, EG4). In addition, local workforce and volunteers work in order to create "heat for everybody", which is why the social value of the heating system is crucial (EG3). Indeed, one interviewee pointed to the symbolic power it would have for local acceptance and integration if Egeskoven decided to adopt the community heating system (EG3, EK1). This initiative can be seen as a great example of how socio-political infrastructures involving local workforce and volunteers create and sustain environmentally sustainable initiatives for a broader audience (Gausset, 2020; Smith & Seyfang, 2007).

Secondly, we learned that FoF played a major role in transforming the local school. Some FoF residents, who became teachers, promoted a greater environmental orientation at the school, e.g. through outdoor teaching and a common garden (EG5, F6). As one informant pointed out, "nature [...] became a big part of school life for these little kids [...] It matters that there are grown-ups which teach them to love nature and be curious about nature" (EG5). As a form of socio-political infrastructure, these environmental values promoted from a

young age may have the potential to contribute to sustainable development in the long term. Today, the school is widely seen as an attraction factor for newcomers and an important 'asset' for Egebjerg (EG1, EG5, F6, MH, NET1).

Another important initiative driven by FoF was the Iværksætterhus (EG5, EK1, TA). Translated as entrepreneurial house, it gives small businesses and start-ups the possibility to rent an office space (TA). An example of such is the organic food procurement initiative organised by one Egebjerg and one FoF resident (EG1, EG5). This is part of a trend of having more organic products sold in the community (EG5, F1, FG2). The Iværksætterhus can be seen as a communal physical infrastructure where sustainable initiatives such as the organic food procurement are organised and diffused. It is also used for hosting local meetings and serves as a hotspot for other community-led initiatives that contribute to environmental sustainability.

In addition to actual initiatives related to FoF, we learned about more intangible impacts of the ecovillage on the community. It was widely recognised among our interviewees that FoF contributed to an overall dynamic environment in Egebjerg, which also attracted newcomers (CP, EG3, EG4, EG5, F6, FG2, M1, MH, NET1, TA). This is where the role of FoF as a catalyst becomes evident by encouraging the wider community to engage in environmental sustainability. One interviewee pointed out that FoF pushed him to change his consumption habits by, i.e., buying more locally (EG3). Moreover, during the focus group we learnt of individuals becoming vegetarian after participating in FoF's shared meals (FG2). These shared experiences stimulated reflection on individual behaviour and consumption choices among Egebjerg residents, whereby we can see FoF diffusing the values at the core of their socio-political infrastructures (Gausset, 2020; Seyfang & Smith, 2007).

Overall, we are able to see that, through scaling up of socio-political and physical infrastructures, FoF enables sustainable initiatives as well as environmental awareness-raising and education more widely in the Egebjerg community (Gausset, 2020; Seyfang & Smith, 2007).

4.2.3 Translation

Beyond replication and scaling up, translation moves to examine the dynamic relationship between the niche and the regime, by evaluating the adoption of socio-political infrastructures that could enable sustainable practices at higher institutional levels (Boyer, 2015; Gausset, 2020; Smith, 2007). Odsherred municipality was found to be highly supportive of the ecovillages and similarly minded newcomers, as shown in Figure 14. The presence of this support was agreed upon by all involved actors (CP, EG1, EK1, EK2, F1, F2, F5, NET1, TA). Egebjerg, to a large extent due to the presence of ecovillages, played a special role as the "frontrunner" or "darling" of Odsherred municipality (F6, MH, TA).



Figure 14. Egeskoven Facebook post. Ecovillage Egeskoven thanking the municipality on their facebook page for their collaboration.

A central contribution to increased community-led sustainable initiatives was the Egebjerg bylaug, a local council initiated by FoF, that acts as a bridge between the community and the municipality (EG1, EG4, F6). According to one Egebjerg informant, it is actually the bylaug which runs most community-led initiatives in Egebjerg today, with many of the initiatives aimed at improving the natural environment and at "climate solutions" (EG1), e.g. biodiversity corridor, bicycle and nature walking paths (EG4, EG5). These examples show how, as a socio-political infrastructure, the bylaug promotes sustainable initiatives in the community. Although the tradition of bylaugs goes back in time (CP), it was with the set-up of Egebjerg's bylaug that new village-level councils began to emerge in the surrounding communities (CP, F6). These local councils have been well received within the municipality, as the Mayor highlighted the municipality's willingness to engage in dialogue with local structures and organisations, as well as the benefits of community-led initiatives in a municipality that would otherwise lack the resources to initiate them (TA). Hence, in addition

to single community-led initiatives, FoF led the establishment of a recognised institutional structure enhancing and amplifying community-led initiatives for sustainable development.

However, our evidence for translation beyond ideological acceptance and willingness to attract ecovillages into the region remains limited, as we found that the actual institutional adoption of FoF's infrastructures by the municipality was weak. None of the sustainable initiatives put forward by the ecovillage have yet been turned into regional legislation or guidelines, nor are their sustainable initiatives being actively promoted at the municipal level. Stronger niche-to-regime translation is hence not found as ecovillages were said to be treated as "any other housing project", following the standardised bureaucratic practice offered to such projects (O1, TA).

4.2.4 Contributions to sustainable development

By triangulating our diverse datasets, we identified that most of the people in Egebjerg believe that FoF and Egeskoven contribute positively to the local environment, economy and community (Figure 15). This supports our findings that FoF contributes to environmental sustainability in the wider Egebjerg community.



Figure 15. Perceived impact of FoF and Egeskoven on the community, economy and environment in Egebjerg. Number of responses is 27. The question was only asked to respondents who indicated that they were from Egebjerg.

Despite the positive environmental contributions identified, most of the identified benefits were ones that did not directly relate to the sustainable practices initiated within FoF. The sole moving in of new residents from FoF into Egebjerg had positive impacts on the local economy and facilities, contributing to the survival of the local school, shop (EG1, EG2, EK1, NET1, WBS) and sports associations (EG5, NET1, NET2.1). Overall, there is a consensus that thanks to FoF, Egebjerg was able to maintain its "assets" such as its public services and vibrant community (NET1), against the background of a potential "complete standstill" of the area (NET2.2). Furthermore, our interviewees generally agreed that Egebjerg will benefit from the incoming of new residents through Egeskoven, which will contribute to the economy by paying taxes, using the local store and sending their children to the local school (EG1, EG2, EK1, O1). Two of our interviewees (EG5, EK1) go on by saying that Egeskoven will be an attractive element for newcomers and tourists.

These contributions remain at the local level, with the Mayor believing that no significant economic or environmental benefits have resulted in Odsherred more widely. The Mayor also doubted that ecovillages' way of living could act as a solution to the sustainability challenges faced by the municipality (TA). The most valuable contributions from FoF to the municipality have been creating new social dynamics, improving social capital and assisting in attracting newcomers into Odsherred municipality more widely (EG3, TA). This was also seen through the strong sense of agency that was recurrent amongst our interviewees in Egebjerg, with their awareness of the fact that "a place like this will disintegrate if nothing is done about it" (EG3).

4.2.5 Challenges to diffusion

Bureaucracy

Through our assessment on the diffusion of FoF's infrastructures to mainstream society, several challenges to niche-to-regime diffusion persisted. Firstly, bureaucracy presented a significant challenge to translation, as a patchwork of existing regulations, infrastructure and networks were seen to mutually reinforce unsustainable practices (Boyer, 2015; Smith, 2007). As articulated by one of the founders of the upcoming ecovillage Egeskoven: "It's a struggle [...] But it's not that they don't have a good willingness towards the project [...] it's because if you want to build something different" (EK1). A FoF resident also identified bureaucracy as a barrier for their sustainable building practices to be adopted by the mainstream, as these

processes add to the costs of alternative practices (F2). In addition, the municipality remains highly restricted by national level legislation and regulations, as they need to "comply with rules made elsewhere" (F2). According to the Mayor one of the main challenges to the realisation of ecovillages within the region is lack of space due to national coastline regulations (TA). Bureaucratic processes hence present some of the main challenges to diffusion at different levels, with actors from the municipality and the ecovillages agreeing on the existence of unnecessary bureaucratic procedures (F1, F4).

Culture clash

Secondly, cultural resistance towards the adoption of community-led sustainable initiatives is present. Through diverse sets of data we identified a fragmented community, with some people arguing strongly against the lifestyle encouraged by FoF, stating it being incompatible to their own (NET2.1, NET2.3, WBS). In addition to the rejection of sustainable practices at a more individual level, some believed that ecovillages had taken over the village, viewing FoF as the main agenda-setter in Egebjerg, leaving little room for other residents' ideas and solutions (F4, F6). Such perspectives (Table 3) were strong amongst people with more conservative mindsets, long-term residents and summerhouse owners (F6) or conventional farmers (MH).

Positive perceptions	Negative perceptions		
"A lot of people in the city liked when that energy came, and energized those who also had ideas and thought they could realize those ideas (). Because of this place [FoF] many progressive people have	"I do not look down on eco-society it is just far from my lifestyle and I think the city is deteriorating" (NET2.3)		
moved to Egebjerg." (F6) "I think a lot of other towns would like to have a Fo close to them." (TA)	"I've heard about it in the years that Fri og Fro is always doing everything, they are always taking the lead in everything and they don't make room for other citizens in Egebjerg to come with solutions" (F4)		
"If it was up to me, then such communities were made all around the city." (NET2.1) "I think the school, the kindergarten, and the grocery store would be closed/shut down if it was not for Fri	"I think most of the people would say it [Egebjerg's reception of FoF] was positive – but there are also some that think that we have taken over Egebjerg" (F6)		
og Fro. With that the rest of the village community would slowly die out." (WBS)	<i>"If you don't live or have the same opinions as the eco-community, you're either in or out" (EG2)</i>		

Table 3. Positive and negative perceptions on the role of FoF in Egebjerg community

The above-mentioned challenges, namely bureaucracy and culture clash, exemplify the difficulty of any single entity to create radical change. In our case, bureaucracy represented the main 'lock-in' at the institutional level, complemented with the conservative rural mindsets of individuals demonstrating the overlapping regulatory, financial, and ideological structures that together conceive and support the prevailing regime (Boyer, 2015; Ergas, 2010). Hence, despite the recognised contributions of FoF in enabling sustainable initiatives in Egebjerg, the approaches of Odsherred municipality still rely primarily on practices outside the niche for stimulating sustainability in the region (TA). From the perspective of the Mayor, the municipality remains highly dependent on the contributions enabled by tourism and summer houses, with less regulations and responsibilities being placed on summer house owners compared to permanent residents (TA). In addition, the mayor emphasised the municipality's goals of creating an attractive urban environment in Nykøbing Falster as one of their ways of attracting newcomers. This demonstrates the dependence on already existing development paths, where shorter-term, economically driven development remains the main frame within which regional development aims to take place.

4.3 Conclusion of analysis

Firstly, we presented how through socio-political and physical infrastructures, like a common vision, a set of communal guidelines and shared facilities, FoF was able to develop and sustain specific sustainable practices (Gausset, 2020; Hansen, 2020). Most of them were shown to be more environmentally sustainable by directly contributing to a lower EF as compared to Egebjerg residents. It, thus, seems like by living in a close community of like-minded individuals such as FoF, the adoption of sustainable practices becomes easier (Hansen, 2020). Despite the vision being weakened in regards to the community aspect, we found the original foundations of the ecovillage in pursuing a sustainable way of life to uphold individual sustainable practices.

In a more indirect way, we identified FoF's contribution to environmental sustainability in the wider Egebjerg peninsula. This became evident through the diffusion pathways of replication, scaling up and translation (Seyfang, 2010) that led to the creation of certain socio-political and physical infrastructures that enabled environmental sustainability (Gausset, 2020; Hansen, 2020). By encouraging and inspiring the set-up of the new ecovillage, Egeskoven, FoF has been part of the spread of ecovillages in the area. Although Egeskoven has yet to be realised, we believe it will not only contribute to environmental sustainability through the

replication of infrastructures and environmental practices inside the ecovillage, but also through encouraging community-led sustainable initiatives more widely. Scaling up, understood as the spreading of socio-political and physical infrastructures by FoF which promote environmental sustainability in the Egebjerg community, could be seen in the heating system, the environmental orientation of the school and the Iværksætterhus. Beyond these initiatives, we found FoF to have an influence on people's mindsets towards sustainability, thereby contributing towards greater environmental awareness in everyday life among Egebjerg residents (Seyfang & Smith, 2007). Apart from setting up the bylaug as a central socio-political infrastructure building a bridge between the community and the municipal level and focusing on climate and the environment, the niche-to-regime translation was found to remain mostly symbolic.

Despite the municipality supporting and attracting ecovillages to the region, lock-ins such as bureaucracy and national legislation were found to remain central obstacles to diffusion. The adoption of small-scale environmentally sustainable initiatives have not been turned into policies and have not aggregated throughout the region. Therefore, most of the environmental contributions happened at the level of the Egebjerg peninsula, while broader contributions to the municipal scale remain limited. Also, although having a potential environmental component, we learned that the central value that FoF brings to the Egebjerg community is rather social in nature by attracting newcomers and maintaining central community facilities such as the school, the local shop and sports associations. This social contribution, despite being widely appreciated, engendered disagreements regarding incompatible lifestyles and FoF dominating the village.

5. Discussion

In line with existing literature on the role of communities in sustainable development, we found the role of socio-political and physical infrastructures to be significant in enabling more sustainable lifestyles (Gausset, 2020; Hansen, 2020; Marckman et al., 2012). Our findings demonstrate the significance of social sustainability as an essential underpinning for environmental sustainability, arguing for their inherent synergy and trade-offs and thus empirically contributing to the growing literature on the role of social and human capital in sustainable development (Pretty & Ward, 2001; Lehtonen, 2004). Contrary to the academic discussions of ecovillages isolating themselves and creating secluded communities (Seyfang & Smith, 2007), we found FoF to be highly active with their surrounding community.

Furthermore, our case exhibits the importance of social engagement outside of the borders of the niche, highlighting the necessity of ecovillages to engage with their surroundings to contribute to sustainable development.

However, our findings also exemplify the inherent trade-offs necessary for diffusion to occur. The gradual loss of vision within FoF could be seen to illustrate the permeation of mainstream values onto the ecovillage over time, challenging the social structures that underpin much of the sustainable daily practices within the community. Such findings have also been present within other studies, where ecovillages have experienced the loss of their community values and hence pillars for their sustainable practices (Temesgen, 2020), as a result of the dynamic relationship between the niche and the regime. Over time, and in its attempts to diffuse its socio-political and physical infrastructures into the mainstream, FoF made efforts to balance at a position of intermediacy, in between the niche and the regime. As Smith (2007) argues, intermediately positioned grassroots innovations are most successful in bringing forth diffusion into the mainstream, where translation occurs through the niche adopting more regime practices and hence becoming more palatable for the wider audience. Intermediacy, in the case of FoF, materialised in its shifting vision and decreased community feeling, but potentially increased closeness to Egebjerg and its diverse groups of inhabitants, enabling its collaboration and creation of sustainable initiatives outside of FoF.

In the context of rurality, much of the support for ecovillages from the regime was seen to result from the landscape pressures that the municipality faces (MH, TA). Attracting newcomers in sustainable ways has been of high interest for the municipality and its politicians, and ecovillages align well with Odsherred's Vision 2025 that highlights the goals of diversity, community, and closeness to nature (M1, Odsherred Kommune, n.d.). Ecovillages thus offered a viable solution to some of the main challenges faced by the villages and the larger municipality of Odsherred such as the scarcity of financial capital, demographic challenges, and fear of closure of public services. Indeed, pre-existing conditions of crisis facilitate effective translation, as they offer a possibility for the niche to inform and diffuse into the mainstream if the regime is placed under pressure to e.g. become more sustainable or attract new demographic groups into the area (Seyfang, 2010; Smith, 2007). What we witness is that the political acceptability of solutions to sustainable development are highly dependent on its capacity to respond to social problems that too often surpass environmental concerns in the public eye (Lehtonen, 2004).

Hence, according to municipal level politicians the context of rurality and 'Udkantsdanmark' could be seen to play a facilitating role in shifting ideological support and the adoption of alternative initiatives, with rural areas offering more space for community-led initiatives (Jungsberg et al., 2021). Decreased investment and role of the public sector in the rural areas has thus allowed for the emergence of a strong civil society with a central role in bringing forth local development (Jungsberg et al., 2021). This could also be seen in the case of Odsherred, where community-led initiatives play an important role, as the municipality would otherwise not have the resources to create certain initiatives (TA). Our findings hence align with larger trends in Nordic rural regions, where local communities and civil society are rising as key players in sustainable rural development, to complement for decreasing public sector involvement (Pain & Hansen, 2019; Jungsberg et al., 2021). Despite the importance of ecovillages in spurring community-led development, the prevailing development path of the municipality remains still driven by economic growth, with tourism and the creation of an attractive environment for investment dominating the agenda (TA). This supports previous findings on the limited capacity of ecovillages to transform societies at large (Hall, 2015).

6. Conclusion of the report

The aim of our study was to understand the role of FoF in shaping sustainable development in Odsherred municipality. By triangulating our diverse datasets on FoF, Egeskoven, the wider Egebjerg peninsula and Odsherred municipality, we found out that FoF contributed significantly to the establishment of socio-political and physical infrastructures, promoting sustainable initiatives, environmental awareness-raising and education more broadly in the Egebjerg community.

Concerning sustainable practices within FoF, our EF calculation shows that FoF is more environmentally sustainable than its neighbouring village Egebjerg, in terms of building materials, energy efficiency, and consumption. Most of their practices can be defined as environmentally sustainable and supported by a collective vision based on the values of community and ecology. The WCS could not be considered as effectively environmentally sustainable, since there seems to be some risk of a possible runoff and leaching of nutrients, with potentially harmful consequences for the environment. Although the common vision has to some extent weakened over the years, most of these practices are kept alive and are pursued on a more individual level. Moreover, our research assesses FoF's contribution to environmental sustainability in the wider Egebjerg peninsula. Replication pathways can be identified in the set-up of the new ecovillage, Egeskoven, a community-led initiative that was inspired and encouraged by FoF. Scaling-up happens, not through the diffusion of specific FoF internal practices, but in a broader sense through the promotion of socio-political and physical infrastructures in the Egebjerg community. These are exemplified by the heating system, the environmental orientation of the local school and Iværksætterhus. Finally, in terms of translation, a significant contribution that moves the environmentally sustainable practices at the institutional level is the bylaug, a village council initiated by FoF. It operates as a bridge between the community and the municipality and promotes initiatives to improve the natural environment and climate solutions. However, stronger niche-to-regime translation in the form of policies or regulations have not been found. Therefore, broader contributions to shifting the municipal scale remain narrow.

Summing up, we can see FoF as a catalyst for environmental sustainability in the Egebjerg peninsula. It is, however, not solely through one ecovillage that sustainability can be promoted, but through community-led actions. FoF therefore does not limit itself to internal sustainable practices, but goes beyond its niche boundaries to contribute towards sustainability more largely.

While our research design limits the generalizability of our results, our case study provides an empirical contribution to the growing interest in the role of community in Nordic rural development (Jungsberg et al., 2021). Our study, realised in a limited time interval, could act as a starting point for an analysis in terms of change and contribution in a longer span of time. Further research on this topic could focus on the evolution of the region post-Covid and after the establishment of Egeskoven. And lastly, comparative studies across ecovillages might also be conducted in Odsherred or in Denmark, to better understand the conditions in which diffusion takes place.

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8. Appendices

Appendix 1: Overview of applied methods

		1	i	1
Method	Respondent	Description	Amount	Code
Semi-structured interview	FoF residents	FoF residents from different households	6	F1-F6
	Egebjerg residents	Residents from Egebjerg peninsula from different households	5	EG1-EG5
	Future Egeskoven residentsBoard members and future residents of Egeskoven		2	EK1, EK2
Expert Thomas interview Adelskov (Mayor)		Current mayor of the Odsherred municipality from the Socialdemokraterne political party	1	ТА
	Clark Pratt	Member of the Enhedslisten political party	1	СР
	Matthias Hansen (Local politicians)	Member of the Venstre political party and Egebjerg resident	1	МН
	Member of Center for Environment and TechnologyMember of Center for Environment and Technology planning committee; involvement in Egeskoven planning		1	M1
Focus group	Egebjerg residents	Residents from Egebjerg peninsula	3	FG1-FG3
Netnography	Egebjerg residents, Egeskoven residents	 Facebook page: Egebjerg - i Odsherred Post Nr. 1 Comment to post Nr. 1 Comments to post 2 	5	NET1 NET1.1 NET2.1- NET2.3
Web-based Survey	FoF and Egebjerg residents	11 responses from FoF; 27 responses from Egebjerg	38	WBS
Soil sampling	-	Soil samples taken from the FoF wastewater cleaning system	14	-

Appendix 2: Contributions to Egebjerg initiated by FoF

What	Mentioned by
Heating system	EG1, EG3, EG4, EK1, F4
School	EG1, EG5, EK1, F6, CP, MH, NET1, NET2.1
Bylaug	EG1, EG4, F6, CP
Shop	EG1, EG2, EK1, NET1
Sports associations	EG5, NET1, NET2.1
Ivearkstaetterhuset	EG5, EK1, TA
Biodiversity corridor	EG1, EG4, F3
Increase in ecological products in local store	EG5, F1, FG2
Egebjerg development project	EG4, F6, MH
Organic food procurement	EG1, EG5
Bicycle path	EG1, EG5
Nature walking path	EG5
Egebjerg website	F6
Summer working camps	F5

The codes in the table represent people that mentioned initiatives made by themselves or other informants.