Drawing policy insights from social innovation cases in the energy field

Matschoss, Kaisa

Elsevier B.V.
2022-02

Matschoss, K, Mikkonen, I, Gynther, L, Koukoufikis, G, Uihlein, A & Murauskaite-Bull, I 2022, 'Drawing policy insights from social innovation cases in the energy field', Energy Policy, vol. 161, 112728. https://doi.org/10.1016/j.enpol.2021.112728

http://hdl.handle.net/10138/338828
10.1016/j.enpol.2021.112728

Energy Policy xxx (xxxx) xxx

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Drawing policy insights from social innovation cases in the energy field

Kaisa Matschoss [a,*], Irmeli Mikkonen [b], Lea Gynther [b], Giorgos Koukoufikis [c], Andreas Uihlein [c], Ingrida Murauskaite-Bull [c]

[a] University of Helsinki, Snellmaninkatu 10, 00014, University of Helsinki, Finland
[b] Motiva Oy, Pohjoinen Rautatiekatu 25, Helsinki, Finland
[c] Joint Research Centre, Westerduinweg 3, 1755, LE Petten, the Netherlands

ARTICLE INFO

Keywords:
Social innovation
Energy transition
Multiple case study
Energy policymaking

ABSTRACT

Social innovation is increasingly turned to when attempting to address pressing social needs and emerging issues having a social impact because of its inherent promise for societal improvement. The aim of this paper is to explore, demonstrate and confirm the potential role of social innovations in contributing towards low-carbon transitions in the energy field. The study locates the adequate fields of intervention for energy policymaking for the support of social innovation through a multiple case study of six empirical social innovation cases in the energy field in Europe. We discuss the energy policy context of the social innovation cases and how they contribute to transition as well as their broader impacts. These cases demonstrate many positive effects including measurable impacts in emissions reduction, green investments and an increase in renewable energy production. The study shows that while there has been no general focus on diffusion, some social innovation cases have scaled up nationally and internationally highlighting the potential of transitions to social innovations on the system level. Finally, the paper highlights that legislative and non-legislative policies play a crucial role in the diffusion of social innovations as they are interlinked with administrative and socio-spatial scales and non-energy-related policies or societal fields.

1. Introduction

Energy consumption and production are important sources of climate change and cause excessive use of resources worldwide. In order to reach a reduction in greenhouse gas (GHG) emissions following the Paris Agreement, energy-related emissions would need to be reduced by around 3.5% per year from now until 2050 (IRENA, 2019). Instead, they have risen by over 1% annually, on average, over a period of five years prior to the COVID-19 pandemic in 2020. The current plans and policies and their implementation are thus not ambitious enough. We need novel solutions in energy production and consumption to reconstruct our consumer society towards sustainability.

These developments have initiated a process of transformation in the energy field, and many innovations have emerged that support a transition towards sustainability. The energy market liberalisation, various regulatory developments and technological advances and mass-market production of renewable energy technologies have spurred the emergence of new actors in the energy markets. While technological and environmental innovations are undoubtedly needed, it is broadly recognised that technology alone cannot solve the issue as our complex societal systems are the initial causes of the problem (Renings, 2000; Diedrich et al., 2011). It has been suggested that social innovations could offer tools to support the transformation towards low-carbon societies (Eichler and Schwarz, 2019; Jäeger-Erben et al., 2015) because social innovation has been seen as an alternative to or an extension of technological innovation (e.g. Cajaiba-Santana, 2014).

Social innovations have been an emerging theme in research and policy in recent years (Wittmayer et al., 2019), and as a new context, they are being increasingly introduced in the energy field (Magnani and Osti, 2016; Mikkonen et al., 2020). There have been recent calls among energy policy scholars, practitioners and citizens to further support the social innovation uptake by policy initiatives at all levels since initiatives proliferate (Wittmayer et al., 2020). For example, the development of small-scale renewable energy technologies and battery solutions have created a group of prosumers (consumers that produce their own energy), and collectives of energy producers and consumers are forming and becoming active participants in the market.

Our study contributes to the ongoing de-contextualisation of the

* Corresponding author.
E-mail address: kaisa.matschoss@helsinki.fi (K. Matschoss).

https://doi.org/10.1016/j.enpol.2021.112728
Received 5 May 2021; Received in revised form 8 October 2021; Accepted 19 November 2021

social innovation concept that allows the informed interpretation and application of it by policy workers and practitioners. The aim of this paper is thus twofold: to explore and demonstrate the potential role of social innovations in contributing towards low-carbon transitions in the energy field and to locate the adequate fields of intervention for policymaking. We understand transition as a systemic change in the unsustainable practices of energy consumption and production (e.g. Markard et al., 2012).

Our research is based on multiple case studies on successful and recent social innovations in the energy field in terms of contributions to behavioural and lifestyle changes and increased citizens' wellbeing. In this article, successful features for social innovations are characterised by compatibility and connectivity (in a non-technical sense) with their institutional and cultural and normative environments (see also Holtgrewe and Millard, 2018, p. 72). Our empirical research compares six such cases in depth and provides understanding on the impacts of social innovations on energy transitions as well as the implications they have for energy policy. In the next section, we briefly introduce the concept of social innovation based on previous literature and provide a definition of social innovations in the energy field, offering our interpretation of the concept in relation to this study. The third section presents a methodological consideration, the used data and the selected projects that are scrutinised and discussed in more detail. In the fourth section, we discuss our findings deriving from the analysis of the projects discussing broader and energy-transition-related impacts that social innovation projects have as well as the context on which the projects operate. In the final section, based on our investigation, we conclude by highlighting the energy policy implications of our study.

2. Literature review for the definition of social innovation in the energy field

Social innovation is an important notion in current policymaking because of its inherent promise for societal improvement. For example, social innovation is highlighted in the European Union's (EU's) Citizenship Report 2020 (European Union, 2020b; see also European Union, 2020a). Literature indicates that the key objective for social innovation is a desirable social change (e.g. Cajaiba-Santana, 2014; Hoppe and de Vries, 2018; Eichler and Schwarz, 2019). Social innovation attempts to address pressing social needs and emerging issues that have a social impact (Neumeier, 2017), such as innovations for sustainable housing (Seyfang, 2010; Lorek and Spangenberg, 2019; Stieβ et al., 2019). Therefore, social innovation policy, research and practice are highly context dependent. Because the scientific points of view, political agendas and understandings derive from field experience, which often diverges significantly, universally defining the notion itself becomes challenging.

Given the importance of addressing the social dimensions of the energy transition and in accordance with Europe's growing bottom-up energy schemes, social innovation gradually enters fields of energy-related policy. Defining social innovation is particularly challenging in the energy field, where the concept arrived recently and is confronted with distinctive realities (Wittmayer et al., 2020). There, technology plays a key role in enabling and supporting social innovations because of the special character of energy and its high dependence on suitable infrastructures. Technological developments can provide solutions as alternatives to old, unsustainable technologies and routines. Thus, technology becomes a key element of the socio-technical platform on which social innovation operates (e.g. Angelidou and Psaltoglou, 2017; Boonstra et al., 2015). Nevertheless, social innovation in the energy field relies on the interaction between the micro-level actor network (e.g. initiators and implementers of energy initiatives) and the macro-institutional framework (e.g. infrastructures, rules and regulations) (Magnani and Osti, 2016).

In addition, locality is important as social innovations more often emerge bottom-up rather than top-down (Howaldt and Hochgerner, 2018). Thus, they contribute to civic empowerment, relationships or collaborations. The reason for this is that socially innovative processes often appear in lower spatial scales (e.g. cities, neighbourhoods). As such processes contribute to new social practices, institutions and systems, their ultimate goal, regardless of being outspoken or underlying, is social change (Cajaiba-Santana, 2014) in its implementation or execution. Nevertheless, a social innovation can lead to truly transformative systemic change only if the innovation has durability and impact. In addition, Hiteva and Sovacool (2017) have found that an important driver for social innovation is purposeful capacity building that is localised and contextually dependent.

Previous literature has identified two alternative approaches for social innovation, where one refers to social innovations having a measurable and tangible impact and the other relates to social innovations as a response to societal problems with the aim of changing the system (Dias and Partidário, 2019). Social innovation thus concerns innovation activities and recognises and manages transformative ideas and ways to do things.

Eichler and Schwarz (2019, p. 14) – based on their systematic literature review on social innovation – suggest that any definition of social innovation should include (1) social need, (2) innovative element, (3) implementation and execution, (4) improvement and (5) relationships and collaborations. In the socio-technical transformation of the energy transition, social innovation must be perceived both as a process and as a strategy capable of setting up customised delivery systems for energy services to foster decarbonisation and society's development by matching technological innovation with innovation in social practices and relations. In an effort to create a workable definition for this, Koukoufikis (2021) considers social innovation in relation to energy transition as follows:

> social innovation in the energy transition regards practices and processes that entail social, economic, technological, governance and/or policy innovations capable to satisfy human and societal needs underpinned by energy and contribute to a low carbon energy transition while in parallel empower vulnerable social groups, and cultivate democratic civic traditions of trust, equity and/or solidarity within and beyond the spatial context on which they occur.

The findings from previous literature and the empirical examination of social innovation cases (Appendix 1) have highlighted the multiplicity of ways and approaches to examine social innovation. For example, we found that while social innovation is usually seen emerging from the bottom up (Howaldt and Hochgerner, 2018), this is not always the case. We may miss some important lessons if we limit our consideration of social innovation only as bottom-up innovations. In a bottom-up case, the innovation is often initiated by local residents, a community or sometimes even the local administration(s). In this study, top-down social innovation based on central political programmes that combine incentives, support, nudging, regulation and prohibitions is also examined.

We thus adopt a broad definition for social innovation and rely on a broader set of aspects in the case selection. Taking stock of the above, we derive a definition of social innovation in the energy field, which incorporates elements from previous theoretical considerations as well as the empirical observations from the analysis of case studies, described as follows: Social innovation in the energy sector can involve innovative means targeting social improvements or innovative methods for social improvements, contributing to civic empowerment, improved relationships or collaborations, while advancing the low-carbon energy transition usually at a local or regional scale, by taking account of the native cultural particularities, social needs or goals while simultaneously striving for the general wellbeing of society during its implementation or execution. The broad definition thus also includes ethical considerations, although empirically, cases acknowledged as social innovations in the energy field show that social innovations do not always have a

dimension focusing on solidarity or that this is difficult to recognise and identify.

3. Methodology, data and case descriptions

This article is based on a multiple case study approach (Yin, 2003) as it analyses data from six European social innovation cases in a comparative setting. We selected these cases from a long list of social innovation initiatives in the energy field (see Appendix 1, Table A1) that were identified and reviewed by their attempt to contribute to an energy sector transition from a social perspective (Mikkonen et al., 2020). The plurality of social innovation projects directly or indirectly linked to energy had to be taken into account when selecting the cases. The cases were selected for an in-depth examination based on a comparative setting, where they represent different kinds of approaches to social innovation. The first choice was made regarding the initiatives' origins and organisation model as we selected cases representing both top-down and bottom-up social innovations. Literature highlights that more often social innovation initiates from bottom up, but our initial scanning of cases (Appendix 1, Table A1) showed that there are also top-down cases that can highlight important lessons for energy policy and energy sector transition, for example, through scaling or diffusion. The novelty in our research is to draw lessons from both approaches and not to limit to only bottom-up cases.

As a second criteria, given the proliferation of energy cooperatives, we selected two energy cooperatives' cases, purposefully targeting different sizes and somewhat different initial targets – one with a more for-profit agenda and one with a not-for-profit one. Third, we looked for cases of different scales; thus, we have analysed a transnational project and others with local character to reflect on the broad variety of different kinds of social innovation. In addition, an emphasis in the case selection was given to business model innovations in order to learn how social innovations in business models in the energy field could contribute to behaviour changes and energy transitions as well as to provide useful policy recommendations for strengthening the European economic area. We also wanted to include a broad European spatial and cultural coverage; hence, the cases come from divergent contexts. Lastly, the selected cases address some form of energy-related habitual behaviour to allow for direct links of policy-related conclusions with citizens' wellbeing improvement.

The cases were scrutinised in terms of their socio-technical impacts, such as impacts on emissions reduction, change in energy production, lifestyles, employment, social justice, increased acceptance of technological innovations, level of trust, local value, involvement of local community, regional impacts and national impacts. Furthermore, as our focus was to extract policy insights, we looked at the positive and negative ways policy and political realities affected the social innovation cases as well as documented opinions over future policy and support measures. The next section introduces our research data and the empirical cases in more detail.

3.1. Research data

The analysis presented in this article is based on data extracted via interviews as well as the available documentation of the social innovation cases. We carried out the interviews during online meetings (five interviews) or on the telephone (one interview) in February–March 2020 (Appendix 2 Table A2). The interviews were based on a structured interview scheme that was systematically used for each of the social innovation cases to collect the research data. The interviews were recorded and thematically analysed based on their impact on energy transition, especially in terms of the social aspects of transition. The extracted primary data represent first-hand information on each social innovation as the interviewees have been working on these projects from the very beginning. As many of these cases present a business model innovation, many interviewees are in a managerial position while some are responsible for communications. Additional materials were provided by the interviewees after the interviews, including articles in printed media, reports, web articles, PowerPoint presentations and video links (a list of the studied documentation can be found in Appendix 3 of this article). However, the interviews form the main source of data because very often there are no formal reports and the information on projects' websites is not sufficient for the purpose of this study. The case descriptions compiled with the help of the collected data were approved by the interviewees in order to verify their correctness.

3.2. Case descriptions

In this section, we present our empirical cases. The case studies included in the analysis are two biomass projects in Hungary (Told village) and Bosnia and Herzegovina, renewable energy cooperatives in Spain (GoiEner) and Germany (Wolfhagen BEG), an Earthship community house in the UK (Brighton) that pilots various energy solutions and a circular economy and the European Energy Neighbourhoods2 project promoting energy efficient behaviour. The biomass project in Bosnia and Herzegovina is a case of top-down social innovation, the Energy Neighbourhoods2 project is a somewhat mixed type and the other four are bottom-up social innovations. All cases of social innovation were ongoing at the time of the study except the Energy Neighbourhoods2 project that was completed in 2013. The project in Bosnia and Herzegovina was planned to be finalised by autumn 2020, but possibilities for continuation were being investigated.

3.2.1. Against fuel poverty with biomass briquettes (2012–, Hungary, local initiative)

A charity called the Real Pearl Foundation has introduced biomass technology in the extremely poor village of Told to produce cheap, clean and sustainable heating fuel. Before the briquette project, the households were burning rubbish and even furniture during the heating season. The initial innovation was made with very simple, mainly hand-powered machinery from agricultural waste materials. Due to poor calorific value and ash problems, an investment was made to improve production technology using local straw. The social objective is to provide an alternative to poorly accessible, expensive wood as well as to reduce the burning of inappropriate materials (e.g. plastic, rubber, treated wood such as furniture).

3.2.2. Biomass Energy for employment and energy security (2016–2020, Bosnia and Herzegovina, national initiative)

The overall objective of the project is long-term reduction of carbon dioxide (CO_2) emissions and improvement of the local population's living standards by supporting the sustainable use of wood biomass through strategic action, establishment of a market value chain framework and raising awareness, which is novel in the country and supports the social development of local areas with biomass. Raising awareness has been implemented mainly among the different professional stakeholders, but some activities have been carried out among the general public. The initiative has produced a biomass atlas showing biomass potentials and supporting their use for the development of the renewable energy sector in Bosnia and Herzegovina.

3.2.3. Earthship Brighton (2002–, construction finalised in 2007, United Kingdom, Brighton, local initiative)

Earthship Brighton is an off-grid building with the aim to deliver a sustainable community centre for local needs and to inspire individuals to make positive actions to generate environmental change by modifying people's behaviour to less carbon-intensive lifestyles. The Earthship house presents an innovative case of a building that heats, cools and powers itself from the sun, harvests its water from the sky and reuses wastewater by using plants as a cleaning system. The building is constructed from waste car tyres and other recycled materials and uses the planet's natural systems to provide all its utilities. A number of courses

and other activities for the local community are organised to inspire the public to adopt innovative sustainable construction and living.

3.2.4. Energy Neighbourhoods, phase 2 (2011–2013, 16 EU member states, implementation at city level)

The energy-saving challenge was taken up by cities in 16 countries. The purpose was to challenge the citizens' way of living so that the participants (citizens) would save at least 9% of energy over four winter months in 2010/2011 and in 2012/2013. Competitions were organised for citizens' groups and winners were acknowledged. The intention of the activity was primarily to support the citizens' change of behaviour through innovative means created by the participants themselves – not make investments. The Energy Neighbourhoods2 project succeeded another similar project that began in 2007.

3.2.5. GoiEner cooperative (2012–, Spain, regional initiative in Basque country and Navarre)

GoiEner is an energy non-profit cooperative with a goal to recover energy sovereignty for citizens by penetrating the currently liberalised parts of the electricity sector: retail (the purchasing of energy) and energy generation. GoiEner involves citizens in renewable energy generation and consumption in a novel, participatory and democratic way. It strengthens the local economy by offering a new way to employ people from the region, distributing tax payments locally and buying local goods and services. GoiEner supports the creation of new renewable cooperatives elsewhere in Spain in order to increase local, democratic and renewable energy resilience in other regions.

3.2.6. Wolfhagen BEG cooperative (2012–, Germany, Wolfhagen, local/regional initiative)

A consumer cooperative that is the co-owner of a municipal energy producer, the Stadtwerke Wolfhagen has emerged as an innovative way for the public to produce their own energy. Green electricity is produced in a wind park, solar park and biogas installation. This is a public-common partnership, where a municipal utility is co-owned and co-governed by a cooperation between the public authority and a citizen/consumer cooperative. A part of its revenue is allocated to an energy efficiency fund.

4. Results and discussion

This section presents and discusses our findings from the perspective of energy transitions. We first examine the political context within which the social innovation operates in order to deliver some initial ideas on supporting and hindering factors of social innovation by energy policy and governance. We then study the immediate impacts of the social innovations related to energy consumption and production and the social impacts they create. The examined cases target either a transformation of the system or its modernisation – that is, either aiming at profoundly changing it or improving the existing structures. We further examine the initial achievements of broader impacts of the cases such as spreading the lessons learned further from the local sites and scaling up. Finally, we discuss the limitations of our study and present future research opportunities.

4.1. Energy policy context impacting social innovations

The interaction of social and political realities and its impact on regulatory frameworks at different levels creates an environment that affects all functions of social innovation and creates opportunities or obstacles to their development and evolution. Social innovations are developed under a given political context composed of local, regional, national or federal and international governance dynamics. Policy-making and governance on several levels influence socially innovative activities as they create legal and financial instruments. Table 1 lists influences identified in the examined cases. Scales and spatial proximity

Table 1
Identified supportive and hampering influences.

Social innovation case	Supportive influences	Hampering influences
Against fuel poverty with biomass briquettes	- good cooperation with the city officials in Told - local support from the village mayor important for the implementation	
Biomass Energy for Employment and Energy Security	- legislation for the energy sector, also regarding renewable energy sources, has progressed - a UNDP-supported study on identification of policy gaps within the energy and forestry sectors in segment of wood biomass to improve the skills at the institutional level and provide concrete guidance on wood biomass use and forest management practices - financing from Czech Development Agency (CzDA) - capacity-building activities with different stakeholders - strong links with policy	- legislation for forestry lags behind (wood is still not recognised as energy carrier by the national law) - forest ownership of areas that are too small (private forest owners account for 30% of the total typically owned land areas around only 0.5 ha) - no legislation for energy service companies - lack of citizen participation in common activities as a part of culture because of historical influences
Earthship Brighton	- good cooperation with the city of Brighton	- The EU Landfill of Waste Directive 1999/31/EC banning end-of-life tyres from landfill so gaining a building permit was not straightforward - lack of suitable land - high property prices
Energy Neighbourhoods2	- financial support from the European Commission - implementation has been done in close cooperation with local municipalities - the winners of the competition were recognised both nationally and internationally by the EU in Brussels	
GoiEner	- strong tradition of cooperatives - national-level support for renewable energy started in 2018 - the recast RES Directive (Directive (EU) 2018/2001) implementation - the EU electricity market regulation requiring the unbundling of activities has resulted in the reorganisation of generation and sales activities - (non-financial) support strong from local administration to solve local problems	- no financial support - traditional energy companies' influence strong in national energy policy - energy cooperatives first seen as 'hippie communities'
Wolfhagen BEG cooperative	- national feed-in tariff system in place since 2000 - the EU regulation requiring unbundling of activities in the electricity market has required the reorganisation of	- opposition to windpower development from the Green Party due to impacts on local nature (faded over time) - lack of land for windpower development

(continued on next page)

Table 1 (*continued*)

Social innovation case	Supportive influences	Hampering influences
	generation and sales activities - strong tradition of cooperatives	and finance is needed upfront for auctions

play a role in the type of relationships between initiatives and administration as bottom-up social innovations often cooperate most with the local administration and policymakers, while top-down initiatives are often initiated and administered at the national or EU level. Social innovations, political realities and citizens are in constant deliberation. Some innovations are developed explicitly to accommodate, service or take advantage of the existent political landscape, but often social innovation emerges as a response to a policy or market failure.

In the case of the Wolfhagen BEG cooperative, two contrasting trends were observed in different levels of agenda setting (local and national). On one hand, energy generation projects were supported and facilitated by the German feed-in tariff system (e.g. Bauwens et al., 2016), while on the other, the construction of windpower plants faced opposition by local political parties because of impacts on the local environment. In Spain, the national government delayed providing support for renewable energy until 2018, which has positioned the GoiEner cooperative in a disadvantaged situation compared to traditional energy companies (e.g. Gregg et al., 2020). The energy companies had resources and a strong role in energy policy lobbying while the cooperative never received any financial support. However, when considering the local level, the situation is quite different as GoiEner closely cooperates with the local governments and is being consulted to solve various local problems (e.g. Antepara et al., 2020).

Local support is very important to social innovations in energy. Both the Low Carbon Trust in Brighton for the Earthship house and the innovation with biomass briquettes in Told have had good cooperation with the respective city. In Told, the support from the local mayor was crucial for the implementation of the project in that he offered the straw from his farm as a resource for the briquettes (e.g. Repo and Matschoss, 2020). In Brighton, the city officials supported the initiative by facilitating process of the building permit after initial problems, as the city considered the Earthship house as important community building activity. While the Energy Neighbourhoods2 project was financed in the context of the EU's challenging energy and climate objectives, the project was implemented in close cooperation with local municipalities that have supportive political structures. Similarly, although national support was guaranteed for the biomass project in Bosnia and Herzegovina as it has been strongly linked with top-down policies, local support for it was also necessary because biomass was used in public buildings.

Beyond contextual political realities, EU legislation can influence national realities that further impact socially innovative activities. The level of impact that the EU legislation has towards it can vary depending on the national policies in place. Our two energy cooperative cases present an example. The recast of the RES Directive (Directive (EU) 2018/2001) requires raising EU renewable energy consumption to 32%. The EU regulation related to the requirement of unbundling activities in the electricity market has led to the reorganisation of generation and sales activities in both cooperatives (GoiEner and Wolfhagen BEG). Nevertheless, in the case of Spain, GoiEner reports that the EU-level regulations have particularly supported the cooperative by necessitating the implementation of new favourable measures at the national level. In Germany, however, the impact of the RES Directive was not strong since national action had been taken earlier, and, for example, a feed-in tariff to RE was introduced already in 2000 (e.g. Bauwens et al., 2016). The announced discontinuation of access to the feed-in tariff scheme led to a boom of RES investments in Germany in 2010–2013, which changed the relative competitiveness position of Wolfhagen BEG in the energy markets.

Another example of national-level policy influence on social innovation in energy comes from Bosnia and Herzegovina. The interviewee reported that the legislation for the energy sector, also regarding RES, has progressed, but legislation for forestry lags (see also Karakosta et al., 2012) as wood is still not recognised as an energy source by the national law. There is no legislation in place for energy service companies. However, the EU accession process will progressively advance the renewal of the legal framework because of the harmonisation process of the Bosnia-Herzegovina legislation to the EU legislation.

We observe some obstacles in the development and implementation of the social innovations created by a combination of local planning regulation and EU legislation. In the case of Brighton Earthship, the EU legislation has banned end-of-life tyres from landfills (Landfill of Waste Directive 1999/31/EC) and the member states have taken different approaches to implement the legislation. Initially, the used tyres were to be used for the construction of the Brighton Earthship (e.g. Pickerill and Maxey, 2009), but it only succeeded after the project first challenged the interpretation of the law in force, so it was not straightforward to obtain a building permit for the use of such materials.

Active citizenship is an important social factor, especially for the emergence of bottom-up social innovations. Nevertheless, they will not emerge no matter how important they are in developing communities and even strengthening democracies if there is no tradition or interest in a participatory approach. Social innovative traditions in the energy sector flourish in a context with a strong tradition of civic engagement and cooperation, but they can also develop in areas with less traditions. An example is the GoiEner cooperative (see also Heras-Saizarbitoria et al., 2018). In the Basque country, there is a strong tradition of civic engagement, which enabled the establishment of the cooperative. However, this operational model was first challenged culturally as some called it a 'hippie community', as the interviewee described the situation.

> *Large energy companies have very much power. They have tried to delay the uptake of laws for opening the market for other energy producers. At first, they considered us as 'hippies', doing 'hippie things' like creating cooperatives, small ones … all very nice. Soon the energy companies realised that they were losing contracts, not only domestic ones but also from the local governments, to energy cooperatives. They don't find us (cooperatives) as an important actor in the field and have been actively campaigning against the cooperatives but without success. The energy companies follow very closely the operations of the cooperatives and will take action (i.e. lobbying to the government) when they find them a threat in the market. At the moment, we are able to carry out our plans. We think that the government and institutions consider us legitimate operators knowing what we do and do it right. We are social innovation labs. We appreciate their trust and that will be crucial if we have to fight for our existence in the future* (GoiEner).

Nevertheless, the general atmosphere changed over time as information and activities spread along with the political changes and the implementation of EU RES legislation facilitating the initiative. In case of the energy cooperative in Germany, Wolfhagen BEG, the model boomed in the renewable energy sector taking advantage from the favourable feed-in tariff system. However, our interviews showed that cooperatives do not necessarily work everywhere. For example, in Bosnia and Herzegovina the interviewee did not consider it as even an option right now in the country because of the lack of citizen participation in common activities and high levels of mistrust among the residents.

> *People are just not interested. Why should I care?, they think. People are reluctant to participate due to the poor economic situation, low interest in energy matters and lack of trust to decision makers* (Biomass Energy for Employment and Energy Security).

Another socio-political barrier highlighted in the case studies relates to the impact of land-use planning, regulation and ownership structures of energy-related social innovations. In Germany, there is a lack of land for windpower development, which makes project development challenging. In addition, it is difficult for cooperatives to compete in power plant land auctions because funding is needed in advance in Germany. Also, in the UK, land is a scarce resource, and the lack of suitable land as well as high property prices can hinder the construction of further building communities such as the Earthship Brighton. In Bosnia and Herzegovina, private forest owners account for 30% of forests. They typically own small plots of land of about 0.5 acres that are used for their own use. This makes integrated forest management challenging and effectively halts the creation of sustainable empowerment unless strong and robust cooperation initiatives emerge.

4.2. Social innovation cases and aspects on energy transition

The six projects analysed address various aspects of the low-carbon energy transition, and through them, impacts start to become visible in local or broader communities (see Table 2 for a documentation of the key areas that the projects address). Energy efficiency is at the core of a desirable energy transition because even renewable energy (RE) solutions entail some environmental impacts and demand non-renewable resources. Furthermore, novel RE supply solutions are an integral part of energy transition and complement energy efficiency measures. An example of such a case with multiple goals is German Wolfhagen BEG, in which both energy efficiency advice and financing solutions are provided along with renewable energy supply. Energy efficiency also has a special focus in the Energy Neighbourhoods2 case that contributes to raising awareness and behaviour changes of local residents.

In the examined cases, renewable energy production, local production and energy security seem to go hand in hand with the objectives of the cases in relation to energy transition. All cases, except Energy Neighbourhoods2, are based on utilising local renewable energy sources, and they have a focus on energy security. Beyond their immediate impacts, such as supporting the local economy and thus improving the wellbeing of residents, the reasons behind the willingness to invest in local energy production include lowering transmission costs, guaranteeing energy security, and providing added value on previously unexploited resources. Two cases are based on novel ways to utilise local biomass sources: Against fuel poverty with biomass briquettes and Biomass Energy for Employment and Energy Security. Solar power is used in Earthship Brighton, Wolfhagen BEG and GoiEner. The Wolfhagen BEG energy cooperative also engages in windpower generation and retail. In analysis of the selected cases, it was clear that local energy production is linked to increased local employment, thus contributing to the overall wellbeing and increased public acceptance of the innovation.

The overall social objectives of all the cases are highlighted especially in the transparency of energy prices, the tackling of energy poverty, the support of energy sufficiency and the induction of behavioural changes. Many cases have several and simultaneous targets, such as the case on Biomass Energy for Employment and Energy Security, which targets the improvement of the living standard of the local population by establishing a market value chain framework, supporting the sustainable use of wood biomass through strategic action, raising awareness about positive aspects of the utilisation of the energy source, fostering the development of enterprises for processing locally available wood biomass and setting up sustainable partnerships that contribute to the economic development of micro-regions.

In terms of social justice, energy poverty is a severe problem especially in Hungary and Spain, and there is an urgent need for effective and affordable energy solutions for local residents, which has led to the initiation of the Hungarian (Against fuel poverty with biomass briquettes) and Spanish (GoiEner cooperative) projects. The Bosnia-Herzegovina case (Biomass Energy for Employment and Energy Security) includes goals of energy poverty reduction at the local level.

> *Over 50% of Bosnia and Herzegovina is covered by forest, of which 70% is owned by the government. Data on the potential for wood biomass utilisation is, however, lacking. Capacity building and skills development of local institutions in Srepreniča region were the first steps to tackle energy poverty. They provided concrete guidance on wood biomass use, forest management and utilisation practices. Collaboration of sectoral institutions is important in decision making* (Biomass Energy for Employment and Energy Security).

A new rising theme is energy sufficiency (e.g. Lorek and Spangenberg, 2019) (not to be mixed with 'energy self-sufficiency'), which essentially means frugal and sustainable consumption by using just enough energy to have all reasonable needs covered. This is a socio-cultural goal targeting a reduction in energy use achievable only by changes in lifestyles and behaviour at the individual, household and collective levels. The Earthship Brighton and Energy Neighbourhoods2 cases contribute to this objective. Behaviour change is an explicit objective in these two cases as well as in Wolfhagen BEG. Gender equality is a significant factor in a few cases, which aim at empowering women to be more active in energy matters in general but also in energy production or as investors. The role of women is emphasised in often female-dominated energy advice delivery or new working conditions such as a teleworking policy. Our cases confirm the finding of Hiteva and Sovacool (2017) that business model social innovations are linked to energy justice and that they contribute to building existing skills, knowledge and social capita, which depend on the local context.

> *You cannot change the community from the outside; it needs to come from within the community. We started to work with a key person, a Roman woman, in the community, to agree that we have the same goal and understand each other. Women were already involved because the project started initially with children's art project – the gender issue was clearly present. Working together developed from there. In Roman culture, women are in charge of household issues, including heating. There are special projects for women now* (Against fuel poverty with biomass briquettes).

Table 2
Impact of social innovation cases from the energy transitions perspective.

Name	Energy efficiency	Renewable energy	Local energy production	Energy security	Transparency of energy prices	Energy poverty	Energy sufficiency	Behavioural changes
Transformation								
Biomass Energy for Employment and Energy Security		x	x	x		x		
Wolfhagen BEG	x	x	x	x	x	x		x
Modernisation								
GoiEner Cooperative		x	x	x	x			
Transformation and modernisation								
Earthship Brighton		x	x	x			x	x
Against fuel poverty with biomass briquettes		x	x	x		x		
Energy Neighbourhoods2	x						x	x

4.3. Broader impacts through scaling up

Previous empirical considerations about social innovations have found that most social innovations start within civil society, either driven by non-profit organisations, citizens, communities or networks (e.g. Howaldt and Hochgerner, 2018), and that societal challenges and local social demands are the key motivation for social innovation. Social innovation initiatives and their sustainability are thus highly dependent on the actors engaged in them because many social innovations are not embedded in public innovation programmes but rather emerge as local responses to societal challenges. Previous literature has also found that a social innovation can lead to truly transformative systemic change and impact only if the innovation scales up (Dias and Partidário, 2019). However, as the purpose of social innovations is to address a social challenge often in a specific area rather than to spread or grow, purposeful scaling up and dissemination do not occur often. Therefore, learning processes of engaged actors and networks play a crucial role in creation of competence to reach transformative impacts (Strasser et al., 2019).

Scaling up does not need to follow a spatial dimension in its spread. Oftentimes distinguishing between the scale of the innovation or its activities (e.g. transnational, national, regional, local) leads to accessing the spatial distribution of activities and impacts of an innovation. Transnational social innovations are typically top-down initiatives prompted by the EU or other international organisations, institutions and actors (see also Avelino et al., 2020). The Energy Neighbourhoods2 project stands out as a transnational project among the case studies, but although the innovation had a large geographical coverage as it extended to 16 EU member states, it was implemented in close cooperation with local municipalities and with hands-on involvement of the citizens at a community level. We find that for social innovations in energy that are not dependent on a specific local fuel source (such as in the examined cases with local biomass), scaling up could take place fairly easily through replication from region to region or country to country.

On the other hand, grassroots bottom-up initiatives that emerged at a neighbourhood or city level may appear to have little potential for broader learning and scaling up at first sight. Nevertheless, they may be made possible only because of a transnational or national public funder or a non-profit organisation as the initiator and organiser. An example of such a case is the biomass project in Bosnia and Herzegovina, which was implemented by UNDP in partnership with relevant ministries and authorities of Bosnia and Herzegovina and received financing from the Czech Development Agency (CzDA). In fact, this project showcases the potential of local innovations for scaling up as it builds on the knowledge and results of a previous bioenergy initiative from 2009 to 2015 organised in Bosnia-Herzegovina and co-funded by UNDP and the Global Environment Facility. Even very local actions can be strongly linked to transnational actors such as global organisations or movements that help to spread the gained knowledge, and in some cases, grow into global movements. An example is Earthship Brighton. Although it is a single community house in the United Kingdom, it is part of a wider international movement being prompted by Earthship projects in Mexico and elsewhere (e.g. Freney et al., 2013). Each case included some impacts that were not intended in the initial phase of the innovation such as in the case of Earthship Brighton described above, which has made the organisers proud of their innovation.

The GoiEner cooperative has strengthened the local economy by employing people from the region and distributing tax payments locally. The cooperative has bought local goods and services, thus multiplying the positive impact on other fields in the area. In addition, it has supported the creation of new cooperatives producing energy with renewable energy sources elsewhere in Spain, which has increased local, democratic and renewable energy resilience in other regions as well. The two energy cooperatives have become part of national and international movements, although they have not been centrally led in any manner. The GoiEner cooperative was established in the Basque country and Navarre regions but today has members around Spain, whereas the Wolfhagen BEG cooperative has members mainly locally but acquires windpower from the broader region. Wolfhagen BEG has pioneered a series of innovative approaches to reducing energy usage via its energy savings fund: the cooperative members currently receive a grant for the purchase of energy efficient appliances, programmable radiator thermostats and on-site energy advice.

Most of the unintended or unexpected impacts are positive, but this may be because of a bias caused by the study method. As we relied mostly on interview data, possible negative impacts or challenges were not highlighted as the organisers quite naturally wish to present their innovation in a positive light, and negative effects are seldom mentioned in promotion material or on websites. The only potentially negative effect mentioned was 'the negative effects caused by the social innovation within other business areas', but as the example presented included 'interruptions in illegal energy supply', it may also be seen as positive from the societal point of view. In Energy Neighbourhoods2, a positive spin-off effect came with the implementation of CO_2 challenges, which led to conversations and exchange of experiences between the participants, adding to the knowledge and social capita of the area. The case in Bosnia and Herzegovina has contributed to setting up sustainable partnerships that contribute to the economic development of micro-regions and can potentially carry the innovation further.

> *Of course, it was combined with energy savings and climate change actions. The underlying idea of the project was to make the campaign inspiring and interesting for participants. We also broadened the scope to mobility and water consumption to give people a broader picture of how they can, by changing their behaviour and making small actions, contribute to climate change abatement* (Biomass Energy for Employment and Energy Security).

Nevertheless, one main benefit of many of the social innovations amongst the case studies is at the same time one of the main barriers: the regional or even very local nature of the projects (see also van den Heiligenberg et al., 2017). While this entails many local benefits, practice has shown that scaling up fragmented initiatives for a larger national or even global impact is resource-intensive, takes a long time and can run into many kinds of problems. However, as scaling up is not usually framed as one of the objectives of social innovation, the selected social innovation cases all are directed at empowering citizens in their local contexts and supporting the energy poor, which makes them strong in their targeted context. While aiming for behaviour change, social innovations especially target households, but they also address local governments, energy producers and tourists via education and the general public and even international decision makers via inspiration to similar actions in other areas. In general, civic engagement is a factor particularly in the emergence of bottom-up social innovations.

> *Looking back, we would have taken some risks if we had more money. We would have invested more in windpower and also in PV. Reduction in fossil energy use is much bigger through renewable energy production than from the energy efficiency actions, like insulation of houses* (Wolfhagen BEG).

4.4. Limitations and future research

An obvious limitation of our research relates to the vast amount of social innovation cases in the energy field. Our empirical analysis can only present a small snapshot of such social innovations. Therefore, it is likely that we have not captured all kinds of impacts and opportunities for scaling up. We, however, think that our study contributes to better understanding the impacts of social innovations in the energy field in different contexts despite this limitation.

We acknowledge that our examination represents a very positive picture of the social innovations. Having this in mind, during the interviews we deliberately asked questions related to possible failures and

difficulties. As expected, the organisers did not highlight many failures, which have also been found in previous studies posing a difficulty in experimentation and innovation (Heiskanen and Matschoss, 2018). In addition, we think that it is especially difficult to publicly discuss any negative implications of such innovations that are supposed to target a social failure and improve the lives of local residents. However, talking about failures is important for the energy transition so that others can learn from them. In our analysis, the selected cases were successful according to our definition; thus, we suppose that the potential failures have not been very impactful in terms of impacts or broader scaling up. Future research could focus on examining cases with failures or challenges in order to enable learning from not so successful innovations. Another future research effort could focus on a scenario exercise to determine how the localities would have developed had there not been a social innovation case, which however requires a different kind of set of cases, in which the immediate impact is more easily identifiable.

A further limitation relates to the collection of research data. We have only interviewed the organisers of the innovations and not, for example, the funders or local politicians. This was done because of practical reasons of available resources and finding a common language, and mainly because we wanted to particularly examine the perspectives of the organisers. While we acknowledge that some perspectives may be missing because of this selection, we nevertheless feel that the overall results are not much impacted by this limitation as the organisers are quite aware of the impacts of their innovation in a broader environment, although these may not have been measurable and have not been translated into quantitative figures. Despite these limitations, we feel that our study complements previous understanding of the impact of social innovations in the energy field. Future research could examine a broader selection of cases or focus on an in-depth study of one case and interview a broader group of stakeholders and participants.

5. Implications on energy policy and conclusions

The set of social innovation case studies examined in this article shows some common features. They all exhibit attempts to involve the local community, and a common feature for success is purposeful capacity building that is localised and adjusted to the context (see also Hiteva and Sovacool, 2017). These cases share successful features such as their compatibility and connectivity with the institutional and cultural and normative environment. In addition, most of them try to achieve emissions reductions and changes in energy production. Based on the analysis, we found that local energy solutions are linked to supporting local employment, changes in energy production and poverty reduction. The cases succeed in the creation of local value and accomplishing local or regional impacts. Many focused on inclusion, and the case Energy Neighbourhoods2 focused on democratic and participatory involvement as an objective. These findings support acknowledging the important role of social innovation in energy field transition and thus merit consideration in energy policymaking.

In terms of impacts, the set of cases demonstrates a wide range of positive effects. Our study finds that these include measurable impacts in emissions reduction, green investments and change in energy production towards renewable energy production along the line of the objectives of the social innovations. Other tangible impacts include increased employment, creation of new markets, improved energy efficiency and reduction of energy poverty, as well as advancements in circular economy as waste materials have been reused or used in energy production. Non-tangible impacts involve increased citizens' acceptance to technological innovations, level of trust, involvement and empowerment of local community, local value and lifestyles. The impacts can also be of different scales such as local, regional or national impacts. We would like to highlight an aspect of social innovation that we think has not been previously brought forth much. As we have highlighted in the results, social innovation has the potential for scaling, regardless of its initial, very contextual and local target and impact. We find that some social innovation cases have scaled up nationally and internationally, but in general, there has been no special focus on scaling up. Through funders and networks of actors, innovations can diffuse and scale beyond their immediate context, which our empirical cases have shown. This has implications for funders, organisers and administrations. Even if the impact of an innovation may initially seem very local and small-scale, it can still reach broader impacts. This confirms the potential of social innovations in the energy field to carry transition potential on the system level.

Legislative and non-legislative policies play a crucial role in the diffusion of social innovations as they are both driven by and drive developments on the field (Ganugi and Koukoufikis, 2018). When it comes to the relationship of policymaking processes and the emergence of social innovative initiatives, this role is even more evident in the energy sector. For example, new or updated legislation and regulations allowed citizens and communities to actively take part in the energy transition, while financing programmes provided the monetary support and incentives for action. As our investigation on the studied projects reveals, policy can support social innovation by providing financial support and subsidies, providing non-monetary support such as nudging by positive reinforcement, using regulation to remove legal barriers, restructuring administrations and streamlining administrative processes. Furthermore, the role of regulations is particularly significant in the case of new market entrants and business model creation (e.g. energy communities/cooperatives).

Two key aspects deserving special reference are the way social-innovation-related policies are interlinked with administrative and socio-spatial scales and non-energy-related policies or societal fields. As social innovations have first and foremost local impacts, even if driven by national or EU-level policymaking, local administrative capacities and the attitude of local governance towards them is important. Our study confirms the findings of previous studies that social innovations in energy have positive impacts on local employment and regional development while addressing energy poverty issues, social justice and inequalities such as gender equality and minimum level of consumption. This not only increases the support of the local community for the energy transition and public acceptance, which are energy policy goals, but makes energy and social innovation candidates part of a broader mix for local and cross-sectoral policy consideration.

Based on these points and insights, the cases studied brought several policy-related issues to surface that require attention in a timely manner. As the global fight for tackling climate change is scaling up, the EU adopted the Fit for 55 legislative package under the European Green Deal while the European Investment Bank (EIB) pledges to become a 'climate bank' aiming to spend a €1 trillion green investment package in 2030. These (among other developments) signal the emergence of favourable legislative and funding conditions that create a window of opportunity – that policymaking on social innovation should exploit to tackle problems on 'traditional' intervention themes.

Thus, by linking these realities to the cases analysed, we indicate the following:

- The cases exhibit empowerment and involvement of local communities. National and local energy policy should consider this and further promote the use of social innovation as a fair transition accelerator. EU member states should do a better job transposing EU directives (e.g. Renewable Energy Directive, Energy Efficient Directive, Electricity Market Directive of the Clean Energy for all Europeans package) into national law in order to allow, encourage and foster the emergence and development of various social innovations in energy faster and more evenly across the continent.
- Policy could highlight successful cases of social innovations and support their transfer to other sites by, for example, removing barriers or providing access to finance via the EU Social Climate Fund. Supporting scale-ups through various other financial schemes is also a key enabling factor.

- Legislative amendments and initiatives should create at least a level, but possibly favourable, playing field justified by the cooperative benefits (e.g. security of supply due to distributed generation based on local renewable energy sources, alleviating energy poverty and social exclusion, improving cohesion and democratic decision making). As social innovation still does not always fit the traditional institutional forms, regulation should allow and stimulate the testing of impacts without immediately imposing the usual regulatory requirements.
- The above advantageous setting can be created via innovative financing, subsidies and taxation schemes that are necessary to overcome initial investment barriers or assist existing social innovation initiatives to the mainstream, e.g. tax deductions for small social entrepreneurs or grants from local authorities for establishing inclusive citizens-driven social innovations in the energy field could be legitimated. An enabling framework should facilitate funding via tax breaks for donors and investors and/or credit guarantees and access to capital credit at low interest rates.
- There is a need for capacity-building activities with different stakeholders at all levels in order to advance governance schemes that can support social innovation in energy. In the EU, this can be achieved, for example, by utilising resources of the European Structural Investment Fund on governance and capacity building, channelling them to social innovation acceleration programmes.

To sum up, all of the selected social innovation cases demonstrate not only various positive social impacts on local societies but also bring very clear contributions to the green transition as a whole. Other benefits that were observed include transparency of energy prices, the tackling of energy poverty, the support of energy sufficiency and the induction of behavioural changes. The social innovation projects have not only strengthened local energy production and energy security in Europe but have also increased transparency of energy prices and helped tackle energy poverty in some vulnerable regions.

Funding

This work was supported by the Joint Research Centre of the European Union [grant number 938 243] as well as the Strategic Research Council of the Academy of Finland [Smart Energy Transitions -project grant number 314325].

CRediT authorship contribution statement

Kaisa Matschoss: Conceptualization, Methodology, Writing – original draft, Writing – review & editing. **Irmeli Mikkonen:** Conceptualization, Data curation, Investigation, Writing – original draft. **Lea Gynther:** Conceptualization, Data curation, Investigation, Writing – original draft. **Giorgos Koukoufikis:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing. **Andreas Uihlein:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing. **Ingrida Murauskaite-Bull:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix 1

Table A1
Long list of social innovation cases

Name of social innovation case	Year/s	Country and level
'Qvinnovindar' (Women of Wind Energy)	2007–	Sweden (national)
Agrarholz Pilotprojekt		Germany (regional)
An Earthship village	2009–2016	The Netherlands (local/Olst, similar projects internationally)
Biomass Energy for Employment and Energy Security in Bosnia and Herzegovina (BiH)	2009–2019	Bosnia and Herzegovina (national)
Cloughjordan EcoVillage	2002–	Ireland (local, Cloughjordan)
Earthship Brighton	2002–2007	United Kingdom (local, Brighton, similar projects internationally)
Energy Awareness Week for second graders in primary schools	1996–	Finland (national)
Energy Co-operative Lug (Energetska kooperativa Lug)	2013–	Croatia (regions of Karlovačka and Zagrebačka županija)
Energy Neighbourhoods (Phases 1 and 2)	2011–2013	16 EU member states (implemented at the city level)
Ènostra	2014–	Italy (national)
Farmpower (original language: Farmivirta)	2014–	Finland (national)
GoiEner cooperative	2012–	Spain (regional, Basque country + Navarre)
INFORSE International Network for Sustainable Energy	1992–	International
MotiVoittaja – a user-friendly low-energy housing concept	2000–2001	Finland (national)
One-stop shop for energy advice (PRIS/FAIRE)	2013–	France (national)
Real Pearl Foundation – Against fuel poverty with biomass briquettes	2012–	Hungary (regional, Hajdú-Bihar)
Robin Hood Energy – a not-for-profit company	2015–	United Kingdom (local, Nottingham City Council)
Sustainable energy awards	2003–	Ireland (national)
Teleworking in public administration	2008–	Malta (national)
Together4Energy	2017–2020	International (European Network of Vulnerable Consumers Energy Advisors)
Wolfhagen BEG	2012–	Germany (national)

Appendix 2

Table A2
Data on held interviews

Social innovation case	Position and organisation of the interviewee	Date of the interview
Against Fuel Poverty with Biomass Briquettes	Technical Project Assistant, UNDP	27 February 2020
Biomass Energy for Employment and Energy Security	Communication and Fundraising Director, Real Pearl Foundation	5 March 2020
Brighton Earthship	Director, Low Carbon Trust	9 March 2020
Energy Neighbourhoods2	Head of Department International Projects, Marketing, B.&S.U. Beratungs- und Service Gesellschaft Umwelt mbH	13 March 2020
GoiEner Cooperative	Communications Manager, GoiEner	4 March 2020
Wolfhagen BEG Cooperative	Chair of the Citizen Energy Cooperative Head of Supervisory Board	11 March 2020

Appendix 3

List of data sources for each studied in-depth case on the internet:

- Biomass Innovation Centre, Bosnia and Herzegovina: http://biomasa.ba/inovativni-centar/
- Brighton Earthship: http://www.lowcarbon.co.uk/home
- Energy Democracy Alliance, heating project to reduce energy poverty in Told, Hungary: https://www.energy-democracy.net/?p=348
- Energy Neighbourhoods2: https://ec.europa.eu/energy/intelligent/projects/en/projects/en2
- Friends of Earth Europe: http://foeeurope.org/Europeans-gain-new-rights-to-produce-their-own-energy-191218 (data retrieved on 24 March 2020)
- GoiEner cooperative: https://www.goiener.com/
- Real Pearl Foundation: https://igazgyongyalapitvany.hu/en/home/
- Real Pearl Foundation, video on the biomass project in Told: https://www.youtube.com/watch?v=NucmAbWoPPU&feature=youtu.be
- REScoop.eu: https://www.rescoop.eu/(data retrieved on 24 March 2020)
- UNDP Project 'Biomass Energy for Employment and Energy Security in Bosnia and Herzegovina': https://www.ba.undp.org/content/bosnia_and_herzegovina/en/home/climate-and-disaster-resilience/BiomassProject.html
- UNDP 'Biomass Energy For Employment': https://open.undp.org/projects/00046049
- UNDP Project 'Biomass Energy for Employment and Energy Security in Bosnia and Herzegovina', video on study tour for policy decision makers in Prague in 2017: https://www.youtube.com/watch?v=O0V2IOkkSZE
- Wolfhagen BEG cooperative: http://www.beg-wolfhagen.de/index.php

References

Angelidou, M., Psaltoglou, A., 2017. An empirical investigation of social innovation initiatives for sustainable urban development. Sustainable Cities and Society 33, 113–125.

Antepara, I., Claeyé, F., Lopez, A., Robyns, B., 2020. Fighting against fuel poverty by collaborating with social services through energy advice: an innovative case from Spain. GIZAEKOA - Revista Vasca de Economía Social 17, 71–96.

Avelino, F., Dumitru, A., Cipolla, C., Kunze, I., Wittmayer, J., 2020. Translocal empowerment in transformative social innovation networks. Eur. Plann. Stud. 28 (5), 955–977.

Bauwens, T., Gotchev, B., Holstenkamp, L., 2016. What drives the development of community energy in Europe? The case of wind power cooperatives. Energy Research & Social Science 13, 136–147.

Boonstra, B., Ooms, M., Huygen, A., Rhomberg, W., Budde, B., Boelman, V., Schon, R., Kwan, A., Pérez de las Heras, B., Ukar, O., Enciso, M., Damianova, Z., Dimova, A., Chonkova, B., Hickey, R., Marmo, D., Tognetti, M., Provvedi, B., Ecer, S., Abouleish-Boes, M., Mohamed Hassan, N., 2015. State of the Art report Social innovation in Energy Supply from a European and Global Perspective. Policy Field Energy Supply D7.1. SI-DRIVE, European Commission, pp. 1–6. https://www.si-drive.eu/wp-content/uploads/2015/12/D7_1-Policy-Field-Report-Energy-Supply-2015-Summary.pdf. last accessed Nov 23, 2021.

Cajaiba-Santana, G., 2014. Social innovation: moving the field forward. A conceptual framework. Technol. Forecast. Soc. Change 82, 42–51.

Dias, J., Partidário, M., 2019. Mind the gap: the potential transformative capacity of social innovation. Sustainability 11 (16), 4465.

Diedrich, A., Upham, P., Levidow, L., van den Hove, S., 2011. Framing environmental sustainability challenges for research and innovation in European policy agendas. Environ. Sci. Pol. 14 (8), 935–939.

Eichler, G.M., Schwarz, E.J., 2019. What sustainable development goals do social innovations address? A systematic review and content analysis of social innovation literature. Sustainability 11 (2), 522.

European Union, 2020a. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. A strong social Europe for just transitions. COM(2020), p. 14 final. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0014&qid=1613470143613. (Accessed 22 February 2021).

European Union, 2020b. Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. EU Citizenship Report 2020. Empowering citizens and protecting their rights. COM(2020) 730 final. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0730&qid=1613470143613. (Accessed 22 February 2021). last accessed.

Freney, M.H.P., Soebarto, V., Williamson, T., 2013. Thermal comfort of global model earthship in various European climates (doctoral dissertation, international building performance simulation association). Available at: http://www.ibpsa.org/proceedings/BS2013/p_1137.pdf. last accessed Sept 7, 2021.

Ganugi, G., Koukoufikis, G., 2018. Presentation of the special issue 'Discourses and practices in Social Innovation, between plurality and clarity. Sociol. Polit. Soc. 21 (2), 5–10. https://doi.org/10.3280/SP2018-002001.

Gregg, J.S., Nyborg, S., Hansen, M., 2020. Components and factors for actualization of collective action initiatives in the energy sector. In: International Sustainability Transitions Conference 2020. Available at: : https://backend.orbit.dtu.dk/ws/portalfiles/portal/220933253/IST_2020.pdf. last accessed Sept 9, 2021.

van den Heiligenberg, H.A., Heimeriks, G.J., Hekkert, M.P., van Oort, F.G., 2017. A habitat for sustainability experiments: success factors for innovations in their local and regional contexts. J. Clean. Prod. 169, 204–215.

Heiskanen, E., Matschoss, K.J., 2018. Evaluating climate governance experiments: participants' perspectives on low-carbon experiments in Finland. In: Turnheim, B., Kivimaa, P., Berkhout, F. (Eds.), Innovating Climate Governance: Moving beyond Experiments. Cambridge University Press, pp. 182–200.

Heras-Saizarbitoria, I., Sáez, L., Allur, E., Morandeira, J., 2018. The emergence of renewable energy cooperatives in Spain: a review. Renew. Sustain. Energy Rev. 94, 1036–1043.

Hiteva, R., Sovacool, B., 2017. Harnessing social innovation for energy justice: a business model perspective. Energy Pol. 107, 631–639.

Holtgrewe, U., Millard, J., 2018. Social innovation addressing societal needs and challenges. In: Atlas of Social Innovation – New Practices for a Better Future.

Available at: https://www.socialinnovationatlas.net/fileadmin/PDF/einzeln/01_SI-Landscape_Global_Trends/01_15_SI-Addressing-Societal-Needs_Holtgrewe-Millard.pdf. (Accessed 20 October 2020). last accessed.

Hoppe, T., de Vries, G., 2018. Social innovation and the energy transition. Sustainability 11 (1), 1–13.

Howaldt, J., Hochgerner, J., 2018. Desperately seeking: a shared understanding of social innovation. In: Howaldt, J., Kaletka, C., Schröder, A., Zirngiebl, M. (Eds.), *Atlas of Social Innovation* - New Practices for a Better Future. Sozialforschungsstelle. TU Dortmund University, Dortmund, pp. 17–21.

IRENA, 2019. Global Energy Transformation: A Roadmap to 2050. (2019 Edition). International Renewable Energy Agency, Abu Dhabi. Available at: https://www.irena.org/publications/2019/Apr/Global-energy-transformation-A-roadmap-to-2050-2019Edition. (Accessed 20 October 2020). last accessed.

Jäeger-Erben, M., Rückert-John, J., Schäfer, M., 2015. Sustainable consumption through social innovation: a typology of innovations for sustainable consumption practices. J. Clean. Prod. 108, 784–798.

Karakosta, C., Flouri, M., Dimopoulou, S., Psarras, J., 2012. Analysis of renewable energy progress in the western Balkan countries: Bosnia–Herzegovina and Serbia. Renew. Sustain. Energy Rev. 16 (7), 5166–5175.

Koukoufikis, G., 2021. Social Innovation and the Energy Transition - towards a Working Definition. European Commission. https://doi.org/10.13140/RG.2.2.19905.58720. JRC122277.

Lorek, S., Spangenberg, J.H., 2019. Energy sufficiency through social innovation in housing. Energy Pol. 126, 287–294.

Magnani, N., Osti, G., 2016. Does civil society matter? Challenges and strategies of grassroots initiatives in Italy's energy transition. Energy Research and Social Science 13, 148–157.

Markard, J., Raven, R., Truffer, B., 2012. Sustainability transitions: an emerging field of research and its prospects. Res. Pol. 41 (6), 955–967.

Mikkonen, I., Gynther, L., Matschoss, K., Koukoufikis, G., Murauskaite-Bull, I., Uihlein, A., 2020. Social Innovations for the Energy Transition. EUR 30446 EN, Publications Office of the European Union, Luxembourg, p. JRC122289. https://doi.org/10.2760/555111(online), 978-92-76-25283-2 (online).

Neumeier, S., 2017. Social innovation in rural development: identifying the key factors of success. Geogr. J. 183 (1), 34–46.

Pickerill, J., Maxey, L., 2009. Geographies of sustainability: low impact developments and radical spaces of innovation. Geography Compass 3 (4), 1515–1539.

Renings, K., 2000. Redefining innovation — eco-innovation research and the contribution from ecological economics. Ecol. Econ. 32 (2), 319–332.

Repo, P., Matschoss, K., 2020. Social innovation for sustainability challenges. Sustainability 12 (1), 319.

Seyfang, G., 2010. Community action for sustainable housing: building a low-carbon future. Energy Pol. 38 (12), 7624–7633.

Stieß, I., Umbach-Daniel, A., Fischer, C., 2019. Smart small living? Social innovations for saving energy in senior citizens' households by reducing living space. Energy Pol. 133, 110906.

Strasser, T., de Kraker, J., Kemp, R., 2019. Developing the transformative capacity of social innovation through learning: a conceptual framework and research agenda for the roles of network leadership. Sustainability 11 (5), 1304.

Wittmayer, J.M., Backhaus, J., Avelino, F., Pel, B., Strasser, T., Kunze, I., Zuijderwijk, L., 2019. Narratives of change: how social innovation initiatives construct societal transformation. Futures 112, 102433.

Wittmayer, J.M., de Geus, T., Pel, B., Avelino, F., Hielscher, S., Hoppe, T., Mühlemeier, S., Stasik, A., Oxenaar, S., Rogge, K.S., Visser, V., Marín-González, E., Ooms, M., Buitelaar, S., Foulds, C., Petrick, K., Klarwein, S., Krupnik, S., de Vries, G., Wagner, A., Härtwig, A., 2020. Beyond instrumentalism: broadening the understanding of social innovation in socio-technical energy systems. Energy Research and Social Science 70, 101689.

Yin, R., 2003. Case study research. Design and methods. Applied Social Research Methods Series 5 third ed, (SAGE publications, Thousand Oakes).